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Beyond the epistemological dichotomy of technical efficiency and social legitimacy in institutions:The emergence of an electrical transaction in Japanese manufacturing industry

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Information and Communication Technology (ICT), particularly with the diffusion of the Internet, stimulates electrical transaction. A large part of the discussion conducted mainly by economists, has advocated the technical openness of the electrical transaction as "electrical market", which is expected to reduce asymmetric information and the other costs incurred, to be more flexible to environmental changes and also to increase innovation. However, contrary to these expectations, the Japanese electrical market has not been successful in this respect. Although many electrical markets were established in the 1990s, most of these have already shut down. Some extremely contend that electrical transaction itself should not correspond to *keiretsu*—the institution of Japanese manufacturing firms.

In our work, we focus on an electrical transaction that was established by NC Network Co.—a venture firm founded by the suppliers of *keiretsu*. The firm initially aims to support cooperation between suppliers beyond the partition of their parent manufactures. Their network is one of few successful electrical transactions in Japanese manufacturing industry, which has more than 13,000 registered members. An important aspect to be noted is that the transaction organized by NC Network Co. isn't employed the logic of the openness of electrical markets. Instead, it is consistent with continuous changes through the history of *keiretsu*. *Keiretsu* has reformed its rules and procedures by means of seeking the efficiency of divergent interests, neither its relationship has been already adjusted. Therefore, NC Network Co. is perceived as a current representation of the institutional arrangement in the Japanese manufacturing industry.

In this paper, we attempt to theoretically examine the above mentioned situation as the dissolution of the epistemological dichotomy between technical efficiency and social legitimacy in institutional theories. On the one hand, economists have considered organizations as institutional instruments to achieve technical efficiency. On the other hand, sociologists have considered technical efficiency (or technology) to be an external factor of institution or occasion of institutional change. We believe that the rearrangement of *keiretsu* and the emergence of the electrical transaction are endogenously led by technical pursuit of self-interests, which are latent conflictive interests within institutions.

1. The epistemological dichotomy of technical efficiency and social legitimacy

In the point at theoretical issue of "technology", we can propose a couple accounts of

institutions functioning as the arrangement of social rules and procedures. (a) One position regards institutions as technical instruments for accomplishing efficiency. (b) The other position considers institutions as socially legitimated on the contrary to being a function of efficiency optimizing. These two opposing positions of the "technology" seem contradictory.

However, there exist thoughtful studies to sophisticate the theoretical relationship between these positions as complementary (eg. Friedland and Alford, 1991; Holm, 1995; Tolbert and Zucker, 1996; Roberts and Greenwood, 1997). Nevertheless, we would insist that these studies have been upon the deep epistemological dichotomy of technology and society. The follow discussion illustrates that, as first, the both of a) economists and b) sociologists has tried to sophisticate their account of technical or social elements of institutions, second, their sophistication, however, has not consider the epistemological dichotomy of them, third, we would reconstruct the "technology" in institution beyond the epistemological dichotomy.

1.1 The efforts for the sophistication of account from the both positions

Roberts and Greenwood (1997) is one of thoughtful studies that tried to sophisticate the account of technical or social elements of institutions. Their aims were integration between the transaction cost theory (new institutional economics) in economics and the institutional theory in sociology.

a) As first, they summarized that the transaction cost theory demonstrates the manner in which new organizational design is adopted in order to minimize the transaction cost caused by bounded rationality (and monitoring costs caused by opportunism) in the market. However, previous studies had overlooked the fact that the design selection of an organization should be also limited in the bounded rationality. Roberts and Greenwood (1997) criticized these assumptions as "hyper rational," and proposed that one should expand the *scope* of bounded rationality to all the phases of organizational design, such as the evaluation of current designs, the search for alternative designs, and the formation of efficiency expectations.

Indeed, the pioneering researches in economics have attempted to solve this problem, for example, the evolutional economics that encompass the affection of organizational routine or path dependency (Nelson and Winter, 1982; North, 1990) and the comparative institutional analysis that incorporates evolutional game into transaction cost theory (Aoki, 2001).

b) In addition, sociologists had never overlooked technical efficiency. Certainly, previous influential studies of the institutional theory emphasized the feature of institution as the "myth" or "fashion" that were inefficiency effects derived from conforming the rules and procedures to legitimated institutions (Selznick, 1957; Meyer and Rowan, 1977; Meyer, Scott and Deal, 1981; DiMaggio and Powell, 1983; Scott and Mayer, 1994). They have presumed

the social institutional legitimacy as oppose to the technical efficiency of traditional rational models.

However previous studies such as that conducted by Meyer and Rowan (1977) or DiMaggio and Powell (1983), illustrated that during initial phases, organizational actors make rational decisions that are driven by a desire to improve performance, that is, technical efficiency. Over time, however, new practices became legitimate as they spread because they were infused with a value beyond the technical requirements of the task at hand (Selznick, 1957, p.17).

As the other account of sociologist for technical efficiency, Scott and his colleagues argued that organizations are affected by both constructed dimensions: technical features and institutional elements（Meyer, Scott and Deal, 1981; Scott, 1991; Scott and Meyer, 1991）.

Furthermore, according to Scott (2001), recent theoretical accounts for institution evaluate technology as an occasion of institutional changes (eg. Barley, 1986). Technical (in)efficiency can also be integrated into the explanation for institutional change theoretically which is not caused only by the technological objects such as tools or machines (eg. Seo and Creed, 2002; Greenwood and Suddaby, 2006).

1.2 The deep dichotomy of technical efficiency and social legitimacy in institutions

As discussed above, it seems possible to be compatible that both the positions on institutions coexist. Roberts and Greenwood (1997) also declared these positions as complementary. However, their work did not carefully consider about the epistemology of technology, so that, their sophistication or declaration of complementarities have been remain ambiguous.

a) On the one hand, there is no doubt that economists presume the achievement of optimized equilibrium by means of competition in market, although they attempt to deal with social aspects of institutions. For example, Nelson and Winter (1982) focused on the social aspect of institutions as organizational routines that are historically accumulated with the time span. However, their claim only introduced the concept of the absolute efficiency of optimized equilibrium in the explanation of the selection phase of which organizational routine survives. Thus, according to Nelson and Winter (1982) , only one surviving organizational routine complements the bounded rationality and achieves optimized equilibrium survive, while the others are not selected.[1]

On criticizing only one optimized equilibrium, such Nelson and Winter (1982) assumed, Aoki (2001) insists many spontaneous orders can be constructed by using evolutional game

[1] North (1990) has same issue. He classified 'alocative efficiency' which is optimized condition and 'adaptive efficiency' which should be complement by designing institutions. Thus he discussed how we can design the institutions complementing adaptive efficiency to achieve allocative efficiency.

theory. The spontaneous orders are bright form the negotiation of agents who seek their own efficiency maximization (p.3).[2] However, if you analyze his arguments carefully, you can find that he also intends to design an institution that leads equilibrium by employing comparative analysis. Thus, while he supports the existence of considerable equilibrium, he seeks meta-equilibrium that encompasses these other types of equilibrium.

Therefore it is not an overstatement to say that economists surpassed the limitations of the economical analysis of technical efficiency that is also included in the concept of bounded rationality. The "hyper rational" analysis depends on the epistemological assumptions of technology, and is not the *scope* of it as defined and applied by Roberts and Greenwood (1997).

b) On the other hand, it is obvious that sociologists have regarded technology as antagonistic to institutional legitimacy in their aims to integrate technology or technical efficiency into institutional theory. Certainly, as previously discussed, recent theoretical accounts for institutional change surely intended to explain the endogenous change process to resolve "the paradox of embedded agency (DiMaggio and Powell, 1991; Seo and Creed, 2002, p. 226)," and not to explain exogenous changes caused *directly* by technological objects or technical efficiency. They only defined the technology as an *occasion* of change process analytically (Barley, 1986; Orlikowski, 1992).

However this is never the sociological account of technology. Grint and Woolgar (1997) keenly pointed out that even if they used the technology only "analytically," they can easily fall into "technicism" where social changes are overwritten upon the essence of technological matter divided from social matter. Zucker (1991) also promoted attention to that Neo-institutionalism ends the only taxonomy of each institution theory without consideration of micro process of institutionalization.

1.3 Beyond the epistemological dichotomy in institutional theories

The confusion resulting from the epistemological dichotomy between technical efficiency and social legitimacy requires us to examine the fundamentals of the theoretical treatment of the technology.

a) Technology as an economic concept is conceived from the extent to which the firm efficiently converts input (resources) to output (products or services) at the abstract level.

[2] In more detail, Aoki (2001) contends that agencies, such as political agency as have power, should design institutions suitable to spontaneous order historically constructed by many agencies. So there exist considerable equilibrium as evolutional game and many institutions. Therefore he warns not to import the institution from other institutions, because institutions have linkages and complement each other. Ultimately, he amplifies the concepts of path dependency. Spontaneous order, which is historically accumulated, determines the institutions. And once institutions are constructed, institutions seldom change. Thus, he insists that each institution evolve continuously according to path dependency.

Technological objects are also attributed to the efficiency of resource conversion. The technological efficiency is conceived as universal criteria limited on the transaction in market. However, the efficiency economists presume has not yet been certified. Indeed, economists have been conscious of it, and therefore, the major textbooks note that the technical efficiency in the market is only a hypothesis (eg. Milgrom and Roberts, 1992; Douma and Schreuder, 1991).[3]

Nevertheless, their limited definition or recognition of efficiency is not sufficient for the analysis of actual economic activities because we would found different conclusions and implications of the some analysis based on same criteria of efficiency. The findings indicate that the existences of various values of economists are inevitably incorporated in their efficiency criterion.[4] In other words, seeking efficiency itself is rooted on some social legitimacies, so as it is not regarded as a constraint from both sides of bounded rationality (efficiency) and legitimacy, such as Roberts and Greenwood (1997) depicted.

b) Sociologists also must explain technical efficiency and technological objects from sociological accounts. When they analyze institutional changes, they must treat the technology as a problem of "paradox of embedded agency" within institution, not from factors external to the institution, such as occasions of change. To pursue technical efficiencies, which done by divergent interest groups in institutions, accelerates to unfold incompatibility that is endogenously derived from internal institutional contradictions and not the exogenous appearance of new technology or inefficient existing criteria. As mentioned in SST, the technology is employed (intentionally or unintentionally) in the politics of interests within institutions (Winner, 1983; Beck, 1994).

We presently do not need to distinguish between the differences of economists' and sociologists' accounts for technology in institutions. Technical efficiency is not defined universally such economists do but is socially legitimized and reflected the divergent values of interests groups (include economists themselves) in institutions. Concurrently, institutional change is not triggered by technical inefficiency or the appearance of new technology but caused by pursuit of the efficiency from the divergent interests and unfolding

[3] For example, in the first chapter of Milgrom and Roberts (1992) that is one of the most notable textbooks of economic, they represent technical efficiency is merely hypothesis that someone assumes. Nevertheless, almost no economist has questioned the premise of it when analyze indeed. Douma and Schreuder (1991) also pointed out that to suppose evolutionary selection is predominantly derived from efficiency implies economic criterion is not exclusive one that economists have assumed. The extent to which efficiency give account for real world must be assess as a result of empirical study. For example, although sociologists' account has a point concerning that school or public sector does not bow to pressure from evolutional selection, almost every economist agree most economic transaction has bowed to great pressure from efficiency per se.

[4] Rawlinson (1977) pointed out the definition of important concepts such as efficiency reflects differences in human values, unless organizational economists are claiming unbounded rationality for themselves while attributing bounded rationality to everyone else (pp.95-96).

incompatibility derived from contradiction in institutional arrangement.

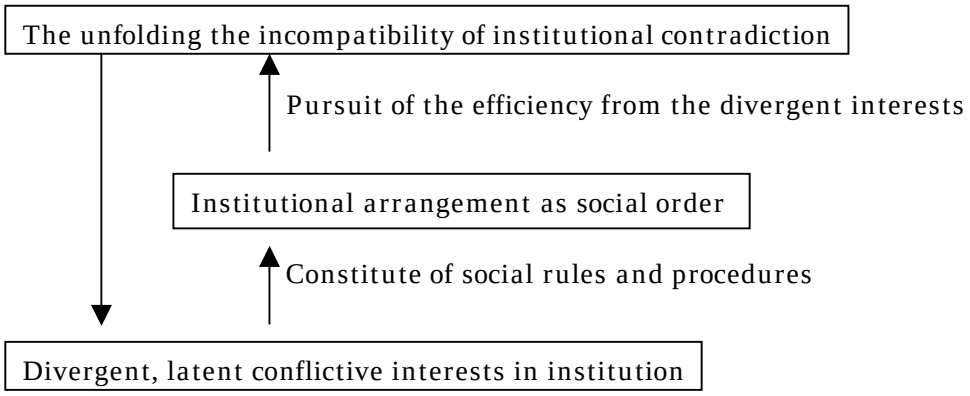

Figure1. Technical pursuit of interests and endogenous change process of institution

The following discussion illustrates the continuous changes through the history of *keiretsu*, the institution of Japanese manufacturing firms, which was especially thought to be the source of the competitive advantage of Japanese manufacturing industry in the 1980s, and is conceived only as an inefficient fashion since 1990s. In our point of view, however, (1)on the one hand, we can observe the institutional arrangement and its efficiency criteria of institutions in each era, (2) On the other hand, they have been constituted and legitimated around the divergent interest groups in institution, particularly the manufacturers and their suppliers seek their own self-interests. (3) Their technical pursuits of self-interests based on the legitimated criterion makes incompatibilities unfold endogenously and these lead to reform rules and procedures and these arrangement in institutions. Moreover, we will examine the leading-edge case, an electrical transactions organized by NC Network Co. that are perceived as the representations of Japanese manufacturing institution of the current or at least, the nearest future.

2. Continual institutional changes and the emergence of electrical transaction in the Japanese manufacturing industry

As it has pursued theoretical examinations, our work looks upon an institution as something that is configured based on various interests that are coordinated in the existing institutional arrangement. Institutions are viewed neither as optimized rules nor as illogical practical frameworks. Our work also explores the purposes of divergent interests in an effort to highlight contradictions within the institutional arrangement from the perspectives of

continual processes where institutional rules and procedures, as well as their arrangements and criteria of efficiency, are altered.[5]

This approach is primarily used to bring an institutional myth in the Japanese manufacturing industry to light (2.1, 2.2, 2.3). This myth was regarded (especially by economists) as one that strongly defined Japanese companies in the 1980s. The roughest definition of *keiretsu* is the long-term business relationship between manufacturers as prime contractors and suppliers as subcontractors.[6] In the relationship based on these long-term business ties, close communication would enable Japanese manufacturers to encourage their suppliers to create more sophisticated technologies. These technologies would enable the manufacturers to produce goods of a higher quality and to sell them at a lower price. However, in reality, these images were just part of the *keiretsu* characteristics in the 1980s. This paper explores this idea from the perspective of continual institutional changes in the historical process of *keiretsu*.

In addition to historical examination, our work also focuses on electrical transactions which have been emerging in a unique way in recent years, as a representation of changes in *keiretsu* in Japan (2.4). *Keiretsu* was looked upon as an advantageous system for Japanese companies in the 1980s, but many people became skeptical about the structure after the 1990s, when Japan's economy slowed down. During the same period, a popular economic issue was electrical markets, or open transactions on the internet. In our country, many electrical markets were launched in the early 1990s. However, one after another, these electrical markets almost closed down. These closings may explain why electrical transaction, including open electrical market, was incompatible with Japanese institutions. However, considering that Japan's *keiretsu* is in the process of continual changes, we deny such a hasty conclusion. In fact, unique electrical transactions are emerging as an early sign of Japanese model while many electrical markets are failing. These pioneering cases can be considered a current representation of continual changes in *keiretsu*.

Following each historical period, we illustrate, as first, general look at the institutional arrangement outlining the relationship between manufacturers and suppliers in the Japanese manufacturing industry. Next, examine what interests formed those relationships,

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[5] Much of the evidence explored in this paper has already been analyzed by economic and business scholars (many of whom follow economic guidelines). However, these preceding studies used fragmentary evidence for analysis and did not formulate complete consistent theories. This paper seeks to consistently organize the evidence from preceding studies and explore the comprehensive theoretical framework for the evidence. Refer to Miyamoto（2007）for specific preceding studies and the evidence that the scholars noted.

[6] The prime contractors are major companies, and subcontractors are small and medium-sized enterprises. This paper calls them manufacturers and suppliers, respectively. Strictly speaking, however, the larger companies are given several different names in line with the times. Notably, after the rapid economic growth phase, their main work was to assemble the parts delivered by their suppliers into complete units. As their work involved less manufacturing, they were called assemblers.

and, last, explore how the pursuit of divergent self-interests made changes in the institutions necessary.

We pays attention to the following seven points (Table 1) in relation to the rules and procedures forming the ties between the manufacturers and their suppliers. Each of these points is hypothetically considered to show institutional content in *keiretsu*. With the intent of organizing complicated implications in the arrangement of each time period, we divides the arrangement into sub-arrangements, including "organizational management based on the division of labor between manufacturers and their suppliers," "technological development structure," and "inter-organizational collaborative ties or networks." Nevertheless, the most important fact in our entire analysis is that the institutional arrangements of all the periods incorporate the diversified interpretations of stakeholders, which yield much room for the necessity of changing the institutional arrangements themselves.

Table.1 Constitutions of institutional arrangement

		Postwar period (2.1)	High growth period (2.2)	Oil crisis period (2.3)
Criteria of technical efficiency		Pursuit of stable manufacturing	Meeting demands for diversified product specifications	Pursuit of multifunctional products
Rules and Procedures	(1) Leading role for technical development	Manufacturers' total direction	Manufacturers' initiative	Larger role of suppliers
	(2) Dealt items	Non-core parts	Core component units	System parts
	(3) Dealing style	Ordering parts for suppliers on an optional basis	Ordering parts for particular suppliers	Deals with the techniques of particular suppliers
	(4)Communication method	Drawing-supplied method (*Taiyozu*)	Drawing-approved method *(Shoninzu)* (component unit)	Drawing-approved method *(Shoninzu)* (system parts)
	(5)Evaluation method	QCD	VA/VE	Multifaceted method
	(6)Technical development method	Manufacturers' technical support	Manufacturers' support for capital investment	Technical exchanges among suppliers
	(7) Interorganizational relation	Management integration by manufacturers' capital participation	Mergers of suppliers in the same sector	Networks of industrial agglomerations and technical collaboration among suppliers in different sectors

2.1 Formation of *keiretsu* after World War II (1950–60)

2.1.1 Institutional arrangement in the postwar era

In order to gain a clear understanding of the historical processes of *keiretsu*, we begin by examining the formation of *keiretsu* after World War II. In this period, *keiretsu* sought to pursue the criteria of efficiency as the "stabile manufacturing." Japan's small-scale industrial structure and volatile fluctuations in supply and demand were significant factors

directly linked to the formation of *keiretsu* at this time. The special procurement boom from the Korean War was a symbolic event that intensified this instability. In this situation, manufacturers desperately needed a mechanism to secure stable manufacturing operations and put much energy into forming *keiretsu* as an institution to facilitate this process. It was based on various rules and procedures formulated between the manufacturers and their suppliers.

At that time, (1) manufacturers directed almost all of the processes from product development to manufacturing.[7] They manufactured core parts themselves and dealt with their supplies only when (2) non-core parts were needed. The manufacturers had deals with (3) their suppliers on an optional basis.[8] When placing orders for parts with suppliers, the manufacturers drew up basic plans for various parts. These plans were based on the total design outlining their completed products. The manufacturers then drew up (4) drawing-supplied (drawing to be supplied) portraying the detailed image of these basic plans in accordance with the manufacturing process. The transactions were evaluated according to (5) Quality, Cost and Deliver (hereinafter referred to as QCD) on the basis of parts.[9] Suppliers responsible for the technical development of manufacturers' parts were assisted by those (6) manufacturers in the form of technical support. Manufacturers' advantageous positions were also reflected in organizational management. The manufacturers were the largest stockholders of their suppliers' corporations and constructed management integration through (7) capital participation.[10]

2.1.2 Rules and procedures formed by the interests of manufacturers and suppliers in the

[7] The word *processing* is often used in terms of product quality, and *production* is used in relationship to quantity and costs. This study uses the term *manufacturing* from the comprehensive perspective of adding *assembling* to *processing* and *production*. To place a stronger focus on quantitative aspects, however, the paper uses the word *production*.

[8] The business deals with suppliers on an optional basis do not refer to deals that are not based on ongoing relationships. More specifically, the manufacturers had deals with any suppliers that cooperated in continued transactions, not with suppliers that had particular technologies. However, the manufacturers, while maintaining a certain level of ongoing business ties, halted deals with suppliers that failed to meet the necessary manufacturing quality or imposed extreme restrictions on the volume of trade. That was why *keiretsu* in those days was rather unstable, even if it was intended for ongoing deals.

[9] QCD is an important notion that is used even today for the management of manufacturing processes in many ways. At that time, however, quality was evaluated in terms of whether parts were manufactured strictly in accordance with the drawing-supplied. Costs were assessed in terms of how efficiently these manufacturing operations proceeded. The evaluation of deliver was conducted in terms of whether parts were delivered by the due date.

[10] Seemingly, "business deals on an optional basis" and "business integration through capital participation" are conflicting ideas. In fact, however, the formation of these rules is usually conducted based on a certain time scale and does not pose any contradictions. Manufacturers provided their suppliers with technical support while placing orders for non-core parts. During this process, the manufacturers learned which suppliers could adhere to the manufacturing quality demanded by the manufacturers through their technical support. The manufacturers then entered into management integration through capital participation.

postwar era

The institutional arrangement that seeks manufacturing stability can be regarded as an arrangement that coordinates the interests of manufacturers and suppliers in accordance with the previously mentioned rules and procedures.

The manufacturers' primary purposes in forming their institutional arrangements in the postwar era were to utilize outside organizations in securing stable manufacturing operations with their limited resources in small-scale markets. The manufacturers, many of whom were still small businesses at the time, had the capability of manufacturing only core parts. To handle fluctuations in supply and demand, they had to outsource the manufacturing of (2) non-core parts to (3) outside suppliers on an optional basis. Such orders were easy to place. Therefore, *keiretsu* during this period was (1) directed by manufacturer in every aspect of manufacturing, including product development and technical improvement. Because the manufacturers directed all facets of manufacturing, they needed to instruct their suppliers on what parts to manufacture and how they should be produced. The manufacturers employed the (4) drawing-supplied method by preparing original detailed designs on the necessary parts and then handing those designs to suppliers. The manufacturers expected their suppliers to manufacture the parts that strictly conformed to the drawing-supplied method and placed orders only when those particular parts were needed. Second, another idea behind the institutional arrangement was to ensure the quality of products that was manufactured by suppliers with lesser technical skills. Despite the manufacturers' detailed designs, the (4) drawing-supplied method did not always mean that their suppliers could maintain the quality standards that the manufacturers expected from the resulting products. In order to cope with this problem, the manufacturers adopted the evaluation method using (5) QCD to their suppliers. The manufacturers also needed to provide their suppliers with (6) technical support in an all-out effort to improve the quality of manufacturing operations. As part of the support programs, the manufacturers' engineers inspected the on-site operations at suppliers' factories to ensure that there were no defective components. The suppliers' technical standards were maintained and improved through these (1) manufacturer-led programs. The third aspect of the institutional arrangement involved the manufacturers protecting their suppliers from their competitors. The manufacturers conducted (7) capital participation for business integration to prevent other competitors from luring away suppliers whose technical foundations had been enhanced through the (6) manufacturers' assistance programs.

It is important to note that the suppliers, as well as the manufacturers, facilitated the arrangement of these rules and procedures. The suppliers' principal advantage in forming such an institutional arrangement was that *keiretsu* allowed them to secure operational

stability. Many suppliers experienced difficulties in securing raw materials amidst the postwar confusion. They were hindered by not only the delayed delivery of raw materials from their business partners but also by the unreliability in the quality of materials. These problems forced the suppliers to suffer unstable operations and uncertain fund management. In these situations, *keiretsu* enabled manufacturers to make all the necessary arrangements (1) on manufacturer's direction, including securing raw materials to meet the QCD requirements, and to facilitate the operational stability of suppliers. The second benefit of this institutional arrangement for the suppliers was that they could make the utmost use of their existing general-purpose techniques to respond to orders from manufacturers. Small and medium-sized suppliers produced (2) the non-core parts that could be manufactured by their multipurpose machines, and this situation was advantageous to the suppliers. The (4) drawing-supplied method, where manufacturers made all the essential, detailed directions from designs to manufacturing methods, also eased the burden on many suppliers did not employ engineers with drafting skills. The third benefit was the improvement of manufacturing skills and the maintenance of facilities. In those days, most suppliers were small and medium-sized enterprises run as family businesses, and the suppliers did not have adequate levels of manufacturing skills and facilities. In this difficult situation, suppliers found much incentive in (6) manufacturers' technical support programs and business integration through (7) capital participation that was a perfect source of plant and equipment investment.

2.1.3 Unfolding incompatibilities of the institutional arrangement in the postwar era

Both manufacturers and suppliers were subsequently affected by some contradictions of the institutional arrangement when they both pursued their own self-interests in accordance with a set of rules. Manufacturers found the following three drawbacks in the arrangement. First, the manufacturers grew weary of directing all the detailed designs while dealing with only non-core parts with their suppliers. After having achieved their stable supply of products in the market, the manufacturers expanded their operational scale, and there were growing demands for various specifications of products. Amidst the increase in production, the manufacturers could no longer attain an adequate level of stable manufacturing just by consigning (2) non-core parts to (3) their suppliers on an optional basis. The growing demands for various product specifications made it necessary for the manufacturers to draft more product designs and imposed a heavier burden on the (1) manufacturers to direct the entire manufacturing process from designing to manufacturing based on the (4) drawing-supplied method. Second, the manufacturers could not offer additional (6) technical support to their suppliers as the technical standards of suppliers

rose. The improvement of suppliers' manufacturing skills through the manufacturers' technical support programs made providing higher levels of technical support necessary. In the situation, the manufacturers found providing technical support to be a heavy burden on. Third, *keiretsu* no longer worked well enough to induce suppliers to make efforts for an improved operation. The (7) capital participation of the manufacturers caused cozy and collusive relationships with their suppliers over a long period of time. In addition, the evaluation system with the (5) QCD method covered only the quality control of individual parts and lacked comprehensive criteria for a comparative evaluation of the different kinds of parts. As a result, these loose situations undermined competitive relationships among suppliers.

From the supplier standpoint, the following three disadvantages in the institutional arrangement became apparent. First, the suppliers could not enjoy as much operational stability from *keiretsu* as they had in the initial phase. The suppliers put much energy into capital investment despite great costs because they had to build up their manufacturing capabilities to meet manufacturers' requests for improving (5) QCD. In spite of the suppliers' efforts, the manufacturers had engaged in contracts with suppliers (3) on an optional basis, and the small amount of orders was not enough to make up for the suppliers' capital investments. Second, suppliers did not have enough occasions to utilize their inproved manufacturing skills that they had refined through long-time experience. The suppliers attained more sophisticated manufacturing skill sets through manufacturers' technical support programs. However, they could not gain adequate credit for their higher standards of expertise where the manufacturing of (2) non-core parts was evaluated with the (5) QCD method. Their technical level could not be fully utilized under the contract specifying the manufacturing of parts in accordance with the (4) drawing-supplied method implemented by the manufacturers. Third, the manufacturers' technical support was no longer adequate. The manufacturers' initial support for laying the (6) foundations for manufacturing operations and the (7) capital participation for plant and equipment investment was intended to help young suppliers with their technical base. However, as suppliers built manufacturing facilities and enhanced their operational levels, manufacturers' technical support programs became inadequate for keeping up with the standards of suppliers.

2.2 Institutional changes during the high growth period (1960 to 1975)

2.2.1 Institutional arrangement spread in the high growth period

In the high-growth period, *keiretsu* sought to pursue the criteria of efficiency as "meeting demands for diversified product specifications." As the previously mentioned descriptions about the conflicting factors that surfaced in the postwar *keiretsu* have shown,

manufacturers faced a new challenge of meeting demands for diversified product specifications in their product development, despite the manufacturing stability attained in the postwar institutional arrangement. This task became more important amidst the growth of consumer needs in the rapid economic development phase and the accelerating trends of exporting Japanese goods to overseas countries. In this situation, the transformation of the *keiretsu* primarily sought to meet demands for diversified product specifications.

During this high growth period, an institutional arrangement different from that of the postwar period was established in order to handle the demands for diversified product specifications. Product development and improvement in manufacturing skills were directed by (1) manufacturers' initiatives. However, the parts that the manufacturers formally assigned to suppliers were now the (2) core component units that were combined in the manufacturing process.[11] In regard to business relationships, intensive deals with (3) particular suppliers were conducted. Communication for deals also changed from the drawing-supplied method to the drawing-approved method where (4) detailed designs were entrusted to the suppliers' discretions, though the manufacturers continued to draft the total product and basic parts designs[12]. In response to this change in the design process, the evaluation method for deals was revised to the (5) VA/VE[13] method where the prices and functions of unit components were assessed in a numerical value. To improve the suppliers' technical development, the manufacturers provided them with limited (6) financial support for special manufacturing facilities to process the unit components that they ordered. In addition, manufacturers and their suppliers were more independent from each other in their capital relationships, and (7) mergers were repeated through competition among suppliers in the same business category.

2.2.2 Rules and procedures formed by the interests of manufacturers and suppliers in the high growth period

The institutional arrangement during this period was configured by the manufacturers' and suppliers' aggressive responses towards diversified product specifications.[14] For the first

[11] Component units are combinations of multiple parts, as in the example of car wipers. The combination of these parts is decided in terms of how easily and how efficiently they are manufactured.
[12] *Basic designing* refers to the structural designing of parts based on the overall design of completed products. The designing of parts consists of the *basic design* and the *detailed design* in line with manufacturing processes.
[13] VA/VE (Value Analysis / Value Engineering) is to evaluate parts from the perspective of Value=Function÷Cost. The essence of VA/VE is to maximize the part's function while minimizing its prices. However, if other competitors have products with the same function, the key difference is in their prices. In reality, there are many cases where suppliers manufacture the parts, which were typically manufactured by high-cost machinery. Such manufacturing is more inexpensively accomplished by press work or through one process, which was separated into two before, in the utmost effort to reduce costs rather than pay attention to function.
[14] By 1964, about 10% of the domestic production had been allocated to foreign exports. However, the

point, the manufacturers could dedicate themselves to developing essential technologies to meet the public demands for diversified product specifications by allowing their suppliers to draft detailed designs for unit components. The manufacturers still (1) took the initiative in drawing up overall product designs and basic parts designs. For the manufacturing of (2) packages of core unit components and the drafting of their detailed designs, the manufacturers could entrust those tasks to (3) particular suppliers with good past records in the (4) drawing-approved method. This approach enabled the manufacturers to put the utmost energy into developing essential technologies that would contribute to differentiating their completed products from those of their competitors.[15] Second, the manufacturers could not provide adequate levels of technical support for manufacturing expertise that their suppliers had come to expect from them. Instead, the (6) manufacturers helped their suppliers with their costs for the special facilities and metal casts that they wanted their suppliers to use. The manufacturers also paid for new materials for experimental use with the intent of recruiting good suppliers with solid track records. Third, in order to boost competition among suppliers, the manufacturers encouraged several suppliers to compete with one another on a core unit component basis and introduced the (5) VA/VE method for the comparative evaluation of costs. This approach is called *multiple assessment policy*[16], so as to simplify procedures for the comparative evaluation of several decent suppliers. The manufacturers encouraged (7) suppliers in the same business category to merge in order to select the best suppliers.

In the meantime, suppliers first sought a larger amount of orders to make up for the costs of their capital investments. From the supplier standpoint, the multiple assessment policy based on the (5) VA/VE method gave them the perfect opportunities to join other groups of *keiretsu* and as a result, gain (3) large amounts of orders from manufacturers. Second, the suppliers aggressively competed for orders for (2) core unit components, intending to make good use of improved manufacturing skills that they had developed through long-time experience. The (4) drawing-approved method on a unit component basis allowed the suppliers to draft detailed designs of core unit components directly linked to manufacturing techniques based on their own initiative. By brushing up their skills for detailed designs, the

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increase of exports triggered trade friction. Local manufacturing established for easing the friction affected the differentiation by manufacturing techniques, which made it necessary to develop techniques that would facilitate differentiation by function.

[15] Manufacturing skills depend more heavily on designs, facilities, and craftsmanship and are often brushed up on through on-site operations. In contrast, essential techniques refer to ones that will be useful in differentiating product functions and are usually developed at research laboratories.

[16] Some economists point out that the competition among suppliers based on the multiple assessment policy was a strong driving force for the development of *keiretsu*. However, the multiple assessment policy was launched both during and after the high growth period and cannot be considered a catalyst for the development of *keiretsu* during the postwar period.

suppliers could gain huge profits while attaining the (5) VA/VE levels that the manufacturers expected from them. Third, the suppliers made active efforts to develop their own unique manufacturing skills and increase capital investments by (7) frequently merging with competitors in the same sector and expanding their business scale. In regard to installing special manufacturing facilities that were requested by their manufacturers, the suppliers were granted (6) financial support from their manufacturers. In addition, orders that were inappropriate for unique manufacturing skills (many of the orders were for non-core parts) were outsourced to the secondary suppliers that had failed to merge with other suppliers. These secondary suppliers formed the hierarchical structure among suppliers.

2.2.3 Unfolding incompatibilities of the institutional arrangement during the high growth period

In the pursuit of their own self-interests, the manufacturers and suppliers unfold incompatibilities in the rules and procedures during this period. The manufacturers faced the following three problems. First, their drafting skills declined. As the manufacturers placed orders for (2) core unit components with decent suppliers, the manufacturers paid less attention to their own manufacturing skills. This situation made it difficult for the manufacturers to draw up overall product designs and basic parts designs that were in line with the manufacturing standards of suppliers. That is, the manufacturers had difficulty taking the (1) their initiative in developing expertise related to manufacturing operations, and the (4) drawing-approved method on a unit-components basis did not work well any more. Second, the manufacturers and suppliers were affected by technical discrepancies. As mentioned above, the manufacturers completely depended on their suppliers for the manufacturing of (3) core unit components. They could instead commit themselves to aggressively developing essential techniques that would be effective for the differentiation of their completed products. However, this situation implied that the manufacturers would eventually lose their skills for manufacturing operations. There were frequent cases where the suppliers' manufacturing techniques improved, but it was particularly difficult for the manufacturers to apply the essential manufacturing techniques that the suppliers had developed. The imminent challenge was to reconcile product development with the manufacturing techniques.[17] Third, the competition stimulus model focusing on prices had an adverse effect on product manufacturing. The manufacturers launched the relative evaluation system using the (5) VA/VE method. This method focuses on prices and was

[17] Manufacturing techniques and essential techniques are not independent from each other; they are sometimes interdependent. For example, improving technical levels for manufacturing car suspensions is inseparable from the development of essential techniques for *shock absorbers*.

intended to boost competition among suppliers. Yet this approach caused some suppliers to disregard various factors other than prices, which led to a decline in function and quality.

In the meantime, suppliers were affected by the following three difficulties. First, by getting ahead in competition, the suppliers attained the maximum amount of orders from manufacturers. The deals with (2) core unit components through the (4) drawing-approved method gained large profits for the suppliers with better manufacturing skills. However, the suppliers were constantly exposed to ferocious competition in the comprehensive evaluation system with the VA/VE method. Many of them found it difficult to differentiate themselves from other companies by focusing on factors other than prices. Inevitably, price competition intensified, and the suppliers could not earn enough profits even if they won (3) large orders from manufacturers. Second, the suppliers did not have enough information about what kinds of manufacturing techniques they should develop. To acquire (3) large orders from manufacturers, the suppliers had to incorporate the manufacturers' manufacturing techniques into their own detailed designs. However, the suppliers were only assigned the task of drawing up the detailed designs for (2) core unit parts and were not in a position to know what manufacturing skills would be required in the future. Third, the suppliers did not have an adequate system level to develop manufacturing techniques that would be required in the future. The manufacturers bore the payment only for (6) capital investment for special processing facilities that they originally needed. The manufacturers' financial support was no longer enough. In addition, the manufacturers' intensive efforts to develop new essential techniques for product differentiation created new production skills that could not even be handled by (7) mergers among suppliers in the same sector.

2.3 Institutional changes during the post-oil crisis period (1975 to 1990)

2.3.1 Institutional arrangement during the post-oil crisis period

In the period of the post-oil crisis, *keiretsu* sought to pursue the criteria of efficiency as "meeting demands for multifunction." During the high growth period, the institutional arrangement was intended to meet demands for diversified product specifications. Alternatively, the institutional arrangement during the post-oil crisis period sought to meet demands for multifunctional aspects of products amidst the vibrant development of essential techniques by the manufacturers.[18] As part of the rules and procedures established for institutional content to pursue this multifunctional capability, (1) suppliers played a

[18] Against the backdrop of this situation, the amount of domestic manufacturers' manufacturing decreased. For example, the automobile industry was affected by trade friction during and after the 1980s, and the growth of local manufacturing caused a reduction in exports. During this period with the limited
amount of manufacturing, highly functional products with high profit rates were of vital importance.

larger role in technical development. They also worked with (2) system parts[19] by utilizing essential techniques that would be significant for the functional differentiation of completed products, not packages of unit parts in relation to manufacturing processes. As the significance for completed products grew, deals between manufacturers and suppliers supposedly expanded. Their transactions included not only unit parts for which the manufacturers drafted both complete product and basic parts designs but also the suppliers' technical levels that included total product design processes.[20] The manufacturers had deals with suppliers with (3) higher technical standards. As a communications process, the (4) drawing-approved method was even applied to system parts from the perspective of parts' functions. In regard to the evaluation method for these deals, (5) a multifaceted approach was employed to assess the technical levels of suppliers instead of assessing the unit prices of parts. The technical development of the suppliers was ascertained through (6) their networks. In addition, the suppliers often had (7) meetings for the purposes of technical exchange in industrial agglomeration and conducted cross-sectional technical collaborations.

2.3.2 Rules and procedures formed by the interests of manufacturers and suppliers during the post-oil crisis period

The institutional arrangement during this period was partly established due to coordination efforts between manufacturers and suppliers in pursuit of highly multifunctional products. From the manufacturer's standpoint, the first priority was to incorporate suppliers' manufacturing skills into design processes. The reasoning behind this act was the manufacturers' problems with total product and basic parts designs in line with manufacturing processes. These problems were due to the manufacturers' dependence on suppliers for manufacturing techniques. When ordering (2) system parts that would contribute to the differentiation of completed products, the manufacturers could not complete total product and basic parts designs on their own. That was why the manufacturers, while explaining overall concepts behind their products in the (4) drawing-approved (for system parts) method that illustrated product functions, invited guest engineers who worked for (1) their suppliers to participate in the total product designing. This effort would apply the suppliers' manufacturing skills to the designing processes, that is so-called "front loading". Second, the manufacturers encouraged their suppliers to actively commit themselves to developing essential techniques in the pursuit of

[19] System parts refer to parts encompassing various essential techniques, such as the ABS and car brake systems. The combination of parts is decided in terms of their functions. Generally speaking, system parts are categorized more than unit components.

[20] This study refers to the term *technical levels* as meaning the comprehensive technical capacity, including both *manufacturing skills* and the *essential techniques* that are closely linked to them.

multifunctional products. A problem that occurred during the high- growth period was that manufacturers' aggressive development of essential techniques resulted in wider discrepancies in suppliers' manufacturing skills. This discrepancy occurred because essential techniques and manufacturing skills were inseparable. Paying sharp attention to this point, the manufacturers sought to make good use of (3) essential techniques related to the suppliers' manufacturing skills for functional aspects that would have a great impact on product differentiation. Third, the manufacturers intended to inspire suppliers with eminent technical standards. The VA/VE method focusing on prices eventually incited excessive competition among suppliers and caused them to neglect technical development and quality improvement. On the other hand, within the (5) multifaceted evaluation system, a main focus was shifted to incentive technical fees from cost competitiveness, and the manufacturers tried to recruit excellent and skillful suppliers by using this method.

Meanwhile, the suppliers found it of vital importance to pursue their self-interests by helping manufacturers with their active efforts to create multifunctional products. First, it was imminent for suppliers to break away from excessive cost competition. Dealing with (2) system parts that encompassed essential techniques useful for product differentiation were (3) dealt included suppliers' skills. Therefore, orders for those parts were more appealing to suppliers than the manufacturers' comparative evaluation methods that focused on prices. In addition, some superior suppliers developed their own unique research and development facilities as an approach to the (4) drawing-approved method (for system parts) intended for improving product functions. Second, orders for the system parts that encompassed essential techniques enabled suppliers to gain information about what kinds of techniques they should develop. In placing orders for the (2) system parts, the manufacturers invited their suppliers' engineers to take part in on-site operations so that they could apply (3) their skills to designing processes. These occasions provided the suppliers with the perfect opportunities to learn the future course of development that the manufacturers were seeking. Based on the advance knowledge and information, the suppliers could anticipate the manufacturers' plans in the development of necessary production skills as well as the relevant essential techniques that the manufacturers would need in the immediate future. Third, suppliers often had technical exchange meetings beyond *keiretsu* and business categories. The suppliers needed the essential techniques related to the manufacturing skills that the manufacturers required in their pursuit of highly functional products. In order to address this issue, the suppliers had (6) meetings to exchange information[21] through (7) their networks of industrial agglomerations and cross-sectional technical

[21] For example, welding suppliers consulted with painting suppliers for technical advice and tried rust-resistant welding methods. Collective efforts by neighboring suppliers living within a range of a bicycle ride were just like experiments conducted at the same laboratory.

collaborations. In this situation, the hierarchical structure of *keiretsu* among suppliers gradually changed into the *mountains range pattern* where different groups of *keiretsu* and cross-industrial parties joined. At that time, technical collaboration with home electrical appliance suppliers[22] was particularly animated with the intent of gaining essential techniques linked to electronic devices that many manufacturers had started to develop.

2.3.3 Unfold incompatibilities of the institutional arrangement during the post-oil crisis period

However, the manufacturers faced crucial problems due to their total dependence on suppliers for the development of essential techniques, such as designing system parts. First, the dependence on particular suppliers for designing operations had an adverse effect. By working with (1) suppliers with better manufacturing skills, manufacturers could supplement their insufficient technical operations when they were involved in total product and basic parts designing. However, this means that the (3) manufacturing skills of the particular suppliers were only reflected in the designing operations.[23] The manufacturers, therefore, had to avoid depending excessively on particular suppliers for total product designs from the perspective of securing prominent manufacturing skills and essential techniques of other suppliers. Second, the manufacturers did not enjoy the large advantages that they had previously experienced from long-term relationships with particular suppliers. (3) Dependence on suppliers for product design induced the manufacturers to consign (2) system parts based on the (4) drawing-approved method to some excellent suppliers. However, the multiple assessment policy of the manufacturers allowed the suppliers to have deals with other groups of *keiretsu*, and some suppliers had begun to use the system parts for deals with other groups of *keiretsu*. That was why excessive dependence on suppliers for technical development made it difficult for the manufacturers to secure their product differentiation from their competitors. In addition, (6) the suppliers' active technical exchanges through (7) networks of industrial agglomerations and cross-sectional collaborations even allowed essential techniques useful for product differentiation to leak out to other groups of *keiretsu*. Third, cozy relationships between manufacturers and suppliers recurred. Their collusive ties during the postwar period were resolved by the comparative evaluation system based on the VA/VE method. This method focused on prices

[22] The collaborative actions enabled some suppliers in the automobile industry, for example, to succeed in developing essential techniques that included high-level electronic skills, such as electronic-controlled fuel injection devices and car stereos.

[23] In those days, the manufacturers usually contacted the salespersons of trading companies and measuring instrument manufacturers when looking for suppliers that were in other groups of *keiretsu* or in different sectors. That was why manufacturers had only limited sources of information for accessing other suppliers.

with the intent of boosting competition among suppliers within *keiretsu*. During the post-oil crisis period, however, the manufacturers introduced the ambiguous (5) multifaceted evaluation system in an effort to induce their suppliers to help them with the development of essential techniques that were effective for product differentiation. This approach caused the cozy ties between manufacturers and suppliers to be reshaped. As a result, the manufacturers were often obliged to strike deals with suppliers at their asking prices.[24]

From the supplier standpoint, in contrast, this institutional arrangement caused problems. First, the suppliers experienced extreme difficulties in properly developing manufacturing skills and essential techniques at a development pace that matched that of the manufacturers. At that time, the suppliers went beyond just subcontracting the manufacturing in the (4) drawing-approved plans drafted by the manufacturers. Particular suppliers' engineers with (3) outstanding skills within *keiretsu* were invited as guests, (1) as part of the manufacturers' programs, to be involved with product designing operations. Amidst the progress of these relationships, the suppliers believed that improving their techniques at the manufacturers' pace was inappropriate and considered it vital to develop their own unique manufacturing skills and essential techniques at a pace that surpassed that of the manufacturers. Second, the suppliers were required to develop techniques that would create higher added value. In spite of the suppliers' efforts to develop manufacturing skills and essential techniques, if the manufacturers did not find added value within those techniques, the suppliers were not highly evaluated even with the (5) multifaceted method. In this situation, deals concerning (2) system parts manufactured with (3) suppliers' skills became insubstantial, and the manufacturers often requested unreasonable cost reductions. In response to this situation, the suppliers found it necessary to aggressively develop connections with manufacturers and suppliers of other groups of *keiretsu* and in different business sectors. Third, there was a growing necessity to organize technical development among suppliers in different business sectors. In order to create higher-level added value for techniques among suppliers in different sectors, the suppliers had to break away from the development framework for manufacturing skills and essential techniques through (6) industrial agglomerations networks among suppliers in the same business categories. To facilitate the development of manufacturing skills and essential techniques among suppliers in different sectors, the suppliers needed to shift their foci to more (7) flexible technical exchanges in different business categories from the existing technical development

[24] Economists call this act "the reverse choice of suppliers." In fact, suppliers had long hoped to conduct the reverse choice. For example, the *keiretsu* system during the postwar period was a hotbed of collusion between manufacturers and suppliers, and there was some likelihood of reverse choice of suppliers. However, the arrangement structured by the multiple assessment policy based on the clear criteria of prices prevented these problems from surfacing.

structure.

2.4 Institutional changes by the electrical transaction during the post bubble economy period

Next, we explore changes in the institutional arrangement that has been operational since the 1990s. Against the backdrop of these changes, the incompatible factors of the institutional arrangement during the post-oil crisis period gained significant public recognition after the collapse of Japan's bubble economy in the early 1990s. To cope with these problems, manufacturers and suppliers sought new business relationships while pursuing their own self-interests. During those processes, both parties paid sharp attention to electrical transaction in line with the progress of ICT.

However, both parties pursued divergent self-interests and aimed to use the same techniques to configure completely different institutional arrangements. Both the suppliers and manufacturers focused on the same model of electrical transaction, but the institutional arrangements that each party pursued were strikingly different (Table 2). The following section examines the electrical market where the manufacturers took the initiative in realizing more open transactions (2.4.1). However, most of those markets had already been shut down. Our work then takes a close look at NC Network Co., the electrical transaction organizer that developed through supplier initiatives, and clarifies how manufacturers formulated the institutional arrangement in the manufacturing industry (2.4.2).

Table2. Institutional arrangement aimed by electrical transactions

		Electrical market on the initiative of manufacturers during the post bubble period	Electrical transaction on the initiative of suppliers during the post bubble period (NC Network)
Criteria of technical efficiency		Pursuit of dealing with highly functional system parts	Pursuit of diversified technical development and high added-value orders
Rules and Procedures	(1) Leading role for technical development	Manufacturers' initiatives	Suppliers' initiatives
	(2) Dealt items	Modules of system parts	Suppliers' techniques useful for high added-value
	(3) Dealing style	Open transactions of system parts	Dealing with suppliers in different sectors
	(4) Communication method	Standardized interface	Negotiation based on unique technology
	(5) Evaluation method	Focusing on prices	Focusing on suppliers' unique technologies and their networks
	(6) Technical development method	Cross-border competition among suppliers	Technical consultation and ordering operations among suppliers in different sectors
	(7) Interorganizational relationship	Based on spot transactions	Network among suppliers with unique technology

2.4.1 Electrical market on the initiative of manufacturers

As mentioned above, the manufacturers faced the following difficulties during the post-oil crisis period. First, the manufacturers depended on particular suppliers for designing operations and did not have access to the superior manufacturing skills and essential techniques possessed by other suppliers. Second, the manufacturers no longer experienced the large advantages they had previously enjoyed from the long-term business ties with particular suppliers. Third, competition-free, cozy relationships between manufacturers and suppliers recurred.

The manufacturers pursued the criteria of efficiency as “market transactions of highly functional system parts” to solve these problems. More specifically, as first, the manufacturers tried to regain their initiative in designing operations and paid attention to the three-dimensional CAD. In extreme terms, the simulation capability of the three-dimensional CAD enabled manufacturers to replicate the manufacturing operations in the design process without depending on (3) suppliers' manufacturing skills. Regaining the (1) initiative in designing meant that the manufacturers could sever their dependence on particular suppliers. Second, the manufacturers sought to procure better system parts in a more open way. On a related note, the manufacturers envisaged another potential of the IT-driven model: the possibility of (3) open electrical markets amidst internet developments. If the manufacturers could regain their leadership in design operations, they could create (2) modules of system parts based on the standardized interface and procure the necessary (4) system parts at any time from suppliers (6) all over the world in the form of (7) spot transactions. Third, the manufacturers considered encouraging competition among suppliers again. The manufacturers believed that an auction style should be employed that took advantage of the electrical market and that the economical procurement of system parts should be facilitated by using a (5) mechanism predicated on prices.

The manufacturers were aggressive about the launch of electrical markets in the late 1990s. The intent of the launch was to establish the institutional arrangement in accordance with the previously mentioned self-interests. However, one after another, Japanese electrical markets launched on this principle closed around 2001, and most of them ended in failure. The main reasons for this failure were to unfold incompatibilities in institutional arrangement and the manufacturers' improper configuring of the arrangement in line with the suppliers' self-interests. More specifically, initial uses of the three-dimensional CAD were not as competent at simulating manufacturing processes as the manufacturers had anticipated. Indeed, the three-dimensional CAD facilitated simulations of the manufacturing processes to a certain extent. However, it was obvious that simulations could not cover all the actual techniques that the suppliers had. Therefore, the introduction of the

three-dimensional CAD was not effective enough for the manufacturers to regain their initiative after their long dependence on their suppliers for manufacturing skills and relevant essential techniques. Second, open deals in electrical markets were based on standardized specifications of parts. However, with the exception of some system parts, the standardization was almost impossible, especially with interdependent system parts such as those used for automobiles. Third, the manufacturers had been demanding unreasonable cost cuts from their suppliers after the burst of the bubble economy. The suppliers gradually lost profits because of manufacturers' strong requests for cost reductions. The suppliers expected to be evaluated in terms of technical levels, not prices. The electrical market model did not satisfy the self-interests of suppliers, and a smaller cost burden on the manufacturers lessened the suppliers' incentives toward commitment.

2.4.2 Electrical transaction on the initiative of suppliers

While the electrical market model directed by manufacturers failed, NC Network Co., the electrical transaction organizer based on suppliers' initiatives, succeeded in steadily increasing its registered number of companies and became Japan's largest coordination website for electrical transactions with 13,000 registered companies. NC Network Co. put a strong emphasis on collaboration among suppliers beyond the walls of *keiretsu* and even strived for dealings far beyond the hierarchy comprised of manufacturers, primary suppliers, and secondary suppliers (Figure 2). The specific services to realize this ideal are as follows (Table 3).

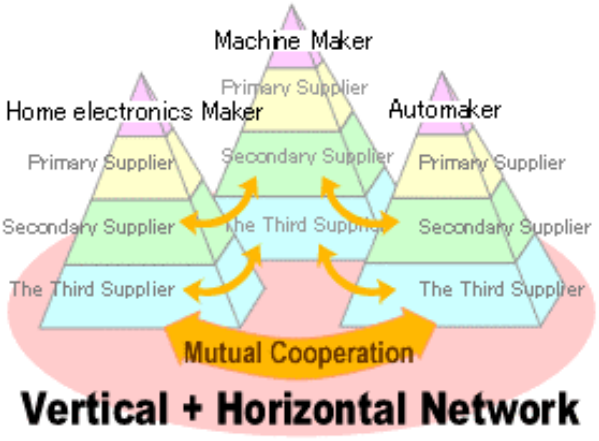

Figure.2 The aim of NC Network Co.
(http://www.nc-net.or.jp/ncnetwork/)

Table.3 Service and contents provided by NC Network Co.

EMIDAS	This is not a mediator of components or devices, but a searching engine of more than 13000 registered suppliers as potential partners for processing classification. We can search partners for condition from processing large classification to small classification. After we search, we can see the homepages of suppliers that meet conditions we set. So we can search not a components or devices, but new partners.
Excellent and Unique Technology Pick Up	This is the service to introduce suppliers' skillful or unique technologies with a picture and letters. We can also search for technology keyword. By this service, suppliers disclose their skillful or unique technologies to draw many orders.
EMIDAS on movie	This is the service to introduce suppliers' technology and operating states of their factory on movie. The movie is produced by NC Network Co., which understands the specialty of suppliers and knows what information to disclose. By this service, suppliers disclose their skillful or unique technologies to draw many orders.
Search Agent	This is the service to search the adequate supplier by NC Network Co. We can search new partner via search agent. The agents of NC Network Co., who have experienced process manufacturing, can understand many suppliers' technologies and selected adequate partners.
NC Network China	This is the service to outsourcing the low added value devices such as still-designed devices or simple structure devices to Chinese or South-East Asian suppliers. To be different from EMIDAS, this service is the search engine of components or devices. And the suppliers also receive high added value orders through this service.
Forest of Technology	This is the bulletin board on which every registered member can ask for technical advices from various suppliers all over the category of industry. Some orders occur on this serves in consulting the technical problem.

The following section reviews the services described in the above table from the perspective of the following three problems that affected suppliers during the post bubble period. First, as already illustrated, the suppliers could not develop adequate levels of techniques at a pace that matched that of the manufacturers. Second, the suppliers found it necessary to create high-level added value for their original techniques. Third, the suppliers faced a new challenge of developing techniques among suppliers in different industrial sectors.

In order to solve these problems, NC Network Co. launched the following services. First, NC Network Co. provides the service that allows suppliers to search for certain techniques possessed by (3) suppliers in various sectors. The search engine, EMIDAS, contains 13,000 registered suppliers. The suppliers can narrow their search from large classifications, such as designing, machine manufacturing, and metal casting, to smaller classifications, such as metal cast designing and industrial equipment, and eventually to a specific trade such as press cast designing. The users can enter in specific requirements and be directed to websites of suppliers who meet those requirements. This system does not have the manufacturer-led electrical market structure where modules of system parts are searched under the standardized interface according to price. However, it does allow for searching for

manufacturing skills and essential techniques offered by suppliers. The prices and deadlines of deals are coordinated (4) among suppliers at every transaction. This mechanism was predicated on the principle of (1) suppliers' initiatives.

Second, NC Network Co. has also launched services called the Excellent and Unique Technology Pick Up and the EMIDAS on Movie. These services were launched in an effort to boost (2) orders for high-level added value by introducing (5) suppliers' unique techniques to manufacturers and suppliers in (3) different industrial sectors and allowing the manufacturers and suppliers to have their evaluations. For example, some suppliers feature the manufacturing operations with extremely tight deadlines while others promote their own micromachining of aluminum materials. What is important about these actions is that the suppliers do not intend to push themselves forward into sales battles but provide their technical information and wait for orders to be placed. This approach stems from the fact that manufacturers who are incapable of creating high-level added value with their suppliers' skills undervalued those techniques. The suppliers can acquire orders for high-level added value by offering technical information through NC Network's services and waiting for inquiries from manufacturers and suppliers in different sectors. This style of marketing can be called "aggressively passive sales," where suppliers offer information instead of techniques to manufacturers. In addition, the NC Network Co. has initiated the NC Network China service to outsource parts to suppliers abroad. This service is intended to enable the suppliers to consign low added-value orders to suppliers in China and other countries through NC Network Co. so that they can pass off manufacturers' pressures for cost reduction. This operation also targets Western manufacturers that browse through the NC Network China in search of cheap Chinese suppliers to induce them to contract with Japanese suppliers for high added-value deals.

Third, NC Network Co. provides the bulletin board service called Forest of Technology to facilitate networks for flexible technical exchanges among suppliers with (7) unique technologies (6) beyond the walls of industrial sectors. If a supplier asks a question about how to remove greasy stains from ceramics on this bulletin board, the company can get answers from various suppliers, including those in different industrial sectors. Suppliers intending to enter a new business field can resolve unfamiliar technical troubles to a certain extent by utilizing this bulletin board system. They can sometimes gain new orders from other suppliers via the information exchanged on the bulletin board. This kind of service facilitates organizational ties among suppliers in terms of technical development. It is an extension of the transformation from manufacturers' full technical support and capital participation to mergers among suppliers in the same sector, networks of industrial agglomerations, and even technical collaborations with suppliers in different sectors.

However, if the electrical transaction organized by the supplier initiatives had not been established as compatible with the manufacturers' self-interests, mistakes similar to those that resulted from the electrical market created by the manufacturers' initiatives would have occurred. In fact, the electrical transaction launched by the NC Network Co. entailed to provide services applicable to the manufacturers' self-interests. More specifically, the institutional arrangement of the transaction has been configured to handle the manufacturers' past problems properly. These problems include the manufacturers' inabilities to introduce better manufacturing skills and essential techniques due to their dependence on particular suppliers, the minimal advantage of long-term business relationships with particular suppliers, and the recurrence of uncompetitive, cozy relationships with suppliers.

The first merit for manufacturer of the NC Network was that the manufacturers could sever their dependence on particular suppliers for manufacturing skills for system parts and relevant essential techniques. The services (1) made available by NC Network enabled the manufacturers (3) to access information on manufacturing skills and essential techniques possessed by suppliers whom the manufacturers had not previously contacted and who worked various sectors. When approaching products that were manufactured by trial-level new essential techniques, the manufacturers could use the NC Network as a supplementary tool to search for suppliers who employed unique technologies. The manufacturers needed these suppliers because the manufacturers lacked operational experience.

Second, the bulletin board service through which (6) suppliers could ask for technical advice was also utilized for the manufacturers' technical consultations. While this service was useful for the suppliers to develop their own unique technologies or look for supplementary skills, it allowed the manufacturers to brush off adverse effects caused by ties with particular suppliers. For example, if a manufacturer posts a technical question on the bulletin board, (3) various suppliers, including those in different sectors, positively provide alternative plans. These plans allow the manufacturer to search techniques other than just those of particular suppliers with whom the manufacturer already has a relationship. The manufacturers also use the NC Network model as the perfect tool to search for suppliers with (4) high-level techniques and (7) their networks. The manufacturers can then contract these suppliers to manufacture total packages of system parts. Paying attention to this point, NC Network Co. has launched Search Agent,[25] a service that allows users to search for suppliers with the (2) necessary technologies in the place of manufacturers. From the very start, NC Network Co., which was established with a focus on suppliers' initiatives and on services for suppliers, did not pay attention to making

[25] A main revenue source of NC Network Co. is service charges for Search Agent.

the suppliers' self-interests compatible with those of the manufacturers. However, NC Network Co. attempted several times and gradually shifted its focus to providing the electrical transaction sites that met manufacturers' needs.

Third, the services provided by NC Network allowed the manufacturers (5) to evaluate suppliers' technologies. The manufacturers had depended on particular suppliers for designing operations and were also obliged to order at the suppliers' asking prices. In this situation, the search engine service EMIDAS, where suppliers with solid technical foundations sought business opportunities, was not entirely helpful to the manufacturers. In contrast, the Search Agent service was more attractive to the manufacturers because it allowed them not only to search for suppliers with high-level technologies, as previously mentioned, but also to place orders at reasonable prices in respect to technical standards.

As the previously mentioned descriptions suggest, the NC Network provided the electrical transaction site structured to address suppliers' self-interests and was also adjusted for those of manufacturers. Therefore, the institutional arrangement is an important model for formulating the rules and procedures of Japan's manufacturing industry, both currently as well as in the near future. It also signifies that *keiretsu* will seek the criteria of efficiency as "diversified technical development and high added-value orders."

3. Conclusion and Discussion

The theoretical point of our work is to explain the endogenous process of institutional change by the dissolution of deep dichotomy of technical efficiency and social legitimacy in institutions. We discussed this point by empirical examination on the continuous processes through the history of *keiretsu*, where the technical pursuit of self-interests embedded in institutions requires reforming rules and procedures, changing institutional arrangement, and renewing the efficiency criterion in institutions (Figure.3). So, our account for institutional change is different from both accounts of the economist who presume (meta)equilibrium even if they are willing to encompass the social affection such as organizational routine or evolutional game, and the sociologist who presume inefficiency of institution even if they are willing to incorporate the efficiency or effects of technological matter to explain institutional changes.

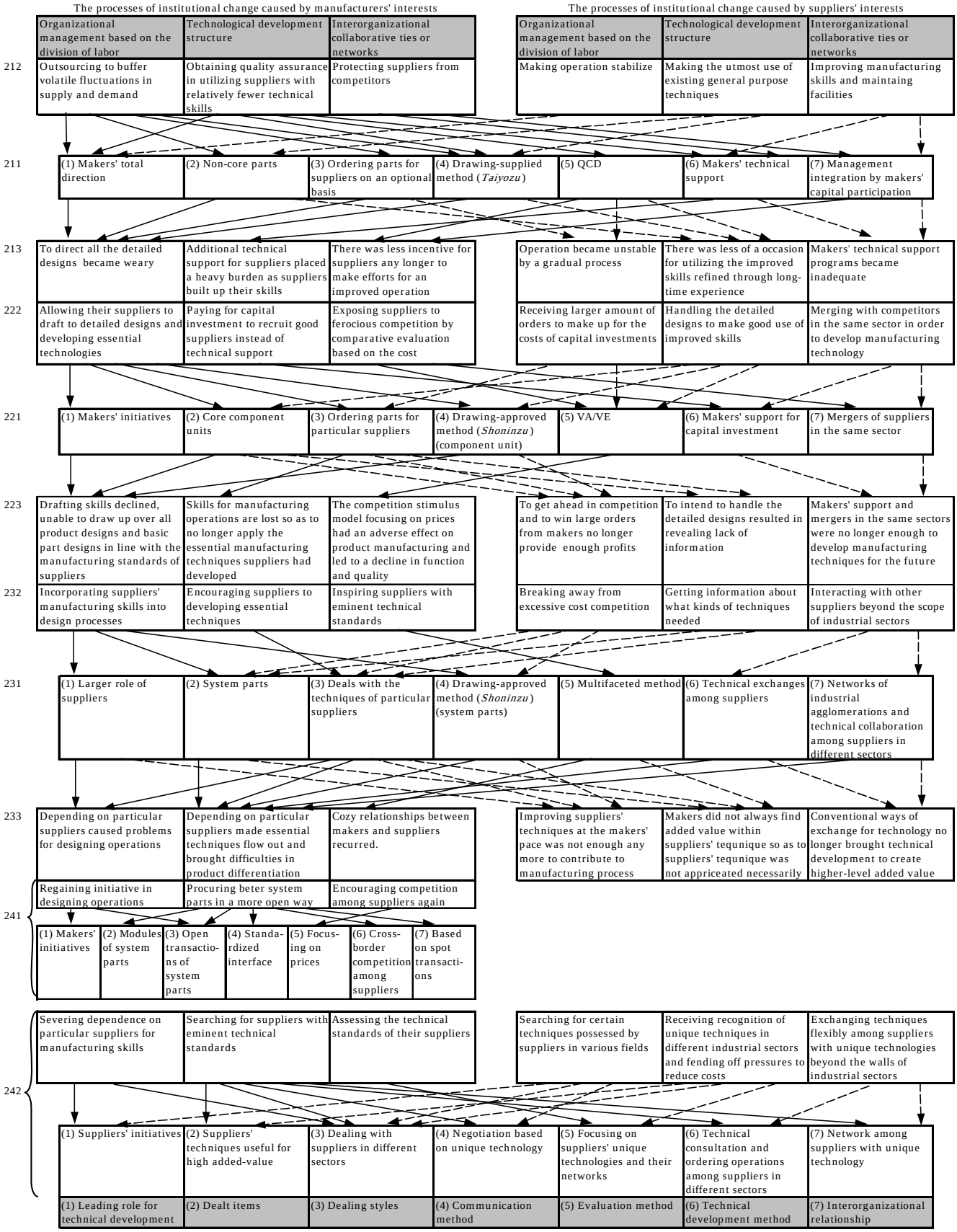

Figure.3 The continuous processes of institutional change in the history of *keiretsu*

To spend the rest of spaces, we would discuss resolution concerning theoretical subjects and further implications from empirical examination. First, our work employed four historical periodization to examine the changes of institutional rules and procedures based on the interests of both manufacturers and their suppliers in *keiretsu*. However we must conceptualize institutional change as continuous process to the last. From the postwar period to the present day, significant changes occurred in the power relationships between manufacturers and suppliers throughout these processes. As this paper has depicted, in the dawn of the institutional arrangement during the postwar period, the manufacturers enjoyed overwhelmingly advantageous technologies in both designing and manufacturing and took the initiative in every aspect. Subsequently, the suppliers gained a larger role in manufacturing operations, but the manufacturers continued to take the lead. The manufacturers' lead was why institutional analyses were analyzed from the manufacturer perspective in most of the preceding studies that treat *keiretsu* as a significant trait of the Japanese manufacturing industry.

However, as our work has explored historical processes, we determined that the positions of manufacturers and suppliers in *keiretsu* reversed. Expressing the power relationships as "suppliers and their customers," not as "manufacturers and their suppliers," is now appropriate. During the period when the manufacturers directed the manufacturing operations, they enjoyed a position as manufacturers and consigned parts that they did not manufacture to their suppliers. In those days, *keiretsu* was organized on the initiatives of manufacturers. Afterward, suppliers took charge of the whole manufacturing operation, and the manufacturers turned into assemblers. Particularly during the post-oil crisis period, when the manufacturers could not keep up with their suppliers in technical development, the suppliers took that position away from the assemblers. The blunder of information digitalization efforts on the manufacturers' (assemblers') initiatives reflected this power shift. Therefore, it is definitely inappropriate to discuss the significance and limitations of electrical transaction itself by just focusing on the failure of electrical markets. The electrical transaction in the Japanese manufacturing industry should be looked at from a broader perspective of continual changes throughout the long history of *keiretsu*. In this sense, the electrical transaction organized by NC Network Co. is a significant model in which to examine the current institutional changes of *keiretsu*.

Next, we should conduct thorough endogenous analyses so that a mixture of endogenous and exogenous factors will not affect our study's outcome. Many of the preceding studies explore the "paradox of embedded agencies," in which agencies are embedded within institutions and the institutions themselves changes. These studies did not explain everything based on endogenous factors but presented comprehensive models that partially

incorporate exogenous elements (e.g. DiMaggio and Powell, 1991[26]; Oliver, 1992[27]; Greenwood and Hinings, 1996[28]). In regard to the empirical examination of our work, technological and environmental changes involving manufacturing industries may be considered exogenous factors that affected *keiretsu*. For example, the postwar formation of *keiretsu* was spurred by the emergency procurement for the Korean War.[29] In the 1960s, the growing consumer demands and the growing amount of exports were important factors. The expansion of local manufacturing to ease trade friction in the automobile industry in the 1980s and the collapse of the economic bubble in the 1990s can also be regarded as substantial exogenous factors for institutional changes. However, we have pointed out that technical improvement and progress should be looked at from the viewpoint of practical effectiveness. In relation to environmental factors, the same institution is not always formed under the same conditions. Exploring the endogenous formative process of *keiretsu* is necessary. In addition, it is conceivable that exogenous impacts on *keiretsu* are embedded within multilayered institutional changes (Holm, 1995).

Third, it is essential to examine the basis on which we theorize the relationships between institutional changes and technologies. The empirical examination of this paper has shown that institutional changes are inseparable from technological improvement and progress, and in recent years, the number of IT models has accelerated. This association does not mean, however, that the institutional changes were caused by exogenous technical factors. Technology is a tool for strongly driving the divergent self-interests of institutionalized interest groups and therefore, it promotes unfolding incompatibilities that resulted from contradictions in institutional arrangements endogenously. Information technology, which is related to language, will play a particularly large role in inducing reflective practice to interests embedded in the time-space situation, which have been neglected (Woolgar and Grint, 1991; Matsushima, 1999; 2003). Fuller (2001) declares that the impact of information technologies in terms of their action-oriented aspects *polarizes* existing knowledge and accelerates institutional changes. The pursuit of the practicality of technologies will provide the platform for theorizing about the relationships between institutional changes and technologies.

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[26] DiMaggio and Powell (1991) insisted none of the authors regards institutions as entirely immutable or institutional change as a strictly endogenous process (p.30).

[27] Although Oliver (1992) pointed out traditional studies of design change have identified exogenous factors almost exclusively as precipitating initial change, she imports the concept of social pressures as external factors to explain institutional change.

[28] Greenwood and Hinings (1996) proposed framework to understand institutions change. According to their framework, institutional change has derived from both exogenous factors (market context, institutional context) and endogenous dynamics (interests, values, power dependencies, and capacity for action).

[29] If a strong focus of attention is to be placed on a military factor, the *keiretsu* system can be considered to have been initiated during the Sino-Japanese War and World War II.

Fourth, the previously mentioned two viewpoints lead to reexamining the methodological meaning of analyzing institutional changes. In institutional analysis, we usually look at a particular system on the basis of a certain pattern of critical thinking (Scott, 2001[30]). However, this methodology does not mean that we should theorize that institutional changes are caused by exogenous factors. If a researcher conducts an institutional analysis with a focus on a certain aspect of the subject, then the exogenous factors are the ones that have been strategically excluded from the scope of the institutional field for the analysis. Therefore, theorizing on these exogenous factors that are excluded from the scope of the institutional field yields methodological contradictions in explaining institutional changes. If any exogenous factors, such as technological and environmental ones, play an important role in explaining institutional changes, it is necessary to incorporate the phase of analyzing those changes from an endogenous perspective into the analytical framework.

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[30] He commented it is useful to distinguish, as a first step, between processes or factors exogenous to the institutional system under study that trigger change versus forces internal to the system (p.187).

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