The Relationship between Interorganizational Interdependence and Coordinating Agencies: An Empirical Investigation

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Abstract

Although several authors have theorized about the implications of interdependence for the development of coordinating agencies, no decisive conclusion has emerged. The present study empirically investigates the relationship between interorganizational interdependence and coordinating agencies by using the survey data on common facility cooperatives. Interdependence is classified into pooled, sequential, and reciprocal types as in Thompson (1967). The result shows that the rate of the development or the utilization of coordinating agencies differs among three types of interdependence. That is, the rate is the highest for pooled interdependence, moderate for reciprocal interdependence, and the lowest for sequential interdependence. These findings provide support for Alexander's (1995) hypothesis on coordinating agencies in relation to interdependence. Implications of the findings are discussed.

Key words: Interorganizational Analysis, Interdependence, Thompson's Typology, Coordinating Agency, Common Facility Cooperative

1. Introduction

Organizational literature has repeatedly insisted that the concepts of "interdependence" and "coordination" are inseparable from each other. Division of labor necessarily produces a greater or lesser degree of interdependence among organizational units [1]. Actions taken by one unit affects the actions or outcomes of another unit and ultimately the effectiveness of the entire organization [2, 3]. This implies that an organization's performance is higher when interdependent units take coordinated actions rather than independent actions [4]. Coordination means integrating or linking together different parts or units of an organization to accomplish a collective set of tasks [5].

The above association between interdependence and coordination has been primarily done as *intraorganizational* analysis. The idea that a system composed of interdependent parts needs coordination to enhance its effectiveness must hold true for the higher level of analysis. When autonomous organizations cooperate to serve a larger system, the single organization becomes a subsystem and the unique problem of *interorganizational* coordination occurs [6]. Interorganizational coordination is defined as *a structure or process of concerted decision making or action wherein the decisions or actions of two or more organizations are made simultaneously in part or in whole in some deliberate degree of adjustment to each other* [7].

The phenomena covered under the concept of coordination are extremely broad [8], but probably the interorganizational researchers' major concern has been with regard to the coordinating agency. According to Litwak and Hylton [9], the coordinating agency is a formal organization whose major purpose is to order behavior between two or more other formal organizations (1) by communicating pertinent information, (2) by adjudicating areas of dispute, (3) by providing standards of behavior, (4) by promoting areas of common interest, and so forth. The coordinating agency has also been called by other names, such as federation management organization [10], linking-pin organization [11], or referent organization [12]. No matter what it is named, whether there exists a coordinating agency or not is an

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important factor in considering interorganizational coordination. The reason is that if there is no coordinating agency, then coordination between organizations should be conducted directly by the organizations themselves, and the form is recognized as "coalitional," distinct from "federative" type of form in which a coordinating agency mediates between organizations [8, 10, 13].

Although several authors have theorized about the implications of interdependence for the development of coordinating agencies, research in this area has been limited. To date, no decisive conclusion with clear evidence has emerged. The level of knowledge on this topic is at best suggestive. In order to develop this area of inquiry further, the present study attempts to investigate the link between interorganizational interdependence and coordinating agencies by using a set of empirical data.

This paper is organized as follows. The next section reviews the literature on interdependence and its relation to the development of coordinating agencies. The third section outlines the method and the data used for the present study. The forth section reports the result. The fifth section discusses implications and the final section concludes.

2. Theoretical background

2.1 Interdependence

Thompson [14] distinguished three different ways in which the work of organizational units (or parts) may be dependent upon one another. The first type is *pooled* interdependence, which refers to the situations where "each part renders a discrete contribution to the whole and each is supported by the whole" (p. 54). The second type, in *sequential* interdependence units work in series where the output of one unit becomes input to another unit. The third type, *reciprocal* interdependence exists when an output from each unit becomes an input to the other. These three types of interdependence are illustrated in Figure 1.

The amount of interdependence is defined as *the degree to which the actions and outcomes of one unit are controlled by or contingent upon the action of another unit* [2, 3]. The three types of interdependence, according to Thompson, are increasingly intense or complex in the order introduced. To confirm this, it is advisable to imagine what will happen to the entire system when any one unit within the system breaks [21]. In pooled interdependence, even if any one of

(a) Pooled   (b) Sequential   (c) Reciprocal
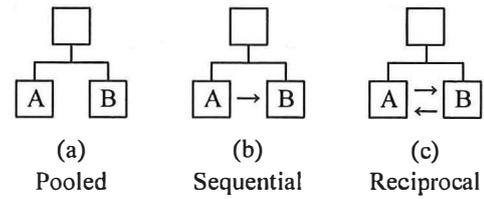
Source: [2], p. 63.

Figure 1 Types of interdependence

units fails, the others can continue to work uninterrupted. But in sequential interdependence, dysfunction of any unit is likely to affect at least the adjacent and possibly all subsequent downstream units just like dominoes. Finally, in reciprocal interdependence, where units provide each other with inputs in no particular predefined sequence, problems in one unit could spill over into other units through various routes and could lead to a system-wide failure.

Thompson's typology is thought to be beneficial to assess differing amounts of interdependence between units not only at intraorganizational but also at interorganizational level of analysis. In fact, his typology of interdependence is widely used in studies on interorganizational relations [15, 16, 17, 18, 19, 20, 21]. In accordance with these studies, the present paper also uses Thompson's typology to distinguish patterns of interdependence between organizations. Definitions and examples of the three types of interdependence are summarized in Table 1.

2.2 Hypotheses on coordinating agencies

It has been shown that increased interdependence leads to a greater need for intra- and interorganizational coordination [5, 8, 14, 22]. For this reason, it can be easily hypothesized that there is a monotonic relationship between interdependence and coordinating agencies. That is, increased interdependence is likely to lead to increased adoption of coordinating agencies. This way of thinking, however, is an oversimplification. Pfeffer and Salancik [23] argue that organizations can use mergers as strategies for absorbing their environmental interdependence. Thus we have to keep in mind that problems of interorganizational coordination not only can be managed by establishing coordinating agencies but also can be converted into intraorganizational matters through mergers.

In this respect, Litwak and Hylton's [9] theoretical argument on coordinating agencies is a compelling hypothesis. They assume a curvilinear relation between interdependence and coordinating agencies, noting that

Table 1 Definitions and examples of interdependence

Type of Interdependence	Pooled	Sequential	Reciprocal
Definition	Units share and use common resources but are otherwise independent	Units work in series where the output from one unit becomes input to another unit	Each unit receives input from and provides output to others, often interactively
Intraorganizational Example	Different units within an organization use a common transportation pool or a common mainframe	A marketing plan becomes the input to production and/or purchasing plans	A surgical team performing an operation; a group of research colleagues designing a study as a think tank; an executive committee of the firm developing a corporate mission statement and strategy
Interorganizational Example	A number of firms use a common data processing center	Various supplier-customer relationships along a value chain or a logistics chain	A concurrent engineering team consisting of customers, suppliers, distribution centers, dealers, shippers and forwarders, and the multiple within-firm units working together to concurrently design, develop, produce, and deliver the automobile

Source: Adopted from [21], p. 283.

high interdependency leads to the merger of organizations, with coordination taking place intraorganizationally, while low interdependence leads to no coordination rather than to coordinating agencies. It should not be forgotten that Litwak and Hylton preceded Thompson [14] and therefore did not use Thompson's typology of interdependence. However, if the typology was developed to represent differences in

Figure 2 Litwak and Hylton's hypothesis
Source: Adopted from [21], p. 283.

the level of interdependence better than any other device, then a theoretically predicted relationship between interdependence and coordinating agencies can be depicted as in Figure 2, which tells us that coordinating agencies are likely to be most frequently adopted when the type of interdependence is sequential.

There is still another important theoretical work on the relationship between interdependence and the development of coordinating agencies. By making direct reference to Thompson's typology, Alexander [15] explores differences in the development of coordinating agencies ("institutionalization" in Alexander's term) across three types of interdependence. According to his view, how much institutionalization is needed for coordination in an interorganizational network depends upon the decomposability of the network into a set of dyadic links in which informal liaisons or boundary-spanners suffice for coordination. He calls this rule "the principle of parsimony." Based on the principle, he suggests "a weakly positive associations between the prevailing interdependence in an interorganizational network, from sequential interdependence that demands the least institutionalization, to pooled interdependence requiring the most" (p. 308). Such theorization about the relationship between interdependence and coordinating agencies can be illustrated as in Figure 3.
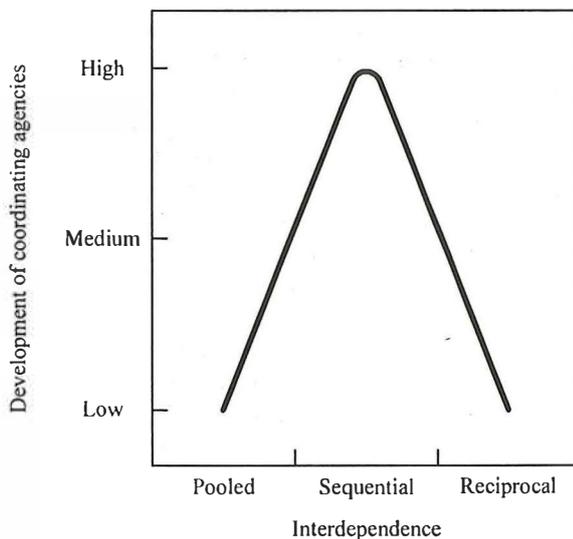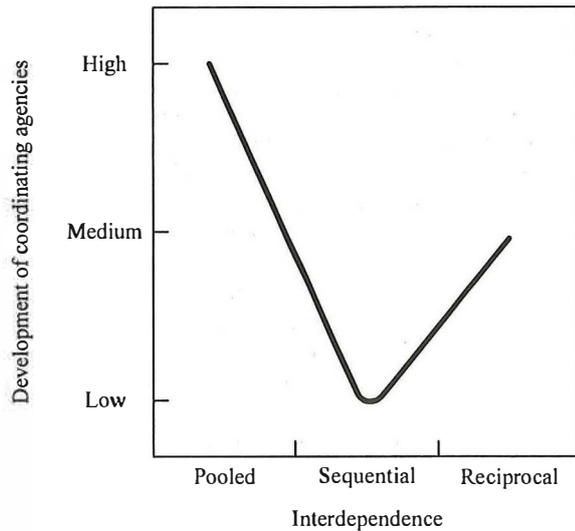
Figure 3 Alexander's hypothesis

Figure 2 and Figure 3 have reached different conclusions though they started toward the same goal of exploring the relationship between interdependence and coordinating agencies. Which figure is correct? As far as sequential type of interdependence is concerned, Alexander's hypothesis (Figure 3) seems to be more valid than Litwak and Hylton's (Figure 2). As shown in Table 1, interorganizational representative examples of sequential interdependence are various supplier-customer relationships along a value chain or a logistics chain. It is commonly believed that such interorganizational networks, as typified by the Keiretsu models of Japanese manufacturing, are governed by the powerful "lead organizations" among participating members, rather than by coordinating agencies acting as third party administrators [24]. In his classical paper on the manufacturer-dealer system, Ridgeway [25] says that the manufacturer is in the logical position to administer the system and provides the dealers with leadership, guidance and assistance. He goes on to say: "Certainly no third party currently external to the system could as efficiently communicate with the dealer, for this would interpose an extra level in the communication chain. Further, it would involve duplication of effort for a third party to attempt to provide the dealers with the necessary guidance and assistance, for much of the work is already a part of the manufacturer's self-administration" (p. 473).

However, we can never confidently say that there are few or no mediating third parties in sequentially interdependent networks until we obtain clear evidence to support this assertion. Moreover, we know little about the rate of development of coordinating agencies in case of pooled or reciprocal interdependence. The model which relates interdependence to coordinating agencies must be built upon empirical knowledge.

3. Method and data

3.1 Method

There are two possible ways of investigating how the rate of development of coordinating agencies differs among types of interdependence (pooled, sequential, reciprocal).

The first approach is as follows: (1) classify a sample of various interorganizational collectivities into the three categories depending upon their nature of interdependence; (2) then measure the adoption rate of coordinating agencies in each category. For instance, suppose that there are 125 collectivities categorized as pooled interdependence and 75 of them have (50 of them do not have) coordinating agencies, then the adoption rate in this category will be estimated as 60%. Park [26] employs such an approach to examine the relationship between types of interdependence and coordinating agencies, though his classification of interdependence (horizontal vs. vertical) differs from that used in the present paper.

The above approach has the following limitations: (a) an interorganizational collectivity is not always characterized by only one type of interdependence. The possibility that the same collectivity has two or more types of interdependence cannot be ruled out. In this case, the classification becomes extremely ambiguous; (b) we should pay attention to the possibility that there might be another difference among categories of interdependence, other than interdependence per se, which could affect the development of coordinating agencies. Previous studies have underscored the number of organizations as such a factor [9, 10, 23]. Litwak and Hylton [9], for example, hypothesize that there is a curvilinear relationship between number of organizations and the development of coordinating agencies, since it is more difficult to develop coordinating agencies where there are a huge number of organizations to be coordinated while there is no need for coordinating agencies where there are only a few organizations. Number of organizations and other critical variables must be adequately controlled.

To avoid these difficulties, the present study employs the second approach like the following: (1) use only interorganizational collectivities with coordinating

agencies as a sample; (2) let the unit of analysis be a cooperative activity through and by the coordinating agency, not be a collectivity; (3) relate activities to the three categories (pooled, sequential and reciprocal) depending upon their nature of interdependence. Stated differently, identify activities which represent each of the categories of interdependence; (4) and then measure the occupancy rate of the representative activities.

3.2 Data

Interorganizational collectivities on which this paper focuses as a sample for investigation are common facility cooperatives in Japan. The common facility cooperatives make up of the majority of small business associations that are jointly established by small and medium enterprises to overcome weaknesses in their resources and positions. The objective of the common facility cooperatives is to improve the economic standings of and promote managerial rationalization for member small business through cooperative activities in the spirit of mutual assistance [27].

The data used in this paper was obtained from the last three surveys of common facility cooperatives conducted in year 1990, 2000, and 2006 by National Foundation of Small Business Associations in cooperation with Prefectural Federations of Small Business Associations [28, 29, 30]. The numbers of respondents (cooperatives) were 20,163 in year 1990, 19,882 in 2000, and 13,158 in 2006.

An interorganizational collectivity having a coordinating agency is sometimes called a federation and is distinguished from a coalition in which coordination is left to member organizations and there exists no mediating third party [8, 10, 13]. According to Provan [10], the federation is an interorganizational collectivity composed of both affiliates, that are legally independent organizations, and the coordinating agency called federation management organization (FMO). Common facility cooperatives can be doubtlessly regarded as federation-type collectivities. Member enterprises correspond to affiliates, while the cooperative meets the definition of the coordinating agency or FMO because it has corporate status and contains administrative components such as directors and staff members. It can be said that the cooperative as a coordinating agency or FMO conducts activities to manage interdependencies between and facing member enterprises.

Activities that the common facility cooperatives can carry out are as follows [27, with modification]:

(1) Undertaking joint production, processing, sales, purchases, storage, transportation, inspection, etc for member enterprises.
(2) Loading capital to members.
(3) Promoting welfare and leisure for members.
(4) Providing education and information for managerial and technological improvement.
(5) Researching and developing new products or technologies for helping members to enter into new areas of business.
(6) Signing collective agreements to improve the economic standing of members.

From among these activities, let us select the most representative of each type of interdependence (pooled, sequential, reciprocal).

(a) Pooled interdependence

As shown by Table 1, in pooled interdependence units share and use common resources but are otherwise independent. Each unit is supported by the whole and there is no direct interaction between units. Among the six kinds of activities listed above, it is the fourth "education and information providing" activity that best exemplifies the feature of pooled interdependence. The cooperative can implement the education and information providing services to member enterprises for the purpose of improving their managerial or technological capabilities. The ways in which this kind of activity would be carried out are the holding of workshops and seminars inviting experts in certain areas, the publication of journals, and so on [31].

(b) Sequential interdependence

Interorganizational examples of sequential interdependence are, as seen in Table 1, various supplier-customer relationships along a value chain or a logistics chain. We ought to be concerned with the interaction between units (member enterprises) that join a cooperative. This principle is maintained in cases of (a) pooled and (c) reciprocal interdependence. However, sequentially-interdependent enterprises are not always organized into a cooperative. Therefore it is impossible or makes no sense to measure the occupancy rate of the activity which represents sequential interdependence, since there may not be this type of interdependence inside any cooperatives. Consequently, the focus has been shifted away from the interaction within cooperatives towards the interface between cooperatives and their external environments. In so doing, the sixth activity, i.e., "signing of collective agreements" emerges

as the typical example of sequential interdependence. Such agreements are made between wholesalers and the cooperative of manufacturers; between wholesalers and the cooperative of retailers; between the chief contractor and the cooperative of its subcontractors; between manufacturers and the cooperative of dealers; and so forth. Contractual agreements include various terms and conditions of business, such as payment methods, transaction prices, usance, and so on. When collective agreements are concluded, effects of the agreements act directly to member enterprises even though the contracting party is the cooperative [31].

(c) Reciprocal interdependence

Grandori [19] points to the development of a new service or product or the accomplishment of a complex industrial project as an example of interfirm reciprocal interdependence. In either case a variety of techniques should be drawn upon in order to achieve a change in some specific object, as in the case of a surgical team performing an operation (see Table 1). It can be easily imagined that in these reciprocal tasks burdens on communication and decision are not light. Among the six kinds of activities carried out by cooperatives, it is the fifth "research and development" activity that has a distinctive characteristic of reciprocal interdependence. Under the norm of rationality, cooperatives group members who have similar needs in order to effectively and efficiently accomplish the joint activity [32]. When members sharing common needs to enter into new areas of business are grouped together and the joint research and development program is implemented, reciprocal interdependence occurs between members and ad hoc coordination named "mutual adjustment" by Thompson [14] is required.

As identified above, education and information providing is the best example of pooled interdependence; signing of collective agreements is of sequential interdependence; research and development is of reciprocal interdependence. Below, how much cooperatives carry out these representative activities will be shown.

4. Result

Every three statistical survey of common facility cooperatives reports the state of implementation of joint activities carried out by the cooperatives. There is almost no change in classification of various activities each time (there are about 30 kinds).

In every survey, the activity regarded in the present paper as the representative of sequential interdependence is labeled as "signing of collective agreements with counterparties." The representative of reciprocal interdependence is labeled as "research and development of products and technologies." The "education and information providing" activity is presented separately divided into "education and training" and "information gathering and providing." Since it makes little difference which is chosen, the present paper would prefer the former "education and training" category as the typical example of pooled interdependence. Occupancy rates of these three activities (education and training, collective agreements, research and development) are summarized in Figure 4.

The occupancy rate of each activity varies slightly with time. However, it remains unchanged that the rate
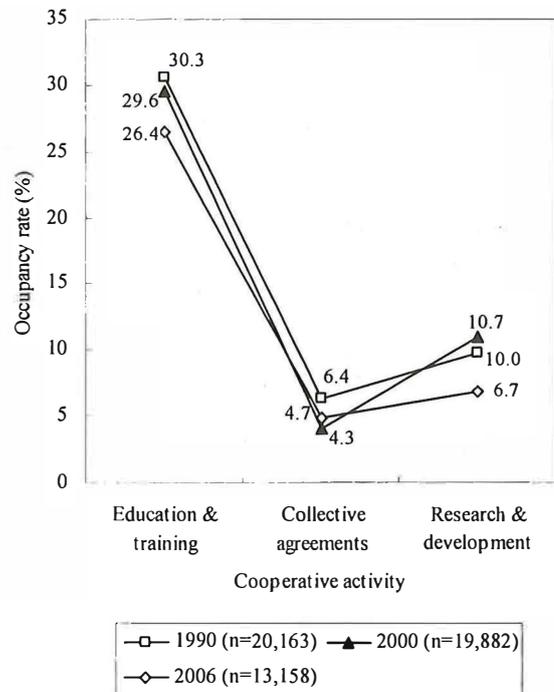
Note
At every survey point, the chi-square test was used to determine whether we can reject the null hypothesis that the occupancy rates are independent of the types of activities. The calculated chi-square value was 5,105.97 in year 1990, 5,432.88 in year 2000, 3,425.53 in year 2006, all of which have less than a 0.001 probability of occurring.

Source: Adopted from [28, 29, 30].

Figure 4 Occupancy rate of each cooperative activity

of collective agreements is the lowest, the rate of research and development is the second lowest, and the rate of education and training is the highest. What can be read from Figure 4 is the capital letter "L" which inclines to the left and this result provides strong support for Alexander's hypothesis visualized in Figure 3.

5. Discussion

This study has empirically examined the relationship between interorganizational interdependence and coordinating agencies. The result indicates that *the occupancy rate of the activities is the highest for pooled interdependence; moderate for reciprocal interdependence; and the lowest for sequential interdependence.* These findings provide support not for Litwak and Hylton's [9] but for Alexander's [15] hypothesis on coordinating agencies in relation to interdependence.

As pointed out in the earlier theoretical discussion, sequential interdependence between organizations tends to be coordinated directly by the member organizations, centered around the "lead organizations" [24]. The result of this paper reinforces this view. In Figure 4, the occupancy rate sags in the middle of a continuum of interdependence. The "sag" can be explained by the above-noted principle of parsimony [15]. The principle postulates that sequentially interdependent networks of organizations can be easily decomposed into a set of dyadic links, so mediating third parties are rarely necessary.

Grandori [19] offers a slightly different account for the sag. According to her revised classification of types of interdependence, sequential type is categorized into "transaction" interdependence as opposed to "collective action" interdependence into which pooled and reciprocal types are categorized. Such classification suggests that regulating transactions is easier to handle without coordinating agencies than governing collective actions. As demonstrated by Olson [33], actions to produce collective goods can be hardly realized without coordinating devices or efforts. Therefore, in case of collective action interdependence, it is thought that there is room for third party mediation.

Polar points on a continuum of interdependence, pooled and reciprocal, resemble each other in that they both are categorized as collective action interdependence. However, as shown in Figure 4, a large disparity in the occupancy rate exists between these polar opposites. In my opinion the origin of such asymmetry is not difference in the necessity of coordination but difference in the difficulty of coordination. According to Thompson [14], reciprocal interdependence is far more difficult to coordinate than pooled interdependence. If so, it is appropriate to think that the low occupancy rate in case of reciprocal interdependence reflects neither lack of interest nor lack of necessity, but lack of feasibility. Table 2 provides evidence that support this way of thinking to some degree. The last three surveys conducted by National Foundation of Small Business Association asked respondents which kinds of activities 1) they put in practice, and 2) they would prioritize in the future.

Table 2 Present and future situation of each cooperative activity

		Education & training (Pooled)	Collective agreements (sequential)	Research & development (Reciprocal)
1990 (n=20,163)	A) put in practice	6,114	1,291	2,013
	B) prioritize in the future	3,110	641	1,790
	B/A ratio	50.9%	49.7%	88.9%
2000 (n=19,882)	A) put in practice	5,885	852	2,136
	B) prioritize in the future	3,471	394	1,568
	B/A ratio	59.0%	46.2%	73.4%
2006 (n=13,158)	A) put in practice	3,470	617	886
	B) prioritize in the future	1,732	110	616
	B/A ratio	49.9%	17.8%	69.5%

Note
    At every survey point, the B/A ratio was significantly higher ($p < 0.001$, two-tailed) in "research & development" than in "education & training."
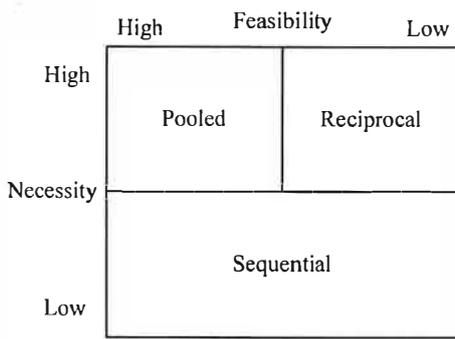
Source: Adopted from [28, 29, 30].

Figure 5 Necessity and feasibility of mediated coordination

The numbers of respondents who answered "put in practice" and "prioritize in the future" are shown in row A and row B, respectively, of Table 2. It can be observed that the B/A ratio is consistently higher in "research and development" than in "education and training," suggesting that respondents would more like to coordinate reciprocal interdependence but cannot afford to do so.

Taken together, the occurrence of coordinating agencies is hypothesized to be affected by two dimensions: (1) necessity, and (2) feasibility. In case of sequential interdependence, necessity of mediated coordination via the agencies is low, thus leading to the lowest occupancy rate. On the other hand, in case of pooled interdependence, the necessity is high and feasibility of mediated coordination is high, thus leading to the highest occupancy rate. In case of reciprocal interdependence, the necessity is high while the feasibility is low, thus leading to the modest occupancy rate (see Figure 5). Such an interpretation seems to provide a more complete description of the link between types of interdependence and coordinating agencies than has been asserted in the existing literature.

6. Conclusion

This study has sought to investigate the link between interdependence and coordination at the interorganizational level of analysis. Interdependence has fallen into three types according to Thompson [14]: pooled; sequential; and reciprocal. Each type of interdependence was represented by the activity that common facility cooperatives can undertake. This study showed significant difference in the degree to which coordinating agencies are utilized depending upon the nature of interdependence. That is, *the rate was the highest for pooled interdependence, moderate for reciprocal interdependence, and the lowest for sequential interdependence* as shown in Figure 4.

Several limitations of the present study should be mentioned. First, my analysis may have been biased by the sample. The findings presented here are limited to the cases of common facility cooperatives in Japan. Before generalizing the findings, additional research using other sample of interorganizational networks must be undertaken. It is also should be noted that the left-leaning L-shape (Figure 4) is a generalized character of common facility cooperatives; some segmented sub-groups show exceptions. Survey reports [28, 29, 30] divide common facility cooperatives into about 20 kinds of sub-groups according to the differences in goals of cooperatives or in characters of member organizations, and form cross-tabulation tables of sub-groups and activities in practice. The tables show, for example, that the occupancy rate of "research and development" is generally low in sub-groups such as "wholesalers' housing complex cooperatives," "distributors' housing complex cooperatives," and "cooperative department stores," all of whose members are non-manufacturers. Therefore, the line of the occupancy rate among these cooperatives represents the downward-sloping curve rather than the left-leaning L-shape. As illustrated by this example, activities that cooperatives conduct should fit with goals of them or needs of member organizations, so we should not adhere to the idea that the left-leaning L-shape is common.

Second, this paper has related "education and training" to pooled interdependence, "collective agreements" to sequential interdependence, "research and development" to reciprocal interdependence. Such an approach is against Thompson's [14]. He insists that interdependence types lie on Guttman scale. That is, a system having sequential interdependence contains pooled interdependence. Likewise, a system having reciprocal interdependence contains sequential and pooled interdependence. If so, "research and development" would have features of not only reciprocal interdependence but also sequential and pooled interdependence. The recognition that the types of interdependence form a Guttman scale may lead to completely different methodology, results and interpretation from those of the present study. I hope that competition between alternative approaches will bring about the progress of research in this field.

Third, as noted earlier, the phenomena covered under the concept of coordination are extremely broad [8], so future research should also investigate many more aspects of coordination in connection with interdependence, thus leading to a better understanding about the implications of interdependence for network functioning and effectiveness. The study reported here has taken a step in this direction.

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