

## STRATEGIC CONNECTIVITY IN EXTENDED ENTERPRISE NETWORKS

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### ABSTRACT

Extended enterprises are networks of organizations interconnected to exchange critical resources, such as raw materials, labor, access to markets, specialized skills and knowledge. Information technology (IT) is a key component in managing these interorganizational dependencies. IT can be used to disintermediate supply chain partners or, conversely, tightly couple relations by binding operational functions, processes, strategic plans and knowledge.

As IT strategies are developed and implemented, how can organizations visualize and manage interorganizational linkages to gain or maintain competitive advantage? To address this problem, this paper uses the Dependency Network Diagrams (DNDs) representation methodology to augment existing strategic frameworks. DNDs diagrammatically depict the exchange channels, governance controls, and roles within the extended enterprise. DNDs enable the essential elements governing interorganizational relations to be captured and communicated, compared with alternative arrangements, and evaluated in terms of performance and flexibility under changing conditions. With this new tool, organizational strategists can systematically analyze and compare alternative arrangements of electronic channels with an emphasis on deploying interorganizational processes and control systems that synchronize activities across the trans-organizational interface.

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### 1 The Extended Enterprise

Recently there has been a shift from inward-looking strategies of using information technologies (IT) for functional efficiency and process optimization to an interest in using IT to manage the outward-looking strategies of extended enterprise relationships. Organizations are increasingly focused on improving supply-chain processes, customer relationship management, and value-adding processes within their organizational networks. Emphasis on supply-chain integration, horizontal connectivity, and “source-to-use” strategic planning has increased the importance of understanding, and managing, the extended enterprise.

Existing tools developed in the post-industrial era, such as data flow diagrams and process flow diagrams, work well to design and develop information technologies internally within the organization. In extra-organizational relations, however, this inward manufacturing-process orientation abstracts away critical elements of extended relationships, such as influence and power relations, alternative governance controls, and indirect coordination. Tools are needed to represent the unique problems of coordination, influence asymmetry, and indirect governance inherent in extended enterprise systems.

#### 1.1 The Extended Enterprise

Organizational relationships are networks of resource interdependencies. The “extended enterprise” view includes suppliers, buyers, vendors, customers, government agencies, and other external organizations that are critical to the success of the organization. Organizations seek out relationships with external organizations that provide critical resources, such as raw materials, labor, access to markets, specialized skills and knowledge, and will structure their internal operations to insure access to these critical resources.

Information is a key component in managing these interorganizational dependencies. IT can be used to disintermediate supply chain partners or, conversely, tightly couple relations by binding operational functions, processes, strategic plans and knowledge. IT can impose new processes, conditions, and direction onto dependency organizations, or modify the terms and conditions in the continued supply of a needed resource. This influence can compel dependent organizations to make changes in internal processes, organization and direction [Pfeffer, 1992]. Organizations can thusly use information technologies to redefine their network affiliations and the roles of dependent organizations, in effect restructuring the industrial space in which they occupy.

This paper proposes the use of the Dependency Network Diagram (DND) representation methodology to examine, define, and develop extended enterprise systems. DNDs diagrammatically depict essential elements of the

extended enterprise – the exchange channels, governance controls, and roles that constitute networked relations. Use of DNDs enables these essential elements of the extended enterprise to be captured and communicated, compared with alternative arrangements, and evaluated in terms of performance and flexibility under changing conditions.

To understand the contribution of DNDs in modeling interorganizational IT, we begin by examining three strategic frameworks commonly used in conceiving the extended enterprise: Linkage Analysis Planning, Critical Success Factors Method, and Investment Strategy Analysis. We then briefly describe the DND methodology. The contribution of the DND methodology in representing the essential elements of the three strategic orientations is then discussed. Contributions of DND representations are presented at the end of the paper.

## **2 Three Strategies for The Extended Enterprise**

### **2.1 Linkage Analysis Planning**

Linkage Analysis Planning [Primožic *et al*, 1991] concentrates specifically on networked relationships along the value chain and the role of electronic channels. Analysis starts by identifying linkages that are relationships the organization has with other entities. Analysis is focused on the control, management, and cooperation involved in each of the linkages identified. This analysis identifies potential under-commitment of management resources to critical linkages, exploitation of relationships, and a systemic view of the overall channel to achieve a “win-win” strategy for all inter-networked organizations. Primožic *et al* believe that successful organizations in the future will be those that control the electronic channels.

Primožic *et al* suggest a shift from inward-looking strategies of functional efficiency and process optimization to an emergence of an outward-looking strategy of extended business/organizational relationships. Strategic boundaries expand to coordinate networks of suppliers and customers as the scope for planning, management, and control. These networks encompassing the focal organization are termed the Extended Enterprise. Electronic channels extend from the focal organization to include suppliers, buyers, vendors, customers, government agencies, and other external organizations that are critical to the success of the organization [Primožic *et al*, 1995].

Linkage analysis planning has five basic components:

1. to understand “waves of innovation,” focusing on revenue generation instead of cost reduction;
2. to exploit successively distinct experience curves, providing investment in the fundamentally different technologies that disrupt the continuous learning curve;
3. to define power relationships that exist among the various players in building electronic links among enterprises;
4. to map out the extended enterprise and manage the relationships within it, anticipating change and exploiting cross-organizational arrangements;
5. to plan the creation, distribution, and presentation of information across electronic channels to improve marketing, administration, distribution and customer service.

Primožic *et al* contend that competitive advantage will depend increasingly on being able to exploit the collective resources of one’s extended enterprise. They propose that organizations that control the electronic channels will be more successful because of the ability to address new niche markets as these markets arise. Furthermore, as use of IT leads to a smaller, faster-paced world, organizations with the longest electronic reach into their extended organization will have an advantage.

### **2.2 Critical Success Factors Method**

The Critical Success Factors Method [Rockart, 1979] proposes that organizational strategy may best be based on identifying elements of the organizational environment that are critical to operation or exposed to significant threat.

Sources for identifying these critical success factors include (1) the industry in which the business occupies, for competition over scarce resources, institutional arrangements that facilitate or inhibit strategies, and connectivity to other organizations; (2) the company itself and its situation within the industry, often dictated by a few dominant players; (3) the environment, such as trends, technological innovation, and governmental influences; and (4) temporal conditions or areas of company activity that normally do not warrant concern but which are currently unacceptable and need attention.

The emphasis of the Critical Success Factors Method is to isolate key areas of exposure to the focal organization with regard to key resources, extra-organizational influences, and changing regulatory forces within the network in which the company operates.

### 2.3 Investment Strategy Analysis

In contrast to the channel view of linkage analysis and the issues-based view of the critical success factors method, Norton and Gibson (1974) propose a strategic development method that focuses on the allocation of investments and the deployment of IT resources. In describing the four stages of organizational computing, Norton and Gibson suggest that organizational and technological deployment strategies move from internally oriented strategies of transaction automation and managerial support to a more progressive strategy of systems that serve to network the focal organization with key users outside the company such as customers and suppliers. In this view, organizations with greater outwardly connected networks of interaction will have greater sustainable strategic advantage.

### 2.4 Strategic Connectivity

The common theme of these methods is the notion of electronic channels to capture the coordination element of electronic channels, specifically the alignment of operational processes and the establishment of exchange governance across inter-networked organizations. Electronic channels include processes and control systems that synchronize activities across the trans-organizational interface. The electronic channels that support the extended enterprise relationship enable organizations to create and distribute operational functionality and codified work processes. Governance controls mediate the coordinated exchange across electronic channels, specifying the terms and conditions, often contractual in form, under which networked organizations manage their interface boundaries and their relation with one another [Mintzberg, 1979][Malone & Crowston, 1994].

Each of the methods proposed above suggest that organizational success is being increasingly tied to the extended enterprise and the appropriate use of electronic channels that allow organizations to change in order to more closely integrate their business operations. Organizations need to incorporate strategic connectivity through these electronic channels to enable transfer information and knowledge between organizations and to coordinate operational functions and assets. "Industry restructuring," assert Primožic *et al* (1995), "will take place throughout the entire Extended Enterprise and will cause entire industries to be transformed."

### 2.5 Research Question

The central question raised by these strategic methodologies is, as these strategies are developed and implemented, how can organizations visualize and manage interorganizational linkages to gain or maintain competitive advantage?

As an organization's success will increasingly depend on its ability to ensure it is able to achieve strategic advantage by exploiting not only its own internal resources but the collective resources of the entire extended enterprise, an important component of any strategy is the identification and analysis of interorganizational relations. Because the competitive environment today is no longer a simple one where organizations are pitted against like organizations, management must ensure that they can identify the key components of the electronic channels and infrastructure required to do business in the future.

*The ability to maintain competitive advantage for many organizations will be greatly enhanced by developing a strategy to form alliances and partnerships and to utilize the functions being provided by new innovative industry and association entrants. This will be the most effective means to providing key elements of the electronic channels and infrastructure.* [Primožic *et al*, 1995]

This is the purpose of this paper. Here we use the Dependency Network Diagram representation methodology to depict exchange channels, governance controls, and roles within the extended enterprise. Dependency Network Diagrams (DND) target the key components of electronic channels for communication, analysis, and evaluation of strategies in the extended enterprise.

## 3 Dependency Modeling

Dependencies are interface relations between organizations where the activities required by one to achieve a goal are supplied by another. The range of organizational activities defines the ability of an organization to pursue goals, and the inability to perform activities defines the dependencies the organization has on others [Dastmalchian, 1986]. When internal activities are insufficient to satisfy specific needs, organizations negotiate for exchange of the required capacity. The outcome of these negotiations is the dependency relationship.

The dependency relationship consists of the activities necessary to support, manage, and execute the exchange relation, the definition of the roles each organization plays in the exchange relation, the goals each holds in entering into the exchange relation, and the terms and conditions governing the exchange relation. The combination of a specific set of behaviors and the goals to which the behaviors are oriented defines a role [Bormann, 1975][McGrath, 1984][Zigurs & Kozar, 1994], and so exchange relations can be viewed through the characterizations of the roles

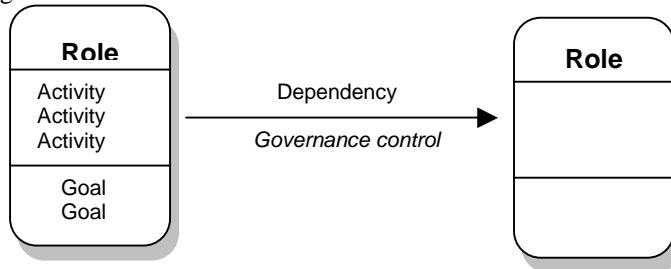
played and the systems of control that govern the roles within a dependency network. Governance controls exist to assure that actions in the exchange comply with the demands of the exchange [Pfeffer & Salancik, 1978].

The design of organizational information technology is closely related to role definitions. Dansker *et al* suggest planning IT involves explicit definitions of roles and responsibilities [Dansker et al, 1987]. Roles have been identified as an important component of organizational memory and changes to roles as impacting the common knowledge shared in organizational processes [Wijnhoven, 1999]. Interorganizationally, firms develop new strategy options for differentiating products and services when information technologies integrate lines of role interaction [Kambil & Short, 1994].

Dependency Network Modeling [Tillquist *et al*, 2002] explicitly depicts the roles, goals, and activities within an interorganizational setting. Modeling dependencies is based on diagrammatic representations of activities, roles, goals, and governance controls. The representation of roles includes both a motivation and a capacity to perform goal-oriented activities, as well as the terms and conditions agreed upon by the exchange partners in regulating the dependency relationship.

### 3.1 Diagrammatic Constructs For The Dependency Network Diagram

Construction of a representational syntax for dependency networks begins by defining roles to represent distinct sets of activities and goals. Roles are depicted graphically in the DND as rounded rectangles separated into three areas. The name of the role occupies the upper area of the rectangle, the activities associated with the role in the middle area, and the goals associated with the role in the lower area:



For illustration purposes, we define two roles,  $r$  and  $s$ , to represent two hypothetical sets of activities and goals, as illustrated in the DND of Figure 1. For each role, we define the activity sets allowable for the role to perform as  $A_r$  and  $A_s$ , for roles  $r$  and  $s$ , respectively. These activities may be the distribution or processing of information, or the provisioning of a resource (such as access to materials, labor, skills or a market).

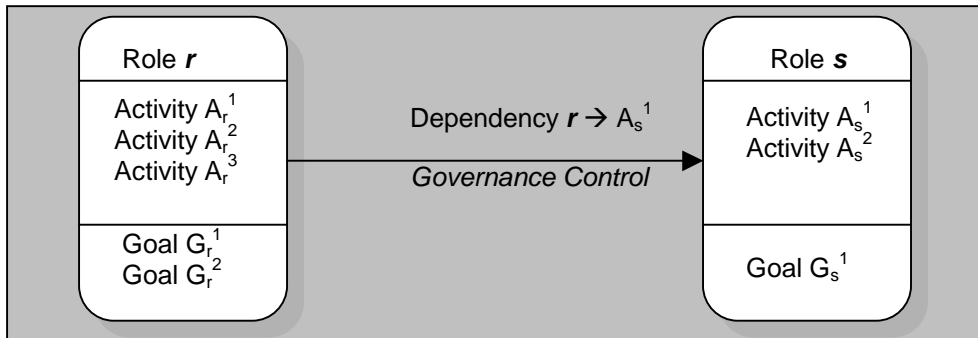


FIGURE 1. Diagrammatic Constructs of DND Representations

Each activity set consists of activities performed by the associated role, and are represented in the DND depicted in Figure 1 as the set of activities  $\{A_r^1, A_r^2, A_r^3\}$  for role  $r$  and the set  $\{A_s^1, A_s^2\}$  for role  $s$ . In other words, role  $r$  has the functional capacity of independently performing activities  $\{A_r^1, A_r^2, A_r^3\}$ .

Each role also has depicted the associated goals for each role. Goal sets for roles  $r$  and  $s$  are depicted in the DND as  $G_r$  and  $G_s$ , respectively. Goal set  $G_r$  is comprised of the two goals  $\{G_r^1, G_r^2\}$  in this depiction, while  $G_s$  has only one goal in its goal set,  $\{G_s^1\}$ .

The activities are invoked by each role in terms of the accomplishment of a goal. For illustration purposes, we define activities  $A_s^1$  and  $A_s^2$  as necessary and sufficient to accomplish  $G_s^1$ . This within-role dependency of goal  $G_s^1$  upon activities  $A_s^1$  and  $A_s^2$  may be described as:

$$G_s^1 \rightarrow \{A_s^1, A_s^2\}$$

Thus we define the achievement of the singular goal of role  $s$  to be contingent upon completion of activities  $A_s^1$  and  $A_s^2$ , and role  $s$  as *independent* with regard to its goal.

A between-role dependency is formed when a role's goal is dependent upon the activities of another role. Using the example from Figure 1, we define the achievement of goal  $G_r^1$  to be contingent upon the activities  $\{A_r^1, A_r^2, A_r^3\}$  performed by role  $r$  and the activity  $\{A_s^1\}$  performed by role  $s$ . This forms a dependency between role  $r$  on role  $s$ :

$$G_r^1 \rightarrow \{A_r^1, A_r^2, A_r^3\} \cup \{A_s^1\}$$

We thus define a dependency between role  $r$  and an activity of role  $s$ , making role  $r$  *dependent upon* role  $s$ . The dependency is modeled in Figure 1 as the arrow ( $\rightarrow$ ) between role  $r$  and role  $s$ . The arrow is interpreted as "role  $r$  is dependent upon role  $s$ ."

Governance over the exchange of needed resources is depicted as an element of the dependency. The dependency in Figure 1, Dependency  $r \rightarrow A_s^1$ , is mediated by the terms and conditions negotiated between role  $r$  and role  $s$ , shown in the diagram as the governance control.

Extended enterprise networks can be depicted given these five basic constructs of role, activity, goal, dependency and governance.

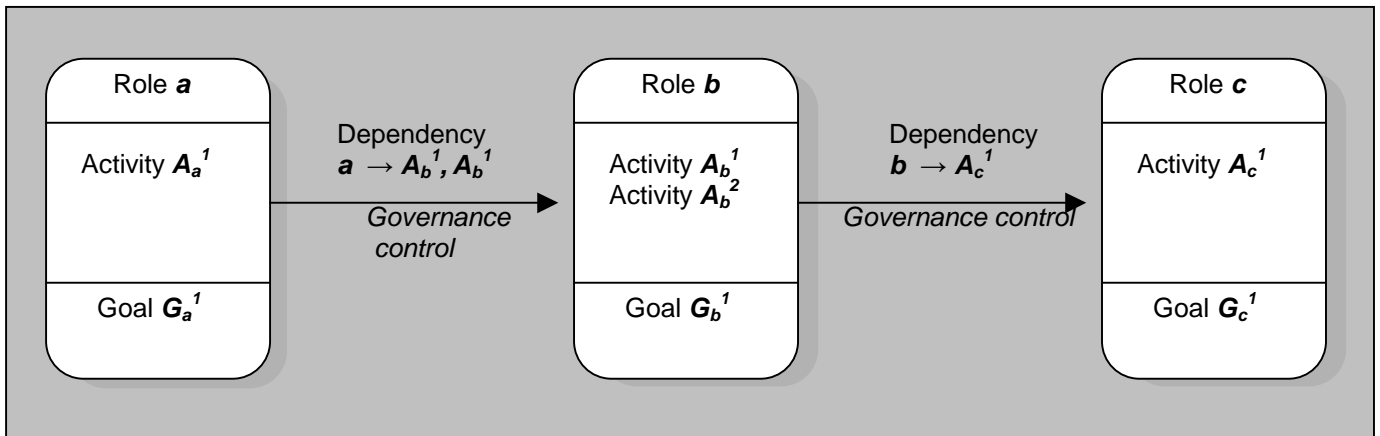


FIGURE 2. DND Representation of Transitive Dependency

For illustrative purposes, let us assume there exist three organizations in an extended enterprise. Each has a role in the extended enterprise, and are thus labeled roles  $a$ ,  $b$ , and  $c$ . Given the steady state of a tripartite interorganizational relationship between roles  $a$ ,  $b$ , and  $c$  (depicted in Figure 2), we can describe the following (singular) dependencies:

$$G_a^1 \rightarrow \{A_a^1 \cup \{G_b^1 \rightarrow \{A_b^1, A_b^2\}\}\}$$

and

$$G_b^1 \rightarrow \{\{A_b^1, A_b^2\} \cup \{G_c^1 \rightarrow \{A_c^1\}\}\}$$

That is to say, a goal of role  $a$  ( $G_a^1$ ) is dependent upon completion of an activity internal to role  $a$  ( $A_a^1$ ) and the completion of two activities external to role  $a$  ( $A_b^1, A_b^2$ ). Therefore a dependency is created of role  $a$  on role  $b$  to

complete activities  $A_b^1$  and  $A_b^2$ . Activities  $\{A_b^1, A_b^2\}$ , in turn, are motivated to be performed by role  $b$  in achieving its own internal goal,  $G_b^1$ .

The second equation reflects the situation where role  $b$ 's goal cannot be satisfied internally through the activities  $A_b^1$  and  $A_b^2$ , and thus a dependency of role  $b$  on role  $c$  is created. Role  $c$  provides the necessary activity,  $A_c^1$ , for role  $b$  to achieve its goal.

The entire extended enterprise can be described:

$$G_a^1 \rightarrow \{A_a^1 \cup \{G_b^1 \rightarrow \{\{A_b^1, A_b^2\} \cup \{G_c^1 \rightarrow \{A_c^1\}\}\}\}$$

where role  $b$  acts as the transitive bridge between role  $a$  and role  $c$ .

A typical supply chain can be modeled using the DND methodology using the representations described above. Figure 3 depicts the relationships between a manufacturer, a distributor, and a retailer in such a supply chain. The manufacturer designs and produces the product, with the intention of earning revenue from product sales. The distributor depends upon the manufacturer to produce the saleable product, and a written contract governs the terms and conditions of the exchange. The retailer depends upon the distributor to deliver the product, with each order governed by the terms and conditions of the purchase order and existing informal agreements between the two.

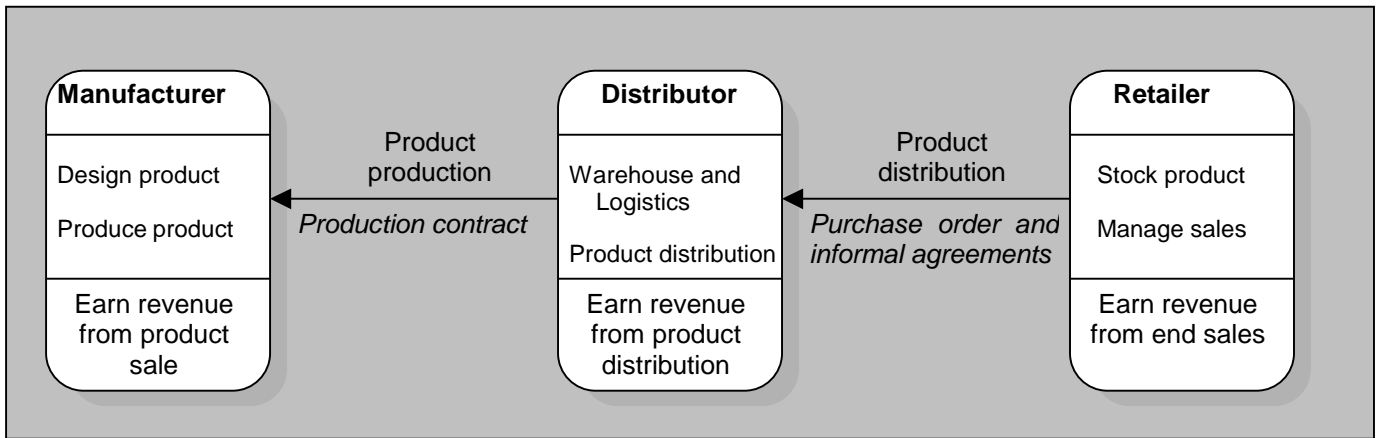


FIGURE 3. DND of example supply chain

For further illustration purposes, a simplified example of the DND representation of an academic setting is portrayed in Figure 4.

### 3.2 Dependency Modeling and IT Strategic Analysis

The dependency modeling approach of Dependency Network Diagrams is useful in augmenting existing IT strategic analysis for business applications. DNDs provide visibility of extra-organizational linkages, and detailed information about the structure and criticality of exchange relationships. Using DNDs to depict these relations improves the strategist's capacity to successfully employ Linkage Analysis Planning, Critical Success Factors, and Investment Strategy Analysis in the extended enterprise. The explicit theoretical foundation and development of the DND methodology supports each of the extended enterprise strategic approaches.

### 3.3 Linkage Analysis Planning

By identifying linkages the organization has with other entities, DNDs enable strategists to identify the control, management, and cooperation involved in each of the linkages. Key elements of the boundary-spanning linkages become explicit as support and governance activities across the exchange relation are identified and isolated in developing the DND. The requisite support activities and governance control, whether in formalized contract or informal tacit agreement, can be systematically analyzed and codified into boundary-spanning information and process sharing activities.

As the linkages between organizations, dependencies are a key focal point for the organization of management resources. Explicit depiction of the relationships improves the Linkage Analysis by clearly identifying linkages that lack the appropriate management and support activities. Linkages that support activities critical to an organization's goals, for instance, can be identified and the exchange support activities buttressed in order to manage various exchange relationships with the external environment and to ensure stability [Pfeffer & Salancik, 1978]. Using

DNDs, areas of under-commitment of management resources can be easily identified by the presence (or lack of) exchange support activities depicted surrounding the dependency.

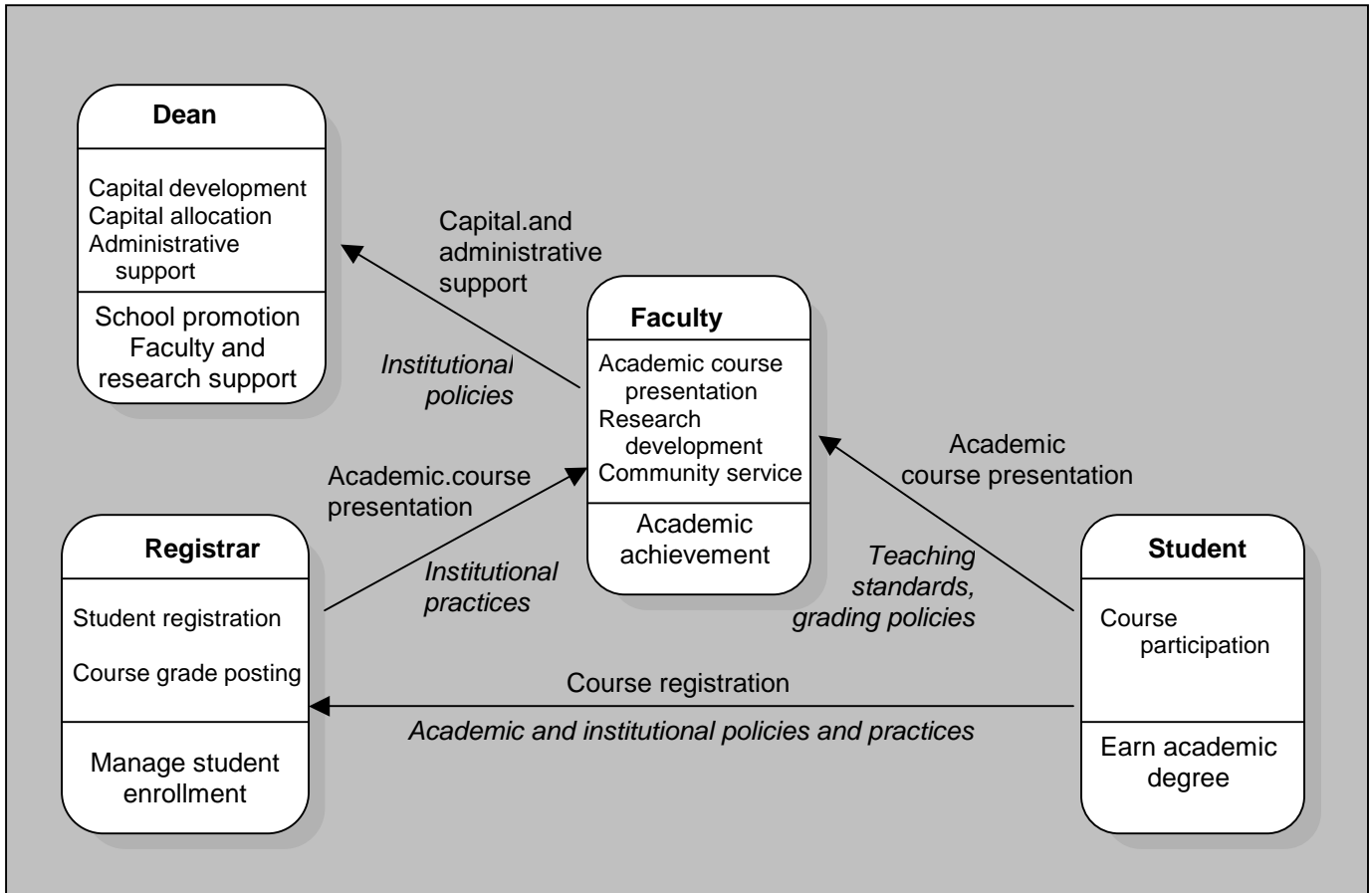


FIGURE 4. An academic DND example

DNDs also identify excesses in managerial and operational systems that support secondary or obsolete linkages, and enable these resources to be redeployed more efficiently. Strategists can reallocate management and support activities to ensure consistent and efficient exchange with partner organizations. Organizations can use the DND analysis to know how and where to restructure internally, deploying IT to stabilize exchange relationships and to efficiently manage boundary relations.

By promoting a systemic view of the overall channel, DND representations improve chances for organizational success by improving visibility and control over the electronic channels. The diagrammatic representations allow channel partners a shared view of linked processes and information, creating a common understanding of the entire extended enterprise. Without this capability, the tendency is to become myopic as the complexity and detailed knowledge necessary to manage individual exchange relations leads to narrow, segmented views of an organization's exchange network.

DND representations enable organizations to seek out relationships with other organizations along the patterns of dependence they satisfy for resources. This enables strategists to map a broad scope in the planning, management, and control of suppliers and customers. Relationship building becomes a strategic exercise, selectively choosing appropriate channel partners and building strong relationships between them. This ability to visually map out the extended enterprise enables strategists to manage exchange relationships, anticipate change, and exploit cross-organizational arrangements.

The systemic view of the extended enterprise also facilitates coordination among the exchange partners. This shared view, which can be manipulated and analyzed, enables strategists to plan the creation, distribution, and presentation of information across electronic channels, improving marketing, administration, distribution and

customer service for the entire network. The purposeful use of IT within this plan enables the network to anticipate and react to fast-paced changes in the environment.

### 3.4 Critical Success Factors Method

Diagrammatic representations of dependency relations are an equally powerful tool in supporting the Critical Success Factors (CSF) Method. Cornerstone to the CSF method is the ability to identify elements of the organizational environment that are critical to operation or that are exposed to significant threat. By focusing on the acquisition of needed resources and the management of the interorganizational exchange, DND representations provide the source for identifying critical success factors.

By definition, DNDs identify sources of scarce resources, the institutional arrangements structuring the acquisition of needed resources, and connectivity shared with other organizations. The DND methodology isolates key areas of exposure to the focal organization with regard to key resources, extra-organizational influences, and changing regulatory forces within the network in which the company operates. The DND methodology provides for analysis of these exchange channels, presenting CSF strategists with concrete tools to identify and manage complex interorganizational relations.

For CSF analyses, relative influence of an organization to its environment is crucial in fending off competitive advances and in imposing organizational interests onto exchange partners. These opportunities for some organizations to exercise influence over others is explained by the dependencies they share [Fromm, 1981][Frooman, 1999]. Relative dependence on others for resources creates leverage in the dependency relation. Dominant organizations can exert control by determining whether exchange partners get the resources and in determining how the resources can be used [Emerson, 1962][Frooman, 1999].

DNDs identify and describe structures of influence within exchange relations, depicting structure and relative strength of influence in the various relations. DNDs depict the relations of influence between the company and its situation within the industry, and identify the dominant players within the extended enterprise. These influential organizations, such as governmental regulators, monopolists or oligopolists, or single-source suppliers, are readily identified and their sources of influence made clear. These are the sources for critical success factors in the CSF method [Rockart, 1979].

### 3.5 Investment Strategy Analysis

“It is the fact of the organization's dependence on the environment that makes the external constraint and control of organizational behavior both possible and almost inevitable” [Pfeffer & Salancik, 1978]. DND representations that capture and convey these behavioral and control aspects of external relationships, and therefore have a unique capacity to enable organizational strategists to move from internally oriented IT strategies (e.g., transaction automation and managerial support) to more progressive IT strategies supporting interorganizational networks.

Norton and Gibson (1974) propose strategies focused on interconnected networks of organizations enjoy greater sustainable strategic advantage. Understanding these relationships, in terms of the process and governance activities necessary to manage and regulate them, is essential to investment strategies. DNDs enable organizations to identify and formalize processes coupling these external relationships and to establish stable consensus about the terms and conditions that govern these relationships.

## 4 Conclusions

The DND method for depicting and analyzing the activities, governance, and pathways of influence coupling organizations within the extended enterprise supports a variety of interorganizational IT strategies. With increasing interest in the extended enterprise, representation methodologies depicting the interface boundary are becoming correspondingly important. The DND representation enables organizational and technological strategists to design and evaluate processes and control systems that synchronize activities across organizational boundaries. The unique capabilities to reflect the process and management activities needed to coordinate the interorganizational interface enable strategists to clearly visualize the extended enterprise system.

The DND representation methodology captures the coordination elements of electronic channels, specifically the alignment of operational processes and the establishment of exchange governance across inter-networked organizations. Providing this tool for analyzing interorganizational IT deployment directly supports and adds to prior insights from linkage analysis planning, the critical success factors method, and investment strategy analysis. Organizational strategists can systematically analyze and compare alternative arrangements of electronic channels with an emphasis on deploying interorganizational processes and control systems that synchronize activities across the trans-organizational interface. The DND representation supports the extended enterprise relationship, enabling organizations to identify, analyze, and populate the electronic channels among its networked partners.



DNDs provide the ability to meet the challenges facing internetworked organizations: to map out the extended enterprise and manage the relationships within it, anticipating change and exploiting the collective resources of one's extended enterprise, and to plan the creation, distribution, and presentation of information across electronic channels to improve marketing, administration, distribution and customer service.

DNDs also provide the ability to identify and assess critical success factors, including industrial factors associated with competition over scarce resources, institutional arrangements that facilitate or inhibit strategies, and connectivity to other organizations. DNDs provide the capability to identify critical success factors within the company itself and its situation within the industry, and to map out critical success factors within the environment, such as trends, technological innovation, and governmental influences.

Organizations with greater outwardly connected networks of interaction will have greater sustainable strategic advantage. Organizational success is being increasingly tied to the extended enterprise and the appropriate use of electronic channels that allow organizations to change in order to more closely integrate their business operations. The Dependency Network Diagram representation methodology provides a concrete tool for organizations and researchers to systematically depict and analyze these increasingly important industrial arrangements.

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