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Combining Theoretical Perspectives on the Organizational Structure-Performance Relationship

Starling David Hunter
Carnegie Mellon University, starling@andrew.cmu.edu

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COMBINING THEORETICAL PERSPECTIVES ON THE ORGANIZATIONAL STRUCTURE-PERFORMANCE RELATIONSHIP

STARLING DAVID HUNTER III

Abstract: Much of the literature linking organization structure to performance falls into two broad research streams. One stream concerns formal structure – the hierarchy of authority or reporting relationships as well as the degree of standardization, formalization, specialization, etc. The impact of formal structure and other elements of organization design on performance is typically contingent on factors such as strategic orientation, task characteristics, and environmental conditions. The other research stream focuses on informal structure – a network of interpersonal and intra-organizational relationships. Properties of informal structure are typically shown to have a more direct (less contingent) impact on organizational performance. Despite these pronounced differences in the conceptualization of organization structure, considerable overlap and complementarity exist between the two research streams. In this article, I compare and contrast a pair of exemplars from each stream – the information processing perspective and the social network perspective – with respect to their conceptualizations of organization structure and its relationship to performance. Several recommendations for future research that combines the two approaches are offered.

Keywords: Organization structure, formal organization, informal organization, contingency theory, information processing, social networks

Over the last several decades, numerous studies have examined the relationship between organizational structure and performance. Those studies may be broadly divided into two research streams. In one stream, the conceptualization of structure is formal: it is a hierarchical pattern of authority relationships that varies along key and measurable structural dimensions such as centralization, formalization, vertical and horizontal differentiation, span of control, and specialization. A broad range of theories and perspectives adopt this conceptualization. They include, but are not limited to, contingency theory (Donaldson, 2001), information processing perspective (Burton & Obel, 1998; Galbraith, 1974), complementarity theory (Milgrom & Roberts, 1995), configuration theory (Doty, Glick, & Huber, 1993; Ketchen et al., 1997), resource-based view of the firm (Markides & Williamson, 1996), decision theory (Huber & McDaniel, 1986), and managerial and organizational cognition (Wood & Bandura, 1989).

Running concurrently to this stream of research is one that has linked informal structure within organizations to the effectiveness or performance of individuals (Cummings & Cross, 2003), groups and teams (Cross & Cummings, 2004; Hansen, 1999), and to larger organizational subunits (e.g., Shaw et al., 2005; Tichy, Tushman, & Fombrun, 1979). Unlike the formal structure research stream, with its emphasis on prescribed reporting relationships and their correlates, here structure is defined by informal networks of voluntary social interactions and relationships, including information sharing, advice seeking, interpersonal communication, and friendship ties (see Kilduff & Krackhardt, 2008, for a recent review).

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Although research from both streams often appears in the same journals, there is nothing approaching consensus concerning the nature of the structure-performance relationship. Building such consensus might usefully begin with a discussion of the many similarities and complementarities between the two approaches. Toward that end, I focus my attention on two of the best-known and most representative exemplars of each stream: the information processing and the social network perspectives. The remainder of the article is organized as follows. The next section contains an overview of the information processing perspective on organization structure and design. It is followed by a similar summary of the social network perspective. Both of these sections contain descriptions of each perspective's key assumptions, concepts, commonly used measures, and empirical research. The fourth section applies concepts and measures from each approach to a case study, including a comparison of the formal and informal structures of the same organization. The section after the case analysis identifies common themes across the two research streams and suggests directions for future research. The final section is the conclusion.

INFORMATION PROCESSING PERSPECTIVE

Information acquisition, its processing and dissemination throughout the organization – these are central concerns of the information processing perspective on organization design (Daft & Lengel, 1986; Tushman & Nadler, 1978). As such, the key "design problem is to create an organizational design that matches the demand for information processing with the information processing capacity" (Burton & Obel, 1998: 7). According to Galbraith (1974), the principal determinant of this problem is task uncertainty: "the greater the uncertainty of the task, the greater the amount of information that has to be processed between decision-makers" (Galbraith, 1974: 10). Task uncertainty is itself a function of other factors including an organization's technology, size, culture, and strategy as well as characteristics of its external environment (Burton, Lauridsen, & Obel, 2002).

Typical of this perspective's definition of design are Burton & Obel's (2004) six sets of parameters: (1) configuration, (2) complexity, (3) centralization, (4) coordination and control mechanisms, (5) formalization, and (6) incentives. According to those authors, configuration "specifies the general principle for dividing the work, breaking the tasks into subtasks and coordinating activities...(and) the overall units that are the basis for making decisions and communicating with each other" (p. 46). The most well known of the structural configurations that they describe are the functional, divisional, and matrix structures. Whereas configuration establishes the basis for the division of labor, complexity establishes the configuration's "breadth, depth, and dispersion" (p. 73). These three dimensions are operationalized as (a) horizontal differentiation (the number of departments, units, or subunits in an organization), (b) vertical differentiation (the number of levels in the organizational hierarchy), and (c) spatial differentiation ("the geographical dispersion of the activities in the organization" (p. 77). The third of the six design parameters is centralization, which is "the degree to which formal authority to make decisions is concentrated in an individual, unit, or level" (p. 80). Its measure is the degree of "direct involvement" that top management has in "gathering and interpreting the information they use in decision-making" and the degree to which this group "directly controls the execution of a decision" (p. 80). A related concept is span of control, which refers to "the number of workers directly supervised by an administrator" (Bell, 1967: 100). The latter three elements of organization design, as defined by Burton & Obel (2004), are coordination and control mechanisms, formalization, and incentives. Broadly speaking, all three encompass a wide range of systems, processes, roles, practices, policies, and interventions, any of which may influence a design's structural properties and/or information processing capacity.

Empirical Research in the Information Processing Perspective

Several empirical studies conducted within the information processing perspective have examined the relationship between the aforementioned formal structure variables and organizational performance. While a full review of that literature is beyond the scope of this article, two important trends are noteworthy. The first concerns variation in the unit

of analysis. Structure includes the design of departments and functions (e.g., Alexander & Randolph, 1985), business units and divisions (e.g., Olson, Slater, & Hult, 2005), and the organization as a whole (e.g., Nandakumar, Ghobadian, & O'Regan, 2010). The second trend concerns the nature of the relationship between the structural parameters and performance. In short, it is almost always contingent. That is, the effect of structure on performance is almost always a function of its alignment or fit with other important organizational factors. For example, consistent with Miles & Snow's (1978) contingency model, Ramaswamy, Flynn, and Nilakanta (1993) reported that only certain combinations of "product-market strategy" and decentralization of decision-making were positively related to performance (measured by sales growth and return on assets).

Similarly, other research studies have found a wide variety of contingent relationships: the relationship between decentralization and financial performance moderated by "performance aspirations" (Richardson et al., 2002); decentralization and the performance of manufacturing plants mediated by the presence of "time-based manufacturing practices" (Nahm, Vonderembse, & Koufteros, 2003); formalization and financial performance mediated by "supply chain process variability" and moderated by "environmental uncertainty" (Germain, Claycomb, & Droge, 2008); organizational structure (mechanistic or organic) and firm performance moderated by "business-level strategy" (cost-leadership or differentiation) (Nandakumar, Ghobadian, & O'Regan, 2010); decentralization and firm performance moderated by the "explicitness of strategy articulation" (Love, Priem, & Lumpkin, 2002); decentralization and financial performance moderated by "organizational functioning" (the presence and/or prevalence of integrating mechanisms, worker empowerment, training, and cross-functional design teams) (Andersen & Jonsson, 2006); organizational structure (decentralized or bureaucratic) and the effectiveness and timeliness of the product development process moderated by "product innovativeness" (Olson, Walker, & Ruekert, 1995); multi-divisional structure and rate of return moderated by the firm's "diversification strategy" (vertical integration, related diversification, or unrelated diversification) (Hoskisson, 1987); configuration (divisional or functional structure) and financial performance moderated by the level of "decentralization" (Hill & Pickering, 1986); structure (vertical participation, horizontal participation, and formalization) and unit-level performance moderated by "technology" (uncertainty, stability, and variability) (Alexander & Rudolph, 1985); span of control and performance moderated by "task difficulty" (Bohte & Meier, 2001); and both formalization/specialization and organizational performance moderated by "dynamism" of the firm's economic environment (Sine, Mitsuhashi, & Kirsch, 2006).

In addition, examples of multi-variable contingency relationships include (a) Olson, Slater, & Hult (2005) who found overall firm performance to be a function of the degree of fit among the structure of the marketing function, the function's strategic emphases, and the overall business strategy; (b) Khandwalla (1973) who found that firm profitability was a function of the positive association between eight organizational variables including vertical integration, decentralization, and the type of organizational configuration (divisional vs. functional); and (c) Jennings & Seaman (1994: 459) who found that the relationship between strategy (prospector, defender, analyzer), organizational structure (organic or mechanistic), and performance to be moderated by the degree of firm "adaptation…a period of gradual, long-continued, and incremental change in response to environmental conditions."

Now we turn to the social network perspective on organization design – one with initially different but ultimately complementary assumptions, methods, and measures.

SOCIAL NETWORK PERSPECTIVE

The social network perspective on organization design takes as its starting point the fact that human beings are "social creatures" embedded in "networks of relations" with others that are instrumental to the accomplishment of "many of life's tasks", both within and outside of formal organizational settings (Kilduff & Krackhardt, 2008: 1). According to this view, it is both the "formal relations of authority" and the "informal links…across departmental and hierarchical boundaries" that holds business organizations together and enables them to accomplish their goals. Numerous structural parameters first developed in the broader

literature on social network analysis have been applied to the network analytic approach to organization design. Among the most relevant concepts for our purposes are centrality, connectivity, similarity, and hierarchy.

Centrality measures indicate the relative importance or influence of nodes or actors within a network (Bonacich, 1987; Borgatti, 2005). Two of the most commonly employed measures of centrality are degree centrality and between-ness centrality. The former is simply a count of the number of links or connections that one node has to others in the network. For example, a node A with links to three others named B, C, and D would have a degree centrality equal to three. Between-ness centrality is a measure of the frequency with which a node lies on the shortest paths connecting all nodes in a network to all other nodes. The greater the number of these paths upon which a node lies, the greater is its between-ness centrality.

Measures of connectivity indicate the extent to which nodes or actors in a network are directly connected to one another. One basic and commonly employed measure is density, which is the ratio of the number of connections between pairs of nodes to the number of possible connections (Wasserman & Faust, 1994). In a network of five nodes, where connections are not directed, there are ten possible pairs of nodes. If only five pairs of those nodes are connected, then the density of the network is 50 percent. A second measure of connectivity is a network's diameter, which is the longest of the shortest paths between any pair of nodes in the graph (Knoke & Yang, 2008).

As for measures of equivalence, two nodes in a network are considered structurally equivalent if they are connected in the same ways to one or more other nodes in the network (Sailer, 1978). A less restrictive form of similarity is "regular" equivalence which requires only that two nodes are analogously related to equivalent others (Wasserman & Faust, 1994). For example, all branch managers in a banking organization relate to their subordinate shift managers in the same way although none of them supervise the same shift managers.

The measures of hierarchy consist of four mutually exclusive and sufficient graph theoretical dimensions (GTD) of hierarchical structures with proposed calculations for each (Krackhardt, 1994). In short, the four measures capture the degree to which a given structure differs from the ideal or "pure hierarchical structure" or "out-tree" (p. 93). The first of the four measures is connected-ness: the greater the proportion of actors that are connected in the same component, the more hierarchical is the structure. The second dimension is reciprocity. Reciprocity implies equality, something that is not inherent in hierarchy. As such, the greater the number of ties that are reciprocated, the less hierarchical is the structure. The third dimension, efficiency, concerns the number of in-bound links per node when authority relationships are directed from superior to subordinate or the number of out-bound links when the direction is reversed. To the degree that each node – except that of the ultimate boss – has more than one such link, the less hierarchical is the structure. The final measure of hierarchy is the unity of command. In short, every pair of employees in a hierarchical network has one node in common that directs ties to both of them. Put another way, they have one node in common in their respective chains of command. In the case of a formal organization structure, any third person higher in the hierarchy to whom they both defer is their "upper bound" (p. 99). There can be several such upper bounds for any pair of employees. In a formal organization chart, the least upper bound of a given pair of employees is "the closest boss who has formal authority over both of them." The greater the number of pairs of nodes that do not have a least upper bound, the less hierarchical is the structure.

Empirical Research in the Social Network Perspective

In the last few decades, several studies have examined the effects of the afore-mentioned measures of social (informal) structure in organizations on a variety of measures of organizational performance. Typical examples of empirical research at the group, team, and business-unit levels include analyses of the effects of (a) centrality and density in an inter-personal communication network on business-unit sales (Shaw et al., 2005); (b) centrality of leaders in a friendship network on group performance (Mehra et al., 2006), (c) density in a knowledge-sharing network on team performance (Reagans, Zuckerman, & McEvily, 2004); (d) hierarchy in an interpersonal communication network on work group performance

(Cummings & Cross, 2003); (e) centrality in an interunit knowledge-sharing network on business-unit innovation and performance (Tsai, 2001); (f) path-length (diameter) in an interunit knowledge network on project completion time (Hansen, 2002); (g) density in a hindrance network on group performance (Sparrowe et al., 2001); (h) density and centrality in intra- and inter-team instrumental networks on team performance and viability (Balkundi & Harrison, 2006); and (i) centrality in an advice-seeking network on bank branch profitability (Sarkar, Fienberg, & Krackhardt, 2010).

Notably, for these various levels of analysis, no published empirical studies examine the interaction of formal *and* informal structures on organizational performance. However, there are a few widely cited case studies that attempt to do this; chief among them is Cross et al.'s (2001) Exploration & Production Division case, which we discuss in detail in the next section.

CASE APPLICATION: EXPLORATION & PRODUCTION DIVISION

In order to provide an illustration of the unique insights of the social network perspective on organization design, Cross et al. (2001: 104) compared and contrasted the formal and informal organizational structures linking the "top 20 executives within the Exploration & Production Division" of a "large petroleum organization." The context for the case was the firm's implementation of a "distributed technology to help transfer knowledge across drilling initiatives." Given the high capital intensity of the deep-sea drilling industry, the firm stood to reap hundreds of millions of dollars per year in cost savings if all platforms could drill as rapidly and cost efficiently as its best. But while the firm had very strong incentives to disseminate best practices, its top management also expressed concerns about its ability "as a group to create and share knowledge." The first step in the organizational network analysis that followed was to map the information flow of the top 20 executives within the Exploration & Production Division (E&PD). This involved asking each of the executives to identify those individuals in the division they went to for information to get their work completed. As shown in Figure 1, the analysis revealed a "striking contrast" between the formal structure – depicted on the left and defined by reporting relationships – and the informal structure as defined by information flow and depicted on the right. Typically, linkages in a representation of the resulting information-seeking structure would be "directed" (i.e., have arrows on one or both ends). However, for simplicity's sake, the researchers chose to indicate only the presence of a linkage and not its direction. Further, only the most effective (i.e., strongest) ties are depicted.

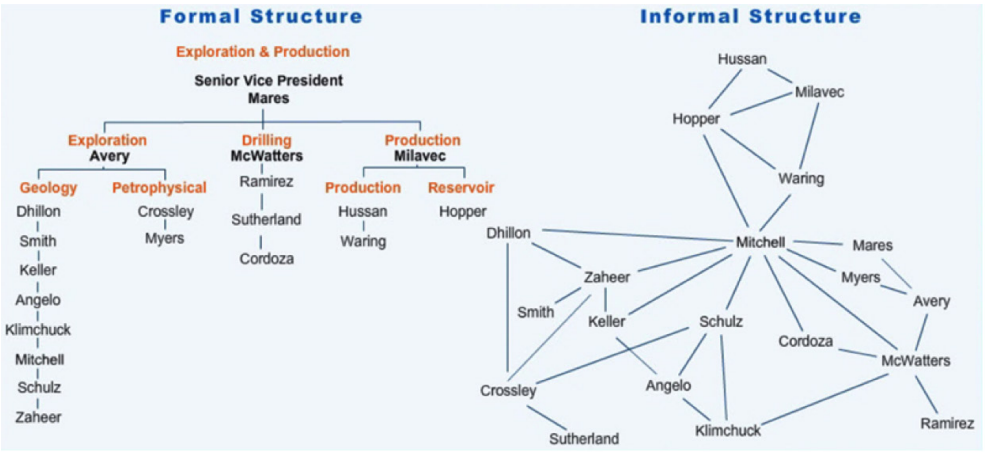

Fig. 1. Formal and Informal Structures in the Exploration & Production Division
Source: Adapted from Cross et al. (2001)

Among the most evident insights gained from the analysis was the pivotal role of Mitchell, who had not only the most connections in the information flow network but who was also the only point of contact between the Exploration and Production Departments within the

E&PD, and one of two connecting links between the Exploration Department and the Drilling Department. A discussion with the executive team revealed that Mitchell had become so central partly because of his reputation for "expertise and responsiveness." The result was that both the number of information requests he received and the number of projects in which he found himself involved had become excessive. Eventually, he became a bottleneck in the information flow, slowing down the entire E&PD and increasing his own stress levels. Not surprisingly, one of the first proposed interventions was to reallocate to other E&PD members some of the information requests coming to Mitchell.

A second insight of the analysis was that Mares, the Senior Vice President, was more peripheral to the information flow network than expected. It is not uncommon for executives, over time, to become less accessible to their subordinates and less knowledgeable about their activities. However, Mares further contributed to his peripheral position through his lack of responsiveness.

A third insight from the case analysis was the complete separation of the Production Department (Milavec, Hopper, Hussan, and Waring) from the Drilling Department (McWatters, Sutherland, Cordoza, and Ramierz) and the existence of only a single link to the Exploration Department – via Mitchell. Interviews with E&PD executives revealed that several months before the analysis took place, the Production Department had been moved to a different floor in the same building. The network analysis revealed that the physical separation had resulted in fewer "serendipitous meetings" than when all three departments were co-located on the same floor.

Below, the dozen-plus measures common to the information processing and social network perspectives are applied to the E&PD case in order to better understand their shared and unique insights.

Centrality

First among the social network measures considered above was degree centrality, the number of links associated with a given node in a network. In the above depiction of the informal structure, degree centrality ranges from a high of ten (Mitchell) to a low of one (Ramirez, Sutherland, and Smith). The remaining members of the organization have between two and five links to other actors, with the average being 3.2 links. When the formal structure is instead represented as a network of directed reporting relationships, as depicted in Figure 2, Mares is seen to have three inbound links while Avery, McWatters, and Milavec have ten, three, and three links, respectively. They each have one outbound link to their superior, Mares. Their sixteen subordinates all have a degree centrality of one because they each report only to their own boss. Thus, we can see here that span of control (the number of direct reports a manager has) is analogous to, or perhaps is a special case of, degree centrality (the number of inbound and/or outbound links to a given node). In the information processing perspective, span of control is used to quantify the number of direct reports a given manager has. As shown in the formal structure above, Mares is the head of E&PD and has three direct reports – Avery, McWatters, and Milavec – and thus a span of control of three. In sum, these three direct reports have a span of control of ten, three, and three, respectively.

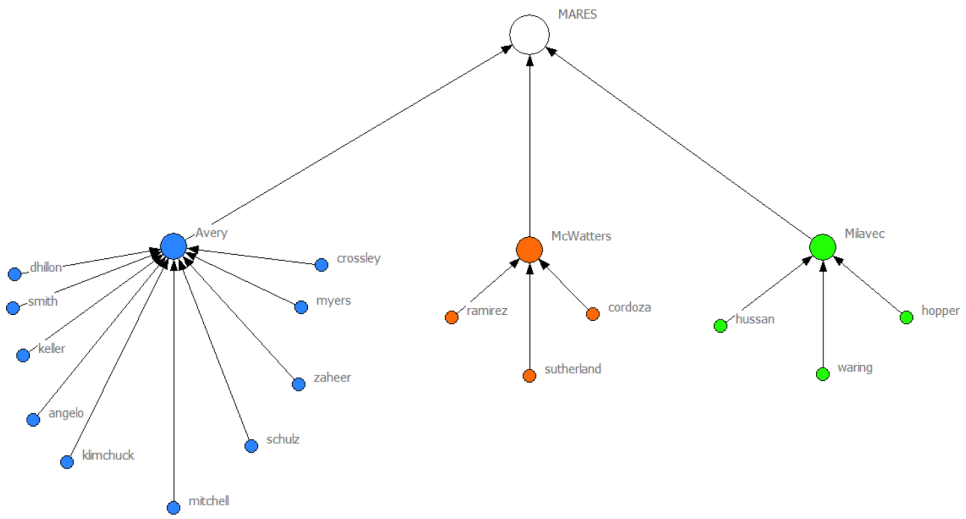

Fig. 2. Formal Structure of the Exploration & Production Division Represented as a Network of Directed Reporting Relationships.
Source: Adapted from Cross (2008) and Cross et al. (2001)

The second centrality measure was between-ness centrality, a quantity based on the number of times a node is found on the shortest paths connecting all other nodes. In the informal structure, Mitchell has the highest between-ness centrality (112.2), followed by McWatters (31.3), Zaheer (27.7), Hopper (24.5), and Schulz (21.3). The six members with the lowest between-ness centrality are Milavec (0.50), followed by Sutherland, Smith, Hussan, Cordoza, and Ramirez, all of whom had between-ness scores of zero. In the formal structure, again represented as a network of reporting relationships, only the three department heads – Avery, McWatters, and Milavec – have non-zero between-ness scores. Avery has the highest score (10.0) among them because he lies on the path between all ten of his subordinates and the rest of the organization. Because they have the same number of subordinates, McWatters and Milavec have equal between-ness centrality scores of three. It should be noted that since the formal structure is comprised of directed linkages, all paths end with Mares, the most senior member of the organization. However, if the relationship is bi-directional – reflecting the fact that information flows both ways between superiors and subordinates – then all nodes can be reached by all other nodes, and Mares' between-ness centrality becomes second only to that of Avery. Notably, in this example, the between-ness centrality of an actor is partially a function of position in the formal structure – all paths lead to Mares who is at the top of the formal hierarchy – but, more importantly, a function of position in the informal structure – Avery is lower in the hierarchy but is found on a greater number of paths because he has more direct reports.

Cohesion

The first of the measures of cohesion is density, which is calculated as the number of links divided by the number of possible links. Recall that the reporting relationship is not reciprocal – reporting relationships only go in one direction. As such, in the formal structure of the E&PD, density is equal to (n-1)/(n*(n-1)) = 19/(20*19) = 1/20. This quantity is significant because n-1 is the minimum number of links required to connect n nodes. Although at least two other of the network perspective's archetypal configurations can do this – the line and the star – the former is impractical among organizations of the size typically studied by analysts and scholars while the latter is typically not observed in groups of more than ten members. Thus, in practice, the reporting relationship – at least in its ideal form – is the only one that includes all members in such a sparsely connected (i.e., low-density) network. By contrast, the density of the non-directed informal structure is 16.8 percent, which is over three times that of the formal structure.

The second measure of cohesion is diameter – the maximum shortest path distance between any pair of nodes in the graph. In the informal structure, the diameter is five and there are

four pairs of nodes at this distance from one another – Avery and Sutherland, Milavec and Sutherland, Ramirez and Sutherland, and Hussan and Sutherland. In the formal structure with directed reporting relationships, the diameter is only two. That quantity is equal to one less than the value of the structure's vertical differentiation which, as mentioned previously, is a measure of the number of hierarchical levels.

Equivalence

The two measures of structural similarity are regular and structural equivalence. Two or more nodes are said to be structurally equivalent if they have the exact same connections to other nodes. In the formal structure above, the subordinates of each department head have the same pattern of connections – they each have one tie to their common superior. Specifically, the ten subordinates of Avery are structural equivalents; the three subordinates of McWatters are structural equivalents; and the three subordinates of Milavec are structural equivalents. The three department heads themselves are not structurally equivalent, however, because while they do have a common tie to their mutual superior – Senior Vice President Mares – they do not have identical ties to others. Instead, these three are regular equivalents; they have analogous patterns of links to equivalent others. In management parlance, regular equivalents are known as "opposite numbers" because they hold analogous but not identical positions within the structure. Thus, all of the subordinates of the three department heads are regular equivalents because they all occupy similar positions in the structure, just not identical connections.

In general, incidences of regular and structural equivalence are much less frequent and difficult to identify in informal structures. An examination of the informal structure panel of Figure 1 indicates that there is only one pair of structural or regular equivalents – Myers and Mares who are both connected only to Mitchell and Avery. According to UCINet (Borgatti, Everett, & Freeman, 2002), a popular network analysis software program, the three other groups are nearly, but not exactly, structural equivalents in the informal structure – Ramirez and Cordoza (Drilling), Milavec and Hussan (Production), and Waring and Hopper (Production). Notably, even though this is an informal structure, the members of each pair of near-equivalents belong to the same department in the formal structure. There are also three groups that are close to being regular equivalents: McWatters (Drilling) and Hopper (Production); Avery (Exploration), Dillon (Exploration), and Ramirez (Drilling); and Schulz and Zaheer (Exploration). Here, only the latter group has all members in the same department in the formal structure.

As shown in Table 1, all 32 ties in the informal network are classified according to their role in the formal structure (Column 1) and the specific parties to each pair, by department (Column 2). As the tabulation indicates, just over half of the links (17 of 32) are among structural equivalents in the formal structure (i.e., between subordinates of the same superiors). Another seven links are between superiors and their subordinates. Thus, three-quarters of the links in this example are between bosses and their subordinates or among the subordinates themselves. Another five links are between regular equivalents (i.e., between people occupying the same position in the hierarchy but in different departments and thus with different superiors). Lastly, there are just three links that cut across either a hierarchical and/or departmental boundary. This suggests that, on the whole, formal relationships – or, more specifically, the equivalences defined by the reporting relationship – may be strong predictors of informal ones. Notably, it is these last eight links that Cross and Cummings (2004) found to be positively related to individual-level performance. Specifically, they found a significant and positive relationship between the number of ties an individual has to other departments and the individual's performance. They also hypothesized a similar relationship between individual performance and ties that span hierarchical levels but found only partial support.

Table 1. Classification of Links in the Informal Network of the Exploration & Production Division

Roles in the Formal Structure	Specific Parties to the Links	Count
Structural equivalents in the formal structure (subordinates of the same superiors)	Production Department (headed by Milavec): • Hopper & Waring; Hopper & Hussan Exploration Department (headed by Avery): • Mitchell & Dillon; Mitchell & Zaheer; Mitchell & Schulz; Mitchell & Myers; Mitchell & Keller; Dillon & Crossley; Dillon & Zaheer; Smith & Zaheer; Keller & Angelo; Angelo & Schulz; Angelo & Klimchuck; Klimchuck & Schulz; Crossley & Schulz; Zaheer & Keller; Zaheer & Crossley	17
Superior and subordinates	Production Department (headed by Milavec): • Milavec & Waring; Milavec & Hopper; Milavec & Hussan Drilling Department (headed by McWatters): • McWatters & Ramirez; McWatters & Cordoza Exploration Department (headed by Avery): • Avery & Myers Senior VP Mares to Exploration Department: • Mares & Avery	7
Regular equivalents in the formal structure (members of different departments but the same hierarchical level)	Exploration Department to Drilling Department: • Crossley & Sutherland; Mitchell & Cordoza; Avery & McWatters Exploration Department to Production Department: • Mitchell & Hopper; Mitchell & Waring	5
Non-equivalents separated by hierarchical and/or departmental boundary	Exploration Department to Drilling Department: • Mitchell & McWatters; Klimchuck & McWatters Within the Exploration Department: • Mares & Mitchell	3

Hierarchy

In this case example, the formal structure of the E&PD meets all of the conditions of a "pure hierarchical structure," as we would expect. As such, the score of each of Krackhardt's (1994) four graph theoretical dimensions is equal to 1.0, the highest possible score. As for the informal structure, its connected-ness score is also 1.0 because all of the employees are reachable by all others in the network, though by paths of varying lengths. The reciprocity or hierarchy score is zero, the lowest possible score, because all of the connections were assumed to be bi-directional. If the ties had been directed in this network, then the reciprocity score would have been higher. The efficiency score is less than one (0.924), indicating that the average number of outbound links exceeds what would be expected for the corresponding formal structure. Lastly, the least upper bounded-ness (LUB) score is 1.0, indicating that for every pair of nodes there is one that directs ties to both of them. When each of the 32 ties was randomly assigned a direction, the connected-ness and efficiency scores of the informal structure remained unchanged. The hierarchy score rose 0.01 to 0.934, and the LUB score dropped slightly from one to 0.983. More important than the specific scores, however, is the fact that the four GTD scores establish a quantitative basis upon which the informal structure may be compared to the formal one.

DISCUSSION AND RESEARCH RECOMMENDATIONS

The most notable aspect of the preceding analysis is the near-complete bifurcation in the relationships studied in the two perspectives on organization design. For decades, the information processing perspective has focused primarily upon aspects of the formal organization structure – namely, the pattern of reporting relationships plus configuration, centralization, specialization, and formalization, as well as the integrating mechanisms that help to match information processing capacity with demand. The social network perspective, in marked contrast, has focused on what seems like every meaningful interpersonal and intra-organizational relationship *except* reporting and authority: friendship, knowledge sharing, communication, information seeking, hindrance, socializing, and so on. This is a curious omission and almost certainly not accidental. But accident or no, what's important is that,

at present, we have no empirical study that has modeled both formal and informal structure as a network and linked them to performance at the group/team or business-unit level. The remainder of this section discusses how and why a multiplex or mixed relationship approach may afford fruitful new avenues of investigation for both perspectives.

Benefits of the Information Processing Perspective

The principal benefits of the information processing perspective begin with the inclusion of network analytical terminology and methods into its own conceptual vocabulary. Specifically, this would entail broadening the set of terms used to define organization design itself, design fit and misfit therein, and design strategies. Concerning organization structure, to the well-known and thoroughly studied terms like centralization, differentiation, formalization, etc. can be added several others from the network approach, some of which are similar in whole or part, some of which are complementary, and some of which have no obvious analog. For example, recall that when the formal structure is represented as a network, as in Figure 2, *vertical differentiation* – measured as the number of levels in the hierarchy – is equal to one plus half of the network diameter. Further, recall that the term *span of control* is a special case of degree centrality and thus is applicable to relationships other than reporting and authority. At a more conceptual level, recall that the departmentalization and division of labor that characterizes formal structure results in a set of relationships between them that the network approach refers to broadly as equivalence. Lastly, perhaps the most immediately useful and applicable concept from the network perspective may be Krackhardt's (1994) four graph theoretical dimensions (GTD) of hierarchical structure, which allow any number of organizational structures to be quantified and compared to an ideal standard.

The inclusion of network concepts and methods may also have benefits for the information processing perspective's understanding of design misfits (i.e., the mismatch between the actual design and the one that is prescribed by its many determinants) (Burton & Obel, 2004). For example, in a sample of 252 Danish firms, Burton, Lauridsen, & Obel (2002) found the existence, though not the number, of a broad range of contingency and situational misfits to be associated with lower return on assets. In a similarly constructed sample, Håkonsson et al. (2012) examined the performance consequences of a specific subset of misfits – those between organizational climate and leadership style – and found them to be associated with lower ROA than corresponding fits. Also in this study, the scale used for leadership style contained no items related to the leader's informal or interpersonal relationships with subordinates, let alone their pattern or structure. The network literature, however, has considered this question. Cummings and Cross (2003), for example, found that the existence of "structural holes" (Burt, 1992) in the leader's communication network to be associated with lower group performance. Future research on leadership style-related design misfits could consider whether the structure of the informal networks surrounding the leader speaks to the matter of style, and if so, what effects this has on organizational performance.

The matter of design strategies can also be favorably influenced by an embrace of the network perspective. Recall that while the information processing perspective has a well-developed and theoretically grounded typology of design strategies and integrating mechanisms, it lacks methods to display them in the context of organizational charts (Daft, Murphy, & Willmott, 2010). Were these interventions to be viewed from a network perspective, a potential solution might be forthcoming. Only a few assumptions or recognitions would need to be made. The first would be to conceptualize structure as comprised, firstly, of individuals linked by multiple relationships – reporting, friendship, information seeking, etc. – rather than as individuals in departments or groups linked only by the reporting relationships of their heads (Pearce & David, 1983; Tichy & Fombrun, 1979). The second is to recognize the reporting relationship as one channel, though not the only one, through which information may be exchanged between the individuals that comprise the organization. By extension, the integrating mechanisms and design strategies like direct contact, liaison roles, cross-functional teams, integrating roles, etc. represent information channels not just across hierarchical and departmental boundaries but also between individuals located at different levels and in different departments. Furthermore, as shown earlier, any number of affective

and instrumental ties can also be mapped onto formal structure and be studied as conduits for the flow of information or other resources across vertical and horizontal boundaries.

Finally, recall that the motivation behind most network-centric design strategies is to decrease the path distance that information must travel between individuals in a network. This has obvious analogies to downsizing and delayering in organizational restructuring. But it also has implications for the information processing perspective's motivation, which is to match information processing capacity to demand. This is accomplished by either reducing the demand for information processing or by increasing the organization's capacity to process information. In short, reducing path distance in an information-seeking network, for example, would seem to be an instance of reducing demand. Future research might undertake a more detailed and systematic comparison of the design strategies and integrating mechanisms of both approaches with the aim of unifying them into a single typology.

Benefits of the Social Network Perspective

The use of a mixed-network approach may also have positive implications for research on informal networks in organizational settings, particularly those investigating the effect of information-intensive linkages like knowledge sharing, advice seeking, and information-exchange relationships on performance. Apparently without exception those studies have not considered the information-processing role and capacity of the formal reporting relationship. And as the E&PD case analysis indicated, overlap can exist among reporting or formal and informal ties in intra-organizational networks. At a minimum, therefore, the inclusion of formal reporting relationships in an otherwise informal network results in a greater number of ties. A greater number of ties with the number of nodes held constant spells higher density and average degree centrality, as well as changes in connected-ness, between-ness centrality, diameter, constraint, etc. Whether these changes are trivial or significant depends on the specifics of both the network under study and the nature of the research questions concerning it. More importantly, however, are the potential implications for information processing and exchange in the organization, both of which are antecedents of performance. For example, Sitar (2012) studied the reporting relationship in relation to one informal network (information seeking and sharing). In her study of 109 employees in 12 units of a Slovenian manufacturing firm with a mechanistic organization structure, she found that an actor's immediate supervisor was also the most likely person to provide the employee with advice, help on the job, new knowledge, and to collaborate with the employee on the solution of problems. Similarly, Soda and Zaheer (2012: 760) found "consistency" between informal structure (advice seeking) and "formalized and documented procedures and workflows" to be positively related to measures of individual performance. Future research in organization design from both perspectives should focus on the joint effect of formal and informal structures on performance, particularly at the divisional or business-unit level, which is under-studied relative to individual and group/team-level performance.

CONCLUSION

The purpose of this article was two-fold. The first objective was to show that the information processing and the social network perspectives on organization design have many points of similarity, particularly with respect to their respective conceptual vocabularies. The second objective was to show that these similiarties might also prove complementary, at least as it concerns research on the structure performance relationship. How that might be accomplished was partially demonstrated through the application of several of the similar concepts to a well-known and widely cited case study (Cross et al., 2001). Most importantly, it was shown that when informal linkages are included, the path distances over which information flows through the organization are reduced relative to the distance as measured by the formal structure alone. Perhaps the best demonstration of any complementary between formal and informal structure would be evidenced by empirical research that directly tests for a relationship between these path-distance reducing effects of informal linkages and organizational performance.

REFERENCES

Alexander JW, Randolph WA. 1985. The fit between technology and structure as a predictor of performance in nursing subunits. *Academy of Management Journal* 28(4): 844-859.

Andersen JA, Jonsson P. 2006. Does organization structure matter? On the relationship between structure, functioning and effectiveness. *International Journal of Innovation and Technology Management* 3(2): 237-263.

Balkundi P, Harrison DA. 2006. Ties, leaders and time in teams: Strong inference about network structure's effects on team viability and performance. *Academy of Management Journal* 49(1): 49-68.

Bell GD. 1967. Determinants of span of control. *American Journal of Sociology* 73(1): 100-109.

Bohte J, Meier KJ. 2001. Structure and the performance of public organizations: Task difficulty and span of control. *Public Organization Review* 1(3): 341-354.

Bonacich P. 1987. Power and centrality: A family of measures. *American Journal of Sociology* 92(5): 1170-1182.

Borgatti SP. 2005. Centrality and network flow. *Social Networks* 27(1): 55-71.

Borgatti SP, Everett MG, Freeman LC. 2002. *UCINET 6.0 for Windows: Software for Social Network Analysis*.

Burt RS. 1992. *Structural Holes: The Social Structure of Competition*. Harvard University Press, Cambridge, MA.

Burton RM, Lauridsen J, Obel B. 2002. Return on assets loss from situational and contingency misfits. *Management Science* 48(11): 1461-1485.

Burton RM, Obel B. 1998. *Strategic Organizational Diagnosis and Design: Developing Theory for Application*. Kluwer Academic Publishers, Boston, MA.

Burton RM, Obel B. 2004. *Strategic Organizational Diagnosis and Design: The Dynamics of Fit*. 3rd edition. Kluwer Academic Publishers, Boston, MA.

Cross R, Cummings JN. 2004. Tie and network correlates of individual performance in knowledge-intensive work. *Academy of Management Journal* 47(6): 928-937.

Cross R, Parker A, Prusak L, Borgatti SP. 2001. Knowing what we know: Supporting knowledge creation and sharing in social networks. *Organizational Dynamics* 30(2): 100-120.

Cummings JN, Cross R. 2003. Structural properties of work groups and their consequences for performance. *Social Networks* 25(3): 197-210.

Daft RL, Lengel RH. 1986. Organizational information requirements, media richness and structural design. *Management Science* 32(5): 554-571.

Daft RL, Murphy J, Willmott H. 2010. *Organization Theory and Design*. Cengage Learning, Boston, MA.

Donaldson L. 2001. *The Contingency Theory of Organizations*. Sage, Thousand Oaks, CA.

Doty DH, Glick WH, Huber GP. 1993. Fit, equifinality, and organizational effectiveness: A test of two configurational theories. *Academy of Management Journal* 36(6): 1196-1250.

Galbraith JR. 1974. Organization design: An information processing view. *Interfaces* 4(3): 28-36.

Germain R, Claycomb C, Dröge C. 2008. Supply chain variability, organizational structure, and performance: The moderating effect of demand unpredictability. *Journal of Operations Management* 26(5): 557-570.

Granovetter M. 1973. The strength of weak ties. *American Journal of Sociology* 78(6): 1360-1380.

Håkonsson DD, Burton RM, Obel B, Lauridsen JT. 2012. Strategy implementation requires the right executive style: Evidence from Danish SMEs. *Long Range Planning* 45(2): 182-208.

Hansen MT. 1999. The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly* 44(1): 82-111.

Hansen MT. 2002. Knowledge networks: Explaining effective knowledge sharing in multiunit companies. *Organization Science* 13(3): 232-248.

Hill CWL, Pickering JF. 1986. Divisionalization, decentralization and performance of large

United Kingdom companies. *Journal of Management Studies* 23(1): 26-50.
Hoskisson RE. 1987. Multidivisional structure and performance: The contingency of diversification strategy. *Academy of Management Journal* 30(4): 625-644.
Huber GP, McDaniel RR. 1986. The decision-making paradigm of organizational design. *Management Science* 32(5): 572-589.
Jennings DF, Seaman SL. 1994. High and low levels of organizational adaptation: An empirical analysis of strategy, structure, and performance. *Strategic Management Journal* 15(6): 459-475.
Ketchen DJ, Combs JG, Russell CJ, Shook C, Dean MA, Runge J, Lamoureux S. 1997. Organizational configurations and performance: A meta-analysis. *Academy of Management Journal* 40(1): 223-240.
Khandwalla PN. 1973. Viable and effective organizational designs of firms. *Academy of Management Journal* 16(3): 481-495.
Kilduff M, Krackhardt D. 2008. *Interpersonal Networks in Organizations: Cognition, Personality, Dynamics, and Culture*. Cambridge University Press, Cambridge, UK.
Knoke D, Yang S. 2008. Social *Network Analysis* (Vol. 154). Sage, Thousand Oaks, CA.
Krackhardt D. 1994. Graph theoretical dimensions of informal organizations. *Computational Organization Theory* 89(112): 123-140.
Love LG, Priem RL, Lumpkin GT. 2002. Explicitly articulated strategy and firm performance under alternative levels of centralization. *Journal of Management* 28(5): 611-627.
Markides CC, Williamson PJ. 1996. Corporate diversification and organizational structure: A resource-based view. *Academy of Management Journal* 39(2): 340-367.
Mehra A, Dixon AL, Brass DJ, Robertson B. 2006. The social network ties of group leaders: Implications for group performance and leader reputation. *Organization Science* 17(1): 64-79.
Miles RE, Snow CC. 1978. *Organizational Strategy, Structure, and Process*. McGraw-Hill, New York, NY.
Milgrom P, Roberts J. 1995. Complementarities and fit strategy, structure, and organizational change in manufacturing. *Journal of Accounting and Economics* 19(2): 179-208.
Nahm AY, Vonderembse MA, Koufteros XA. 2003. The impact of organizational structure on time-based manufacturing and plant performance. *Journal of Operations Management* 21(3): 281-306.
Nandakumar MK, Ghobadian A, O'Regan N. 2010. Business-level strategy and performance: The moderating effects of environment and structure. *Management Decision* 48(6): 907-939.
Olson EM, Slater SF, Hult GTM. 2005. The performance implications of fit among business strategy, marketing organization structure, and strategic behavior. *Journal of Marketing* 69(3): 49-65.
Olson EM, Walker OC, Ruekert RW. 1995. Organizing for effective new product development: The moderating role of product innovativeness. *Journal of Marketing* 59: 48-62.
Pearce JA, David FR. 1983. A social network approach to organizational design-performance. *Academy of Management Review* 8(3): 436-444.
Ramaswamy SN, Flynn EJ, Nilakanta S. 1993. Performance implications of congruence between product-market strategy and marketing structure: An exploratory investigation. *Journal of Strategic Marketing* 1(2): 71-92.
Reagans R, Zuckerman E, McEvily B. 2004. How to make the team: Social networks vs. demography as criteria for designing effective teams. *Administrative Science Quarterly* 49(1): 101-133.
Richardson HA, Vandenberg RJ, Blum TC, Roman PM. 2002. Does decentralization make a difference for the organization? An examination of the boundary conditions circumbscribing decentralized decision-making and organizational financial performance. *Journal of Management* 28(2): 217-244.
Sailer LD. 1978. Structural equivalence: Meaning and definition, computation and application. *Social Networks* 1(1): 73-90.
Sarkar A, Feinberg SE, Krackhardt D. 2010. Predicting profitability using advice branch bank networks. *Statistical Methodology* 7(3): 429-444.

Shaw JD, Duffy MK, Johnson JL, Lockhart DE. 2005. Turnover, social capital losses, and performance. *Academy of Management Journal* 48(4): 594-606.

Sine WD, Mitsuhashi H, Kirsch DA. 2006. Revisiting Burns and Stalker: Formal structure and new venture performance in emerging economic sectors. *Academy of Management Journal* 49(1): 121-132.

Sitar A. 2012. Influence of organization on connected learning of individuals in organizations. Doctoral Dissertation. University of Ljubljana, Faculty of Economics. Ljubljana, Slovenia. 284 pages.

Soda G, Zaheer A. 2012. A network perspective on organizational architecture: Performance effects of the interplay of formal and informal organization. *Strategic Management Journal* 33(6): 751-771.

Sparrowe RT, Liden RC, Wayne SJ, Kraimer ML. 2001. Social networks and the performance of individuals and groups. *Academy of Management Journal* 44(2): 316-325.

Tichy NM, Fombrun C. 1979. Network analysis in organizational settings. *Human Relations* 32(11): 923-965.

Tichy NM, Tushman ML, Fombrun C. 1979. Social network analysis for organizations. *Academy of Management Review* 4(4): 507-519.

Tsai W. 2001. Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal* 44(5): 996-1004.

Tushman ML, Nadler DA. 1978. Information processing as an integrating concept in organizational design. *Academy of Management Review* 3(3): 613-624.

Wasserman S, Faust K. 1994. *Social Network Analysis: Methods and Applications* (Vol. 8). Cambridge University Press, Cambridge, UK.

Wood R, Bandura A. 1989. Social cognitive theory of organizational management. *Academy of Management Review* 14(3): 361-384.

STARLING DAVID HUNTER III

Professor
Carnegie Mellon University in Qatar
E-mail: starling@qatar.cmu.edu