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OVERCOMING THE CHALLENGES OF FORMAL ORGANIZATIONAL STRUCTURE: INDIVIDUALS' DESIRE FOR REDUCING THEIR WORKFLOW DEPENDENCIES

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DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Business and Economics
at the University of Kentucky

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ABSTRACT OF DISSERTATION

OVERCOMING THE CHALLENGES OF FORMAL ORGANIZATIONAL STRUCTURE: INDIVIDUALS' DESIRE FOR REDUCING THEIR WORKFLOW DEPENDENCIES

In a field social network study of 141 employees in an international organization, I examined individuals' future desires to either collaborate more intensely with existing network partners or seek out new partners based on the latent value of these social ties – the potential social capital that will be generated from strengthening or building a tie in terms of reducing their formal workflow dependencies on others. Employees tended to desire more intense collaboration with a constraining existing tie (i.e., a bottleneck in their existing workflow network) when they trusted the person, suggesting they believed that the partner would provide high-quality work inputs in a reliable manner once a stronger relationship was built, thus increasing the tie's latent relational value. Building new ties was more likely to happen when it would reduce one's workflow dependencies by detouring around the bottlenecking person and closing disadvantageous structural holes, suggesting those new potential ties had greater latent structural value as they allow the focal individual to reach out to other workers further upstream in the workflow network. When comparing the intentions to use both approaches, the bypassing, structural approach was more prevalent than the tie strengthening approach for reducing workflow dependencies, in spite of the inherent additional costs of searching and building a new tie. The study illustrates how informal networks are used intentionally to ameliorate the deficiencies of the formal organizational workflow network and suggests the relative prominence of the latent structural value of ties as compared to their relational value.

KEYWORDS: Workflow Bottlenecking, Network Change Motivation, Social Capital

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CHAPTER 1. INTRODUCTION

As an organization grows, multiple functions and units tend to emerge to deal with complex organizational problems (Lawrence & Lorsch, 1967). Organizations become differentiated to meet the requirements of complicated external environments, where each subsystem deals with different aspects of environmental demands. At the same time, however, structural differentiation creates greater needs for integration between the subsystems. As the subsystems become more specialized, the members of a subsystem develop a tendency to focus primarily on their subsystem's goal rather than achieving the goal of the entire organization. Given this trade-off, organizations implement a formal structure to coordinate effort among various subsystems. A formal structure, defined as "a system of consciously coordinated activities or forces of two or more persons" (Selznick, 1948), introduces a systematic ordering of positions and responsibilities, which creates a chain of command and a network of required workflow exchanges between employees.

As a rationally-designed instrument for accomplishing organizational goals, a formal structure enhances the organization's functioning in many different ways (Selznick, 1948). Individuals' interactions become more standardized within the required workflow network, which reduces uncertainties caused by individuals' motivations or job attitudes. Furthermore, the highly standardized interaction structure allows interchangeability of organizational members, and thus, the organization becomes less dependent on certain individuals' qualities. In general, a formal structure improves the organization's performance and survival prospects by enhancing the system's stability and reliability.

While this organizationally-mandated interaction structure enhances organizational functioning by standardizing and encouraging communication and accountability among

certain individuals, it also introduces ineffectiveness by constraining the organic, natural flow of resources among employees. Regardless of how carefully a formal structure is designed, an organization's structure is hardly aligned perfectly to the external environment, and thus, cannot address all potential circumstances not anticipated by management. The limitation becomes even more significant when the organization is operating in a rapidly changing environment because the standardized aspects of the structure reduce the organization's flexibility and its ability to adjust its structure to regain fit with the changed environment (Donaldson, 1987).

A major symptom of a formal structure that is not aligned properly with the organization's needs is the development of workflow bottlenecks. Each subsystem has a limited amount of capacity to process and transform resources into an output over a given amount of time (Galbraith, 1973). When demands for the output exceed the subsystem's capacity due to an outdated or poorly-designed workflow structure or unanticipated environmental changes that demand new non-routinized responses, the subsystem becomes a workflow bottleneck which constrains the job performance of other organizational members and damages the organization's functioning by producing outputs of lower quality or that fail to meet the workflow schedule. For example, in early 2017, Tesla, Inc. announced its goal of producing 1,500 of its new Model 3 vehicles in the third quarter of the year, but the company ended up producing only 260 of the cars (Jones, 2017). Tesla attributed the production shortfall to "production bottlenecks" in their workflow. In fact, certain body parts of the Model 3 vehicles had to be produced almost manually as the body shop for producing the newly-developed parts was not fully installed until September (Higgins, 2017).

While much of this research and theorizing has been discussed at the level of the subsystem (e.g., units, departments, and teams), we can also conceive of work as flowing through a network of individuals throughout the organization, and this same notion of bottlenecks applies to those individuals as well. Specifically, employees high in bottlenecking are defined as the individuals who interrupt the job performance of numerous other employees because they are required to process and transfer a high volume of inputs to those employees. For example, MaritimeX, a cargo shipping firm in Mexico, implemented a workflow routine where every client proposal was required to be evaluated by one of its founders, and this became a critical bottleneck in the company's workflow which inhibited the company's growth (Martin & Papadimitriou, 2009). As evaluating a proposal took at least one week, prospective clients frequently withdrew their proposal even before MaritimeX began the review, and as a result, the company missed a number of promising business opportunities. Furthermore, because the proposal evaluation was a necessary step for numerous functional departments' job performance, the founders were hindering the work of many employees in the downstream of the organization's workflow. As depicted in this example, certain individual employees become bottlenecks (a) when they receive inputs from others; and (b) when others are waiting on the focal person for the necessary resources that they provide. Every individual in a required workflow structure can be a bottleneck for others, and the extent to which they are bottlenecking is determined by the number of other employees from whom they receive inputs and the number of others that are waiting on the focal person. When an employee is required to exchange necessary work inputs with a greater number of other employees in the organization, the individual needs to spend more time and energy on synthesizing the

inputs and deciding how to allocate their limited resources between the inputs and the people who are waiting on them. As a result, individuals high in bottlenecking (I will refer to these individuals as "bottlenecking employees") can interrupt the organization's functioning as a whole. In particular, *bottlenecking employees* can negatively affect the performance of other individuals around them, especially when the surrounding individuals are highly dependent on the bottlenecks. For example, when a bottlenecking individual is the main (or only) source from which an employee can gain necessary resources to get their job done, the *dependent employee's* job performance would be heavily constrained by the bottlenecking individual.

Informal and voluntary interactions among employees beyond those required formally could play an important role in addressing the problem of workflow bottlenecking and sub-optimal workflow dependency caused by the formal structure. Informal structure emerges in every organization and takes primacy over the formal structure designed by management because the organizations' professed goals do not provide concrete solutions to members' day-to-day operations (Selznick, 1943). In the context of workflow bottlenecking, the formal structure cannot address the situation where the bottlenecking individuals constrain the dependent employees' job performance because the interactions with bottlenecks are part of the formal structure mandated by management. Moreover, the formal structure can even worsen the situation by forcing individuals to be locked into ineffective workflow exchange relationships.

When an individual's job performance is highly constrained by a bottlenecking individual, it can generate frustration and pose potential negative impacts on their job performance, which encourages the individual to address such concerns by developing

informal ties. As a response to these limitations of the formal structure, employees seek out informal interactions beyond their required workflow, such as informal advice seeking or information sharing, to address the bottlenecking and improve the workflow for oneself. Indeed, informal relationships between employees play an important role as conduits through which resources flow between employees within organizations. Previous literature has shown that strong social ties and a cohesive network structure facilitates knowledge sharing by promoting effective communication (Reagans & McEvily, 2003; Tsai, 2001), especially across formal organizational boundaries (Ancona & Caldwell, 1992; Oh et al., 2004). Informal relationships also act as substitutes for the formal structure and enable collaborative innovation beyond the formal workflow, which results in enhancing the organization's ability to deal with unexpected exceptions to normal functioning (Moreyl & Luthans, 1991).

This study takes a social network perspective to examine individuals' desire for developing informal social ties to others to overcome workflow dependencies imposed by the formal organizational structure. Specifically, I posit that individuals will strengthen and build their social relationships based on their implicit estimation of the "latent value" of these ties – the potential social capital that will be generated from strengthening an existing tie or building a new tie which will reduce their dependency on certain others. Social capital refers to the resources that reside in the structure and content of relations between social actors (Adler & Kwon, 2002; Nahapiet & Ghoshal, 1998). Previous research suggests that there are two different kinds of social capital – relational and structural social capital – generated from individuals' social networks (Lin, 1999a), and

individuals attempt to actively shape the surrounding social structure that provides greater social capital to them (Emirbayer & Goodwin, 1994; Emirbayer & Mische, 1998).

The first type is relational social capital derived from strong social relationships with others. Strong social ties characterized by frequent interactions and the presence of multiple aspects to the relationships (e.g., friendship, advice) can significantly improve the resource flow between the two parties. Strong interpersonal relationships motivate individuals to provide assistance and support to one another (Granovetter, 1982), which will result in prioritizing each other in exchanging work inputs. Therefore, an employee who is heavily dependent on a bottlenecking individual in the required workflow would attempt to overcome such constraint by *strengthening their existing social tie to that bottlenecking individual* to secure reliable access to their work inputs.

The second type of social capital is structural social capital that emphasizes disconnections in the network structure (i.e., structural holes). Researchers have found that while individuals sitting in between disconnected others obtain various benefits, the disconnected actors suffer from a number of disadvantages as they have to rely on the bridging individual to gain access to important resources (Burt, 1992). In the context of workflow bottlenecking, the formal workflow structure where the bottleneck is bridging many disconnected employees creates greater dependence of many individuals on the bottleneck. Therefore, another approach that employees can take to manage their constraint on a bottlenecking individual is to *establish new informal social ties to close structural holes in their networks*. Closing one's disadvantageous structural holes and reaching out to other workers further upstream in the workflow network allow the

individuals to bypass the bottlenecks and significantly reduce an employee's reliance on bridging individuals, which in turn, should enhance their job performance.

In addition, between the two strategies to reduce workflow dependencies, I posit that tie strengthening will be used more frequently than bypassing, because expanding an existing relationship is less costly than building a new tie. While managing social relationships generates substantial benefits, it also incurs significant costs of initiating and maintaining the social ties (Bala & Goyal, 2000, Shipilov et al., 2014). Therefore, when attempting to reduce their dependencies on bottlenecking individuals by strengthening or forming informal relationships, employees will take the costs of each tactic into account as well as the potential benefits that will be gained by performing each behavior. Based on this argument, I propose that the tie strengthening strategy will be more dominant over the bypassing approach because expanding an existing relationship does not incur any initiation costs of searching for new relationship partners, and maintaining old relationships is much easier than keeping new ties ongoing.

Exploring individuals' specific desire for strengthening existing social ties and/or building new ties to certain others can provide important insight in understanding network dynamics. Although a substantial body of research has investigated how networks evolve over time (e.g., Ahuja et al., 2012; Burt & Merluzzi, 2016; Davis, 2010; Sasovova et al., 2010; Zaheer & Soda, 2009), our understanding of the drivers of network change remains unclear because the *underlying cognitive motivations* of individuals who actually engage in tie formation and strengthening has been less likely to be examined directly. Instead, researchers have inferred how individuals' motivations lead to certain network evolution from simply comparing networks observed at different time points. For example, Burt

(2002) observed business relationships between bankers over 4 years and found that bridging relationships that span structural holes tend to decay faster than non-bridging ties, but the death rate was significantly lower when the broker had more experience with bridging. From these findings, the author inferred that bridging ties are sustained by individuals' instrumental motivations; that is, Burt surmised that as a banker gains more experience with spanning structural holes, the individual better recognizes the information and control benefits of occupying brokerage positions, and thus, is motivated to keep their structural holes open. However, without assessing individuals' motivations directly, it is impossible to investigate whether brokering individuals recognized the benefits of spanning structural holes, and whether such recognition motivated them to form and maintain their bridging ties. Furthermore, merely observing network changes does not allow researchers to examine detailed mechanisms that bring about such changes. For example, in Burt's (2002) study of bridge decays, not only does the broker's motivations to span structural holes affect the survival of bridging ties, but also the disconnected others' motivations to close the holes would have influenced the stability of bridges. Inferring social actors' network change motivations indirectly from observing only the consequences (i.e., tie formation and strengthening) of a process involving at least two actors does not allow researchers to investigate the complicated mechanisms that caused the observed network evolution.

The current study suggests a possible answer to the question of individuals' underlying motivations that drive network dynamics by examining directly via survey individuals' desire for collaboration with others. I posit that individuals' motivations to overcome workflow dependency would promote their desire to bring about changes to

their informal collaboration ties to particular other employees. While there has been a substantial body of research on individuals' network change motivations, most studies have focused on individuals' attributes (e.g., self-monitoring personality; Sasovova et al., 2010, tertius iungens orientation; Obstfeld, 2005) and natural tendencies (e.g., homophily; McPherson et al., 2001) as the antecedents of changes in informal network structure, and less is known about the impacts of formal organizational structure on informal networks (with notable exceptions; see, for example, Gargiulo, 1993; McEvily et al., 2014). Suggesting a possible answer to the question about individuals' network change motivations, this study argues that the interpersonal dependencies posed by the formal, organizationally-mandated workflow network motivates individuals to develop their informal social relationships, especially informal collaboration ties, to overcome such constraints (cf., Morey & Luthans, 1991). Informal interpersonal collaboration could play an important role in reducing one's formal workflow dependency on others as it facilitates resource flow (Singh, 2005). I suggest that, when an employee is highly constrained by another in terms of receiving necessary work inputs in the formal workflow network, the focal individual would wish to reduce such dependency either by: 1. strengthening his or her informal relationship with the bottlenecking alter in an effort to have that alter better prioritize their needed inputs within the alter's work portfolio; or 2. by building a new social tie to detour around the bottlenecking individual to secure the inputs from others.[1]

[1] In addition to tie strengthening and formation, there are other modes of network changes examined by previous research. For example, Sasovova et al. (2010) studied tie dissolution as an important aspect of network dynamics. One form of tie dissolution studied by Davis (2010) found that managers often engage in network pruning to remove brokers and their bridging ties in the employee network. Although I acknowledge that tie dissolution is an important network change behavior performed by individuals to manage dependence, the current study focuses on tie strengthening and formation because I was interested in how employees increase resource acquisition through informal collaboration rather than in how they enhance the efficiency of resource exchange in general by removing redundant social ties.

The hypotheses were tested using social network data collected from 141 employees in a small multi-national organization that designs and manufactures large art installations operating in 3 different countries (Australia, China, and United States). Results showed that individuals' desire for strengthening their constraining workflow ties was driven largely by the motivations to leverage their relational social capital, especially their trust in the alter. Individuals were more willing to strengthen their constraining ties when they trusted the bottlenecking other, because strengthening a relationship to someone deemed trustworthy is easier and would potentially provide even more benefits (Levin & Cross, 2004). On the other hand, individuals' desire for building new social ties was influenced mainly by structural motivations to increase their structural social capital. When choosing a future collaboration partner among many possible alters, individuals were more likely to wish to collaborate more with certain employees if doing so closes disadvantageous structural holes in their formal workflow network, and thus, reduces their dependency on a bottleneck in receiving necessary work inputs. One additional contribution of my research is to consider these decisions together as they represent different types of network investments. In essence, I'm asking the question of which network motivation is dominant over the other when facing a dependence situation; I found that individuals tended to prefer the tie formation approach over the tie strengthening approach when they are faced with high workflow dependencies.

CHAPTER 2. THEORY AND HYPOTHESES

2.1 Relational and Structural Social Capital

Social capital is defined as the resources that lie in the content and structure of relations between social actors (Adler & Kwon, 2002; Nahapiet & Ghoshal, 1998). Individual actors are connected to certain others, and the pattern and characteristics of those connections provide valuable resources to the actors embedded in the network of social relations, such as information (Burt, 1992), power and control (Burt, 1997), and solidarity (Coleman, 1988, 1990). Central to the concept of social capital is that there are "better" patterns and types of social ties that generate greater benefits to the embedded actors.

Researchers from a structuralist perspective focus primarily on the pattern or structure of the network of social relationships as the source of social capital. Previous studies based on this structuralist perspective have discovered important effects of being located in a social network with certain configurations alternatively labelled *closure* and *brokerage* (Burt, 2000). A densely-connected network is characterized by a well-connected structure where its members have informal ties to most of the other members of a group. Under such environments, individuals are willing (or forced) to subsume their own interests under those of the entire group, which generates benefits for the group and its members by bringing the group together (Oh et al., 2004). For example, individuals become less likely to engage in opportunistic behavior in a densely-connected group, because its members can coordinate their effort to monitor and sanction opportunism more effectively (Portes & Sensenbrenner, 1993). As a result, strong reciprocity norms tend to

emerge in a group with a dense network structure, which gives rise to greater mutual trust and stronger solidarity among individuals (Coleman, 1990).

On the other hand, having many structural holes in one's network is seen as beneficial from a different structuralist perspective emphasizing information and control benefits derived from sitting in between disconnected others (i.e., benefitting from an absence of ties) (Burt, 1992). The core idea underlying this perspective is that disconnection creates non-redundancy in resources. Disconnected individuals tend to possess non-redundant information and resources because they operate in different social circles and do not share their resources with one another. When an individual bridges such otherwise disconnected people, he or she tends to obtain more timely and diverse information by accessing more heterogeneous sources of information (Oh et al., 2006). Furthermore, the bridging individual also gains greater power and influence over the disconnected people as the broker has control over the resource flow between them (Burt, 1997). It is important to note that, however, while structural holes provide benefits to the bridging individuals, they can have negative impacts on the effectiveness of the network as a whole as they interrupt the resource flow. For example, Bizzi (2013) found that a group's performance was negatively affected by the structural holes in the interpersonal network among the group members because the brokers' manipulative and power-oriented behaviors created frictions within the group and hindered collaboration between members. In the context of workflow network, brokers act as potential bottlenecks that interrupt the organization's overall functioning as their manipulative behavior to gain control over others disrupts the flow of work inputs to the employees downstream in the workflow.

Unlike these structuralist views that focus on the configuration of social ties, other scholars have emphasized the role of the content and quality of social relationships in generating social capital. This relational perspective argues that the strength of ties, determined by interaction frequency, emotional intensity, reciprocity, and multiplexity, significantly affects the resources provided through the ties. In his seminal study on the advantages of weak ties, Granovetter (1973) found that weak ties are more useful in finding jobs because they tend to be wide ranging to different social circles, and thus, provide access to information and resources beyond one's own social circle (Granovetter, 1982). Also, weak ties to people in distant social statuses work as conduits through which power and wealth flow to the focal individual (Lin, 1999b). Later studies, however, revisited the value of strong social ties and suggested that strong ties can be more beneficial depending on the context and the type of resources that individuals seek. For example, Bian (1997) found that strong ties played a more important role in getting jobs in China because job information was classified and circulated only within the Chinese government system to ensure centralized control. Given that distributing job information was illegal, such information flowed only through strong guanxi relationships where both job seekers and government officials had strong trust in each other. Hansen (1999) also found that strong ties were more effective in transferring tacit knowledge because close and frequent interactions were necessary to convey noncodified knowledge and skills. In addition to these instrumental benefits, strong informal ties also provide expressive benefits (Ibarra, 1992; Umphress et al., 2003). Although expressive benefits of social ties have received relatively less research attention (Wellman, 1992), the emotional support that flows

through strong ties is an important aspect of relational social capital that helps individuals to overcome difficult times.

Regardless of whether the focus is on the structure or the relational strength of social ties, the previous social capital literature has paid greatest attention to ties and their attendant social capital that has been already formed, in addition to its outcomes for social actors. More recent studies have begun to examine how social networks change over time and how this affects the formation of social capital. Among many possible drivers of network dynamics (see Ahuja et al., 2012), social actors' purposeful behavior has been recognized as an important factor that promotes network changes. The agency view of social behavior (Emirbayer & Goodwin, 1994; Emirbayer & Mische, 1998) assumes that social actors play an active role in shaping the surrounding social structure in order to create one that is favorable to them. From this perspective, actors engage in unique actions to improve their position in the network, such as forming or strengthening ties to certain others.

Drawing upon this view, the current study investigates social actors' motivations for network changes, especially their desire for overcoming their dependency on other actors. In the context of social networks, when an individual is constrained by another's control over valuable resources, the focal actor can reduce the bottlenecking other's power by implementing two different approaches of fostering social capital: (a) focusing on structural social capital and, thus, closing the disadvantageous structural holes; and (b) focusing on relational social capital and, thus, strengthening the tie to the bottlenecking person. In other words, I posit that individuals will strengthen and build their social relationships based on their implicit estimation of the "latent value" of the ties – the

potential social capital that will be generated from strengthening or building a tie which will contribute to reducing their dependency on others. When an employee expects that strengthening or building an informal relationship with someone would reduce their workflow dependencies, the individual will be motivated to perform such network change behavior.

In particular, the current study focuses on *individuals' intention to collaborate more closely and frequently with certain others in the future*. Interpersonal collaboration plays an important role in the flow of valuable resources. For example, important information diffuses through collaborative relationships (Ahuja, 2000; Singh, 2005), because individuals are more willing to share their knowledge with someone to whom they have had direct social ties than with strangers (Tsai & Ghoshal, 1998). Moreover, deeper collaboration ensures more reliable resource flow under uncertain environments or in the face of unanticipated exceptions as the individuals build a shared identity and engage in joint problem-solving (Uzzi, 1996). Therefore, when their job performance is constrained by someone in the formal workflow network, employees will desire to strengthen or build collaborative relationships with certain others to receive necessary work inputs more reliably and overcome the situation.

2.2 Latent Relational and Structural Value of Ties and Desire for Future Collaboration

Establishing an informal tie to someone who provides one's necessary work inputs has a lot of latent value because strengthening the constraining relationship will contribute to reducing the focal individual's workflow dependency. Expanding the conduit through which necessary work inputs are conveyed will secure the focal individual's reliable access

to the resources needed for better job performance. Once a strong relationship is built between individuals, they tend to be obliged to provide support and help each other, and as a result, prioritize the other party in processing and exchanging necessary work inputs.

Among a number of constraining ties through which dependent individuals receive work inputs, the potential value of expansion is deemed particularly greater from a dependent individual's point of view when the dependent person trusts the bottlenecking individual. Trust is defined as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer et al., 1995: 712). In the context of workflow bottlenecking, strengthening a tie to a bottlenecking person makes the dependent individual even more vulnerable to the bottlenecking person's actions because it exposes oneself to harm if the other party performs poorly. Therefore, if a dependent employee does not already trust the bottlenecking person, the focal individual would be less willing to strengthen the relationship with the other party because he or she would not expect positive outcomes from this effort. In contrast, when an employee has great trust in the bottlenecking person, the individual would believe that the bottlenecking person would provide high-quality work inputs in a very reliable manner once a stronger relationship is built (Levin & Cross, 2004), suggesting the tie has higher latent relational value.

Therefore, when an individual is highly constrained by another in the organizationally-mandated workflow network, the individual will be motivated to expand the tie to the bottlenecking person by forming an informal relationship alongside the required relationship. Such desire will be particularly strong when the focal individual has

greater trust in the bottlenecking other because such behavior bears greater potential benefits. Specifically, I focus on individuals' willingness to strengthen collaboration ties to bottlenecking others, because it will play an important role in reducing the focal employee's workflow dependency. While collaborating closely and frequently with each other, the bottlenecking person would experience greater pressure for reciprocity and support, and as a result, prioritize the exchanges with the focal employee over others. Thus, even if an employee's job performance depends heavily on a bottlenecking individual, the focal employee would still be able to receive work inputs reliably when a strong collaboration relationship is established. In sum, when faced with high workflow dependencies on others, employees would wish to overcome the situation by strengthening their collaboration relationships with the bottlenecking others, especially when they have greater trust in the bottlenecking individuals.

H1: Individuals will desire to collaborate more intensely in the future with an existing alter in the required workflow network when the tie has greater latent relational value (i.e., when that alter is already trusted by ego).

Individuals can also reduce their workflow dependency by leveraging the latent structural value of new ties that can be added to their network. When a new tie is formed, it affects the dependencies among individuals around it by adding new paths through which resources can flow. When two individuals do not have a direct relationship and are connected only indirectly through a third party (i.e., when the third party is spanning a structural hole), such a structure creates strong dependencies between the three actors.

Since the broker who is bridging the two individuals has control over the resource flow between the actors, the disconnected individuals become highly dependent on the broker to obtain valuable resources (Burt, 1992). For example, they have to rely on the bridging individual to gain access to novel information available in the other social circle. Adding a tie that closes the structural hole can significantly change such dependencies between the three individuals. The closing tie would reduce the disconnected individuals' dependency on the broker by allowing resources to flow directly between them, and thus, it has great structural latent value from the perspective of the disadvantaged individuals.

In the context of workflow networks, an employee's job performance might rely heavily on a broker when there is a structural hole, because the focal employee cannot get their job done effectively or quickly without receiving necessary work input from the broker. In fact, having structural holes in the workflow network is inevitable in large organizations because a certain degree of the division of work is required and desirable in order to deal with complicated organizational problems. However, the situation becomes problematic when the bridging individual is a bottleneck who is bridging a number of structural holes in the workflow network. As the workload exceeds the broker's capacity to transform their own inputs into the outputs that others need and are waiting on, the individual might begin producing outputs of lower quality or fail to meet the workflow schedule, which in turn, negatively affects the job performance of other employees who receive inputs from the bottlenecking individual. Under such situations, a new tie that closes the structural holes bears great potential value for the constrained employees, because forming the tie will allow them to reach out directly to employees further upstream in the workflow network and reduce their dependency on the bottlenecking individual.

Forming a tie that closes more than one structural hole will be particularly valuable for the constrained employee because doing so will reduce the individual's dependence on multiple bottlenecks at once. For example, when an input is conveyed to an employee through three bottlenecking individuals, the focal employee has to wait for all three bottlenecks to get his or her job done. Building a direct tie to the source of the input will greatly improve the workflow by reducing the focal employee's workflow dependencies on all three bottlenecking individuals.

Therefore, I posit that individuals would be motivated to form new social ties that close disadvantageous structural holes. When an employee is highly constrained by another in receiving necessary work inputs, the individual will be motivated to reduce such dependency by forming a new social tie that allows the individual to bypass the bottlenecking person. Facing high workflow dependency, an individual will be willing to establish new informal ties with great latent structural value that can potentially lessen one's reliance on certain sources of work inputs.

H2: Individuals will desire collaborating more intensely in the future with a new alter in the required workflow network when the tie has greater latent structural value (i.e., when the tie closes more structural holes).

Given the two possible approaches to reduce their workflow dependencies, employees need to decide whether to pursue a relational option involving greater collaboration with an existing tie or a structural option involving greater collaboration with a new tie. Due to natural limits on the amount of time and effort one can devote to

networking, employees would have to choose one approach over the other. Even if someone has enough resources to utilize both strategies across various parts of one's personal network, the individual will still be unlikely to devote their efforts equally across both strategies, but instead focus more on the more attractive approach to resolving the workflow dependency problem.

I suggest that individuals would prefer expanding their existing ties over building new ties, because strengthening a tie is less costly than creating a new one. Managing relationships with others incurs initiation and maintenance costs (Bala & Goyal, 2000, Shipilov et al., 2014). Initiation costs are the investments that individuals have to make when they search for new interaction partners. When someone attempts to form a new relationship, the individual needs to establish knowledge about the potential partner to deal with the uncertainty associated with the new tie (Vissa, 2012). For example, the individual has to learn about the new contact's expertise to figure out if the potential partner is the right person who can provide the resources in need. The focal individual also needs to understand the potential partner's motivations in order to make sure that the other party is also interested in establishing the tie and willing to put their time and effort as well. On the other hand, maintenance costs are incurred when an individual attempts to keep a relationship ongoing (Bala & Goyal, 2000; Feld, 1981). Maintaining a tie requires time, affect, attention, and other various resources. For example, individuals have to maintain a temporal "pace" in a relationship by reaching out to their contacts on a regular basis to keep the relationship active (Vissa, 2012).

Expanding existing ties is significantly less costly compared to building new ties. By definition, strengthening existing relationships does not involve any initiation costs

because the individuals have already interacted with and learned about one another. Although tie strengthening does incur maintenance costs, the costs are less than when an individual attempts to maintain new relationships. Burt (2002) found the liability of newness in social relationships, where younger ties are more susceptible to decay than more established ties because people need to spend more effort in learning how to appreciate one another and manage their interactions. New ties also require more time and effort to maintain a temporal pace to progress to a more-established, ongoing relationship from which one can actually benefit (Vissa, 2012).[2]

Therefore, in dealing with workflow dependencies, expanding the existing relationship with the bottlenecking other will be a more dominant approach taken by employees than forming a new tie to bypass the bottlenecking individual. When an employee is highly dependent on another in getting his or her jobs done, the individual will prefer strengthening the relationship with the other party by collaborating more with the partner than finding an alternative source of resources, because the former strategy is less costly than the latter.

H3: Individuals will desire collaborating more intensely in the future with an existing alter than with a new alter in the required workflow network.

[2] Some previous works have suggested that there are opportunity costs of tie management. Opportunity costs are incurred when an individual's existing social ties hinder the individual's new tie formation. For example, the ease and familiarity with existing partners can increase the cognitive costs of building new ties (Gargiulo & Benassi, 2000). Strong ties to existing partners also can limit the individual's ability to form new relationships as they create strong reciprocity norms and obligations to support one another. Although opportunity costs are an important aspect of tie management, the present study does not explicitly discuss it because both tie strengthening and bypassing strategies can incur opportunity costs of various types.

CHAPTER 3. METHODS

3.1 Participants and Procedure

The data were collected from 153 employees in a small multi-national organization that designs and manufactures large art installations. These employees were working in 21 functional departments located in 3 different countries (Australia, China, and United States).[3] A typical workflow was sequential involving a number of departments: (1) marketing and communications department proposes and makes an agreement on a project with external clients; (2) designing department creates an art design that meets the clients' needs; (3) project management department arranges the production schedule; and (4) a number of artists with various skills (e.g., architecture, carpentry, chemical handling) work together in workshops to produce the art installation. Also, many projects required collaboration between departments located in different regions due to differences in production costs and government regulations across countries. These long workflow chains caused by the highly differentiated organizational structure generated greater needs for effective interpersonal collaboration across functional and geographic boundaries.

A survey was administered to the entire population of employees in the organization. Of the 153 questionnaires administered, 141 were completed, for a response rate of 92.2%. In this survey, participants responded about their demographic information, job characteristics (e.g., workload, knowledge codification), and job attitudes (e.g., overcommitment, creative self-efficacy). In addition, the survey included sociometric

[3] The data used for this study were part of a broader data collection effort approved by the Swinburne University of Technology's Research Ethics Office ("Creativity Across Global Boundaries: Promoting Innovation in a Bespoke Advanced Manufacturing Firm"; Protocol #20201099-5144). The author was provided with de-identified data that contain anonymous IDs only, without access to identifiers or to any key that would identify subjects. Therefore, this study was approved by the University of Kentucky's Institutional Review Board as a not-human-research (NHR) project that does not require their review.

questions regarding the participants' various relationships with other employees (e.g., required workflow interactions, desire for further collaboration, reliance-based and disclosure-based trust). The final sample was 61% male and had been working in the organization for 4.3 years on average. Most participants (86%) had a bachelor's degree or greater and 19% were managers.

3.2 Analytical Approaches

In the current study, the dependent variable is the desire for further collaboration measured at the dyadic level between 141 individuals, which is formatted as a desired collaboration network matrix (see 3.(3) Measures section below for more detailed description of the measure). Because the rows and columns for this matrix is derived from the same source, there is systematic interdependence. In addition to this, other effects inherent in social networks (e.g., reciprocity, triadic closure) can also cause interdependence between social ties. Such interdependence can cause serious biases to the results derived from ordinary-least squares (OLS) tests (Kilduff & Krackhardt, 1994; Krackhardt, 1988).

In order to address this issue, I used the logistic regression quadratic assignment procedure (LRQAP) in UCINET, which regresses a dependent variable matrix on multiple independent and control variable matrices using a logistic regression function. LRQAP analyses provide a nonparametric test of whether two or more matrices are significantly related (Krackhardt, 1988). This procedure involves a two-step process. First, a standard logistic regression is performed across corresponding cells of the dependent, independent, and control variable matrices. Next, the rows and columns of the dependent variable matrix

are randomly permuted to create a new matrix, and the logistic regression is performed again. The second step is repeated for a significant number of times (in this research, 20,000 times), and beta coefficients and explained variances (R2s) for each permuted regression form the reference distribution against which the observed statistics computed in the first step are compared. If fewer than 5 percent of the beta coefficients calculated from the permuted regressions are larger than the observed beta, the coefficient is considered significant at the .05 level (one-tailed test). LRQAP has been found to be superior to OLS regression analysis for testing hypotheses with dyadic data, such as the data in network analysis (Borgatti et al., 2013). In a similar manner, zero-order correlations between matrices of interest were computed via quadratic assignment procedure (QAP). Both LRQAP and QAP correlation analyses were conducted using UCINET (Borgatti et al., 2002).

In testing Hypothesis 3, however, I used a traditional multinomial logistic regression. To test Hypothesis 3, which proposed relative prevalence between the two strategies that individuals use to reduce their workflow dependencies (i.e., tie strengthening and bypassing), it is required to have complete profiles of individuals' desired collaborations with both existing and new partners, and then predict the probabilities that each type of desired collaboration occurring. LRQAP cannot perform such analysis because it cannot use a matrix with multiple non-ordinal categories as the dependent variable and estimate the probabilities of each category occurring in relation to the independent variables (F. Agneessens, September, 2021). Therefore, I vectorized the complete desired collaboration matrix and the predictor variable matrices, and then ran multinomial logistic regression analyses using each dyad as the unit of analysis.

3.3 Measures

3.3.1 Dependent Variable: Desire for Further Collaboration

Employees' desire for further collaboration was measured at the dyadic level using the social network survey. A roster of all employees' names was presented, and the respondents were asked to check off the people with whom they wish to collaborate more often or more closely in order to perform their job better. They could choose anyone in the organization, including either their own existing ties or new ties. Using these data, I constructed a *desired collaboration* network matrix, with cell X_{ij} coded as 1 if Employee *i* wanted to collaborate more with Employee *j* and coded as 0 otherwise.

Then, the matrix was separated into two matrices to test Hypotheses 1 and 2 because each hypothesis was predicting different phenomena. While Hypothesis 1 was predicting individuals' desire for further collaboration to strengthen their existing workflow relationships, Hypothesis 2 was predicting individuals' desire to build new collaboration ties. To address this, I measured individuals' *existing interactions in the required workflow network* and used it to construct separate desired collaboration matrices for each hypothesis. A roster of all employees' names was presented, and the respondents were asked to check off the people from whom they require important work inputs. The resulting required workflow network had cell X_{ij} coded as 1 if Employee *i* had to receive work inputs from Employee *j* and coded as 0 otherwise. Then, comparing the existing workflow interactions and the desired further collaborations, two network matrices were constructed for each hypothesis: (1) a matrix that represents employees' wish to collaborate more with their existing workflow partners for Hypothesis 1; and (2) a matrix that represents

employees' desire to collaborate more with new people with whom they are not currently required to work for Hypothesis 2.

Testing Hypothesis 3, on the other hand, required complete profiles of desired collaboration relationships. The hypothesis predicted the relative prevalence of individuals' desire for further collaboration with their existing workflow partners compared to their wish to collaborate with new partners. To test this idea, it is required to have a complete set of individuals' desired collaborations with both existing and new partners, and then compare the probabilities that each type of desired collaboration occurring. Therefore, I combined the two desired collaboration network matrices back into a single matrix and recoded its elements as follows: Cell X_{ij} is coded as 0 if Employee *i* did not wish to increase their collaboration with Employee *j*, coded as 1 if Employee *i* wanted to collaborate more intensely with their existing workflow partner Employee *j*, and coded as 2 if Employee *i* wanted to collaborate more with a new partner Employee *j*.

3.3.2 Independent Variables

Latent structural value of ties. The latent structural value of a tie was operationalized in two different ways. In the model predicting individuals' desire for strengthening their existing workflow ties (Hypothesis 1), I measured the latent structural value of strengthening an existing tie by assessing *the number of work input ties that the ego will lose if the tie is dissolved*: this is operationalized by *the changes in the ego's 2-step-reach centrality when the ego-alter tie is dropped*. As the tie is already present in the network, measuring the *potential* value of strengthening the tie requires introducing a hypothetical situation where the tie is absent and evaluating how ego's reception of work

inputs would be damaged. In Figure 1, for example, strengthening the tie to A has greater potential value than strengthening the tie to B for the ego. If the ego loses the tie to A, ego will not be able to receive inputs produced by 5 individuals (C, D, E, F, and G) while dissolving the tie to B will affect the transfer of inputs from only 2 employees (H and I). In other words, ego is more constrained by A than by B, because A is bridging 5 structural holes that are disadvantageous for ego, while B is bridging only 2 of such structural holes. Therefore, if an individual loses access to many work inputs by dissolving a tie, the tie has greater latent structural value, because it means the tie is bridging many structural holes, and must thus be constraining the focal employee. To operationalize this, I assessed the focal individuals' 2-step-reach centrality dyadically. 2-step-reach centrality refers here to the number of distinct individuals within two links of a focal person in the directed workflow network. In Figure 1, for example, ego's 2-step-reach centrality is 9 as the ego can reach nine individuals within 2 or fewer steps. Based on this measure, I assessed dyadic 2-step-reach centrality for each existing tie, or the number of work inputs that is transferred through each relationship. For example, the dyadic 2-step-reach centrality of the ego's tie to A and B are 5 and 2, respectively, and the relationship with A is considered to possess greater latent structural value for the ego.

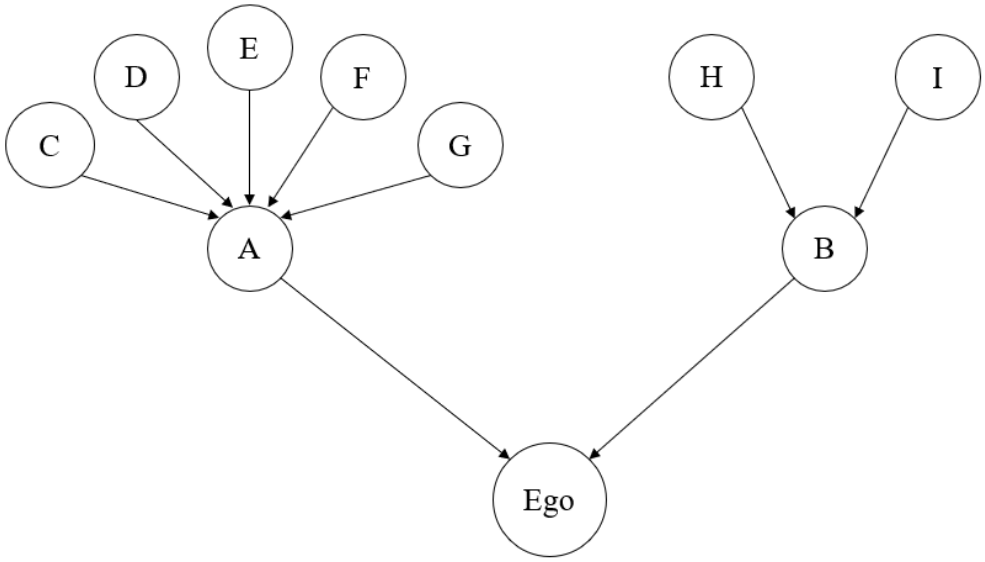


Figure 1. An example workflow network. Each circle represents an employee. Each arrow represents a workflow tie through which work inputs are transferred.

For the model predicting desire for building new social ties (Hypothesis 2), I assessed the latent structural value of a potential new tie by *counting the number of structural holes that will be newly created or closed if ego adds the tie to his or her network*. In Figure 2, for example, building a new collaboration tie to J creates numerous structural holes that ego will bridge, but the new tie does not contribute to reducing ego's workflow dependencies on A or B. On the other hand, collaborating with G does not open any new structural holes for ego, but it reduces ego's dependence on A because it allows the ego to bypass A and receive inputs from G directly. Therefore, a tie has greater latent structural value if forming the tie closes many structural holes and does not open new ones, and thus, allows the focal employee to bypass the bottlenecking individual.

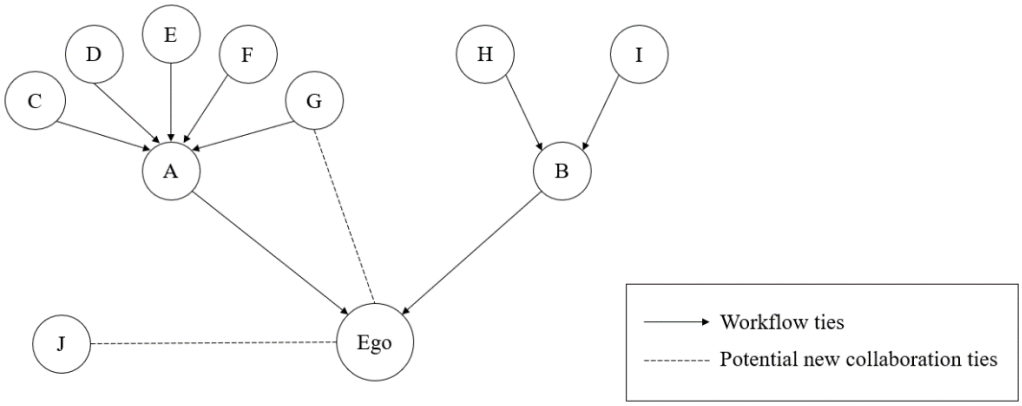


Figure 2. An example workflow network and potential new collaboration ties. Each circle represents an employee.

Latent relational value of ties. The latent relational value of a tie was measured by ego's trust in the alter. When two individuals already trust each other, strengthening the tie will lead to even greater and more reliable flows of work resources, and thus, the tie has greater latent relational value. According to Gillespie (2015), reliance on others and disclosure of sensitive information have been identified as two important forms of trusting behavior in workplace relationships. I measured both forms of trust at the dyadic level using a sociometric survey. A roster of all employees' names was presented, and the respondents were asked to check off the people with whom they have *interacted regularly over the past 6 months* as part of their jobs. Then, the participants rated the degree to which they *are willing to rely on each person's task-related judgments, skills, and abilities* (1= strongly disagree; 7= strongly agree). A tie that was at least "somewhat" trusted (5 or above) was dichotomized as being a trusting relationship. A binary reliance-based trust network matrix was constructed from these data, where cell X_{ij} was coded as 1 if Employee *i* was willing to rely on Employee *j* and coded as 0 otherwise. Similarly, the respondents' disclosure-based trust in each other was measured by asking them to check off the people

with whom they are *willing to discuss their honest feelings about work, even negative feelings and frustration*. A binary disclosure-based trust network matrix was constructed from these data, where cell X_{ij} was coded as 1 if Employee *i* was willing to disclose his/her honest feelings to Employee *j* and coded as 0 otherwise.

3.3.3 Control Variables

A number of individual- and dyad-level variables were controlled in the LRQAP and multinomial regression models. To be included in the dyadic level analyses, the individual-level control variables were transformed into square matrices. First, column vectors of individual-level variables were created, where each row represents the each individual's characteristics. Then, to account for the effects of the focal individual's (i.e., ego's) attributes on a dyad, I constructed ego-effect matrices by duplicating the column vectors of the variables. For the effects of the partner's (i.e., alter's) attributes on a dyad, alter-effect matrices were constructed by duplicating the row vectors.

I controlled for several job characteristics that might influence individuals' desire for further collaboration with others. For each dyad, ego's and alter's *perceived workload* and their *experienced overcommitment* were controlled because individuals might not be able to put forth the time and effort needed to strengthen their existing ties or build new relationships. Perceived workload was measured with a 3-item scale from Siegrist et al. (2009). A sample item was, "over the past few years, my job has become more and more demanding" (α = 0.76). Experienced overcommitment was measured with a 6-item scale also from Siegrist et al. (2009). A sample item was "I get easily overwhelmed by time pressures at work" (α = 0.82). I also controlled for the degree of *knowledge codification* of ego's and alter's job. More frequent and closer interactions are required for tacit knowledge

to be transferred between individuals because such knowledge is hard to articulate or can only be acquired through experience (Hansen, 1999). Therefore, individuals would want to collaborate more closely with others whose knowledge is highly tacit and noncodified. Knowledge codification was measured with a 3-item scale from Gibson and Vermeulen (2003). A sample item was "our department has a formal system to capture our good ideas" (α = 0.86).

Several individual-level attributes were also controlled. Ego's and alter's *creative self-efficacy* were controlled because employees would be more willing to collaborate with someone with high self-efficacy regarding their creativity (Grosser et al., 2017). Given that the organization is operating in an art business, creativity is considered a particularly important organizational resource. Creative self-efficacy was measured with a 3-item scale from Tierney and Farmer (2002). A sample item was "I feel that I am good at generating novel ideas" (α = 0.71). At the dyadic level, employee similarity across various characteristics was controlled, because individuals have a strong tendency to be drawn to interacting with others who are similar to themselves (McPherson et al., 2001). I constructed and controlled for similarity matrices involving *gender*, *department membership*, and *location*, with cell X_{ij} coded as 1 if Employee *i* and *j* have the same attributes and coded as 0 otherwise. In addition, I controlled for individuals' difference in *formal rank*, *tenure*, and *experience in the current industry* at the dyadic level, because employees might be more motivated to desire greater collaboration with someone of higher rank and greater experience in the current organization and industry.

Lastly, several characteristics of individuals' networks were controlled in the analyses for new tie formation. For each dyad, the ego's and alter's *degree centrality in*

the required workflow network were controlled because individuals who are already interacting with many others might not be able to devote the additional time and effort needed to strengthen their existing relationships or build new social ties. *Geodesic distance in the required workflow network* between the ego and alter was also controlled. Specifically, the curvilinear effect of the variable was controlled because employees might be most interested in collaborating with others whose work is related to their own tasks to a moderate extent. Collaborating with someone who is too close or far in the workflow network might not provide useful resources to the focal individual. These control variables regarding the required workflow network were included only in the analysis predicting individuals' desire for tie formation; because the analysis of individuals' desire for strengthening existing relationships examines the direct ties that individuals already have, the geodesic distance for every tie in the analysis was already 1. *Number of common third-parties* between the ego and alter was also controlled because individuals tend to be drawn to interact with each other when they share many common contacts (Krackhardt, 1998). I assessed the regular interaction network among the employees to measure this variable. A roster of all employees' names was presented, and the respondents were asked to check off the people with whom they interacted regularly over the past 6 months. Using these data, I constructed a regular interaction network matrix, with cell X_{ij} coded as 1 if Employee *i* wanted to collaborate more with Employee *j* and coded as 0 otherwise. Then, the number of common third-parties was counted for every dyad and included in the models.

CHAPTER 4. RESULTS

As each hypothesis was tested using different subsets of the data, the descriptive statistics are presented in separate tables for each hypothesis testing. Testing Hypothesis 1 about individuals' desire for tie strengthening involved only the dyads where the ego and the alter have already had an existing workflow relationship. The means, standard deviations, and correlations of those dyads are presented in Table 1. For testing hypothesis 2 which predicted individuals' desire for building new ties, only the dyads where the ego and the alter have not had an existing workflow relationship were included in the analysis. Table 3 demonstrates the descriptive statistics of those dyads. Lastly, the complete profiles of desire for tie strengthening and formation were used to test Hypothesis 3 about the individuals' relative preference between the two approaches. The descriptive statistics of all dyads are presented in Table 5. Overall, on average, each employee has been interacting with 24.2 individuals on a regular basis and required to work with 12.1 of them. The average number of existing required workflow ties that each individual wanted to strengthen through further collaboration was 6.76 (SD = 7.87). In terms of building new collaboration ties, on average, each participant wished to collaborate further with 2.88 other individuals with whom they are not required to work (SD = 4.19).

Hypothesis 1 suggested that individuals would be more likely to wish to collaborate further with their existing interaction partners in the required workflow network when there have already been trusting relationships between them. Model 3 in Table 2 indicates that this is the case. If an individual trusts someone who provides necessary work inputs, specifically with regard to his or her task-related judgments, skills, and abilities, the focal individual tended to desire for more frequent and closer collaboration with the person (*b*

= 0.85, p = 0.006). In interpreting the odds ratio, individuals were 2.35 times as likely to want to collaborate further with an existing workflow relationship partner when they have reliance-based trust in the person. Similarly, disclosure-based trust also motivated individuals' willingness for further collaboration – if an ego was willing to discuss his or her honest feelings about work with a certain workflow relationship partner, the ego was more likely to wish to collaborate further with the alter (b = 0.79, p < 0.001). The odds ratio shows that employees were 2.20 times as likely to desire for further collaboration with a provider of work inputs when they have disclosure-based trust in the person. On the other hand, latent structural value of an existing tie did not have a significant influence on individuals' desire for strengthening the tie (b = 0.01, p = 0.224).

Hypothesis 2 proposed that individuals would be more likely to wish to build new collaboration relationship with someone when doing so closes disadvantageous structural holes in their required workflow network. I found support for this prediction in the LRQAP analysis summarized in Model 6 in Table 4. When choosing their new collaboration partners, employees tended to have stronger desire for further collaboration with someone if the new tie closes more structural holes (b = 0.10, p = 0.006). In interpreting the odds ratio, for each potential structural hole that a new collaboration tie closes, individuals became 1.10 times as likely to want to build the new tie. In addition, latent relational value of a tie also had significant impacts on individuals' willingness for further collaboration with new partners. Reliance-based trust (b = 1.28, p < 0.001) and disclosure-based trust (b = 0.68, p = 0.003) in a potential new workflow relationship partner were both positively associated with focal employees' desire for further collaboration with the person.

Hypothesis 3 predicted that expanding the relationship with the bottlenecking other will be the more dominant approach taken by employees compared to forming a new tie to detour around the bottlenecking individual. I found partial support to this hypothesis. The results showed that individuals preferred the bypassing approach over the tie strengthening strategy in terms of overcoming their workflow dependencies by managing disadvantageous structural holes (Model 9 in Table 6). The latent structural value of a tie motivated employees to strengthen the tie (b = 0.07, p < 0.001) or newly build the relationship (b = 0.04, p < 0.001) in general, and furthermore, the comparison between the two strategies showed that the relative probability of wishing to strengthen an existing tie was significantly *lower* than the probability of wishing to building a new tie as the tie's latent structural value increases (b = -0.12, p < 0.001). On the other hand, employees were more likely to choose the tie strengthening approach than the bypassing strategy when they trusted the bottlenecking person's task-related competence. Consistent with the findings from LRQAP analyses, the latent relational value of a tie encouraged employees to strengthen the tie (b = 3.14, p < 0.001) or form the new tie (b = 0.99, p < 0.001) in general, and the comparison between the two strategies indicated that, when an individual trusted the bottlenecking person's task-related judgments, skills, and abilities, the focal individual was *more* likely to want to strengthen their relationship with the bottlenecking individual than to bypass the person (b = 2.15, p < 0.001). In sum, these results suggest that different strategies for reducing workflow dependencies are driven by different types of latent values of social ties. While the latent structural value of ties motivates individuals to take the bypassing approach and form a new tie to someone further upstream in the workflow

network, latent relational value of ties promoted the tie strengthening approach of deepening the existing relationship with the bottlenecking person.

Table 1. Descriptive Statistics and Quadratic Assignment Procedure Correlations for Hypothesis 1 Predicting Desire for Tie Strengthening[a]

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Desire for tie strengthening	0.32	0.47																		
2. Latent structural value	7.46	9.91	.06																	
3. Latent relational value (reliance-based trust)	0.85	0.36	.13	.06																
4. Latent relational value (disclosure-based trust)	0.30	0.46	.19*	.18*	.20**															
5. Ego's perceived workload	5.39	1.33	-.22*	-.06	-.05	-.05														
6. Alter's perceived workload	5.44	1.22	-.10	.11	.01	.08	.22*													
7. Ego's experienced overcommitment	4.76	1.09	-.08	-.07	.00	-.06	.52***	.01												
8. Alter's experienced overcommitment	4.79	1.13	.01	.08	-.01	.05	.00	.56***	-.02											
9. Ego's job knowledge codification	4.64	1.47	.17	-.10	.08	.08	-.30*	-.18*	-.08	.00										
10. Alter's job knowledge codification	4.50	1.55	.14	.02	.03	.01	-.18*	-.26*	-.04	-.05	.13									
11. Ego's creative self-efficacy	5.89	0.84	-.10	.08	.03	.14	.38*	.10	.25	.00	-.01	-.10								
12. Alter's creative self-efficacy	5.93	0.61	-.04	.09	.01	.10	.14	.35**	.00	.12	-.10	.00	.08							
13. Gender similarity	0.59	0.49	-.01	.06	.01	.14	.02	.04	.00	.00	-.05	-.02	.06	.08						
14. Department membership similarity	0.21	0.41	-.01	.14	.06	.15	-.10	-.04	-.13	-.08	.00	.02	-.05	-.04	.07					
15. Location similarity	0.93	0.26	.03	.13	-.01	.01	-.11	-.07	-.09	-.07	-.06	-.05	-.09	-.04	-.01	.11				
16. Rank dissimilarity	-0.23	1.54	-.14	-.08	-.07	-.11	.19*	-.17	.17	-.17	-.02	.00	.15	-.15	.02	.05	.06			
17. Tenure dissimilarity	-0.74	6.93	-.06	-.04	-.06	-.13	.05	-.08	.08	-.04	.02	.02	-.05	-.05	-.03	.00	.07	.48**		
18. Industry experience dissimilarity	0.24	9.90	-.03	-.10	-.03	-.14	.01	-.05	.01	.02	-.01	.02	.08	-.13	-.02	.01	.01	.37**	.35**	
19. Number of common third parties	25.41	9.74	.03	.12***	.05	.13**	.18**	.20***	.13**	.11*	-.09*	-.06	.03	.12*	.04	-.04	.30***	.02	.05*	-.05*

[a] Number of participants = 141; Number of dyads = 1,418. Only includes the dyads where the ego and the alter have already had an existing workflow relationship.

* $p < .05$; ** $p < .01$; *** $p < .001$; two-tailed tests

Table 2. Logistic Regression Quadratic Assignment Procedure Analyses Predicting Desire for Tie Strengthening[a]

	Model 1			Model 2			Model 3		
	b	Odds ratio	Std err	*b*	Odds ratio	Std err	*b*	Odds ratio	Std err
Control Variables									
Ego's perceived workload	-0.29***	0.75	0.06				-0.25***	0.78	0.06
Alter's perceived workload	-0.09	0.91	0.07				-0.11†	0.89	0.07
Ego's experienced overcommitment	0.12†	1.12	0.07				0.12†	1.13	0.07
Alter's experienced overcommitment	-0.03	0.97	0.07				-0.01	0.99	0.07
Ego's job knowledge codification	0.16**	1.17	0.04				0.13*	1.13	0.05
Alter's job knowledge codification	0.10*	1.10	0.04				0.09*	1.10	0.04
Ego's creative self-efficacy	-0.07	0.94	0.08				-0.19*	0.83	0.08
Alter's creative self-efficacy	0.01	1.01	0.08				-0.03	0.97	0.08
Gender similarity	0.10	1.10	0.12				-0.04	0.97	0.12
Department membership similarity	0.03	1.03	0.15				-0.17	0.84	0.16
Location similarity	-0.11	0.89	0.27				-0.05	0.95	0.28
Rank dissimilarity	-0.25***	0.78	0.05				-0.22***	0.80	0.05
Tenure dissimilarity	0.01	1.01	0.01				0.01	1.01	0.01
Industry experience dissimilarity	0.01	1.01	0.01				0.01†	1.01	0.01
Number of common third parties	0.02**	1.02	0.01				0.02*	1.02	0.01
Independent Variables									
Latent structural value				0.01	1.01	0.01	0.01	1.01	0.01
Latent relational value (reliance-based trust)				0.75	2.11	0.18	0.85**	2.35	0.23
Latent relational value (disclosure-based trust)				0.73	2.07	0.11	0.79***	2.20	0.14
Intercept	-0.56	0.57	0.79	-1.60	0.20	0.17	-0.44	0.64	0.86
Log-likelihood		-831.14			-1031.17			-801.60	
R^2		0.08			0.05			0.11	

[a] Number of participants = 141; Number of dyads = 1,418. Only includes the dyads where the ego and the alter have already had an existing workflow relationship.
† $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$; two-tailed tests

Table 3. Descriptive Statistics and Quadratic Assignment Procedure Correlations for Hypothesis 2 Predicting Desire for Tie Formation[a]

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Desire for tie formation	0.04	0.29																					
2. Latent structural value	9.81	8.98	.04**																				
3. Latent relational value (reliance-based trust)	0.07	0.26	.23***	-.06**																			
4. Latent relational value (disclosure-based trust)	0.01	0.12	.18***	-.06***	.38***																		
5. Ego's perceived workload	5.07	1.33	.00	.23**	.05*	.02																	
6. Alter's perceived workload	5.07	1.34	.01	-.05***	.03**	.02**	-.03***																
7. Ego's experienced overcommitment	4.54	1.20	.02	.20**	.05*	.01	.60***	-.01*															
8. Alter's experienced overcommitment	4.54	1.19	.05***	-.04**	.03*	.01	-.01*	.60***	-.01**														
9. Ego's job knowledge codification	4.57	1.53	.02	.08	.03	.01	-.15*	.02*	.07	.00													
10. Alter's job knowledge codification	4.59	1.52	.01	.01	-.02	-.01	.02**	-.16*	.00	.07	-.02**												
11. Ego's creative self-efficacy	5.78	0.84	.04**	.12	.05*	.04**	.34***	-.01**	.21**	.00	.09	.01											
12. Alter's creative self-efficacy	5.78	0.84	.02	-.03*	.01	.01	-.02**	.34***	.00	.22**	.01	.09	-.02***										
13. Gender similarity	0.47	0.50	.03**	.01	.02*	.05***	.02	.02	.02	.02	.02	.02	.05*	.05*									
14. Department membership similarity	0.04	0.19	.13***	-.10***	.25***	.24***	.00	-.02	-.03*	-.03**	-.03*	-.02*	.02	.01	.07***								
15. Location similarity	0.36	0.48	.16***	-.15***	.30***	.13***	-.01	-.01	-.07*	-.07**	-.06*	-.05	.05	.04	.00	.24***							
16. Rank dissimilarity	0.02	1.46	-.05***	.20**	.04*	-.01	.20**	-.20***	.17**	-.16**	.02	-.02	.17**	-.16**	.00	.00	.02**						
17. Tenure dissimilarity	0.08	-6.04	-.03*	.17**	.02	-.02	.12*	-.11*	.08	-.08	.01	-.02	.06	-.05	.01	.01	.01*	.59***					
18. Industry experience dissimilarity	0.02	11.45	.01	.16**	.01	.00	.05	-.05	.01	-.01	-.09	.09	.16**	-.16**	.00	-.01	-.01	.36***	.34**				
19. Ego's workflow ties	11.16	9.44	.02	.96***	.04*	-.01	.25**	-.02**	.21**	-.01*	.08	.01	.14*	-.01	.02	-.04**	-.01	.19**	.16**	.16**			
20. Alter's workflow ties	11.62	9.86	.03**	-.12***	.04***	.02*	-.02*	.25**	.00	.21**	.01	.09	-.01	.11	.02	-.02	.04	-.18**	-.15*	-.14*	-.04***		
21. Workflow geodesic distance	3.15	1.12	-.12***	-.13***	-.21***	-.08***	-.09*	-.17**	-.04	-.14**	.00	.06	-.10*	-.08	.00	-.11***	-.38***	.06	.06	-.07	-.25***	-.17***	
22. Number of common third parties	7.53	9.29	.20***	-.06*	.45***	.20***	.11***	.10**	.07*	.06*	-.03	-.01	.08**	.07*	.03	.24***	.73***	.03**	.03**	.00	.15***	.22***	-.51***

[a] Number of participants = 141; Number of dyads = 15,094. Only includes the dyads where the ego and the alter have not had an existing workflow relationship.
* $p < .05$; ** $p < .01$; *** $p < .001$; two-tailed tests

Table 4. Logistic Regression Quadratic Assignment Procedure Analyses Predicting Desire for Tie Formation[a]

	Model 4			Model 5			Model 6		
	b	Odds ratio	Std err	*b*	Odds ratio	Std err	*b*	Odds ratio	Std err
Control Variables									
Ego's perceived workload	-0.21†	0.81	0.06				-0.16	0.85	0.06
Alter's perceived workload	-0.25**	0.78	0.06				-0.26†	0.77	0.06
Ego's experienced overcommitment	0.25*	1.28	0.06				0.21	1.23	0.07
Alter's experienced overcommitment	0.34**	1.40	0.07				0.35*	1.41	0.07
Ego's job knowledge codification	0.14†	1.15	0.04				0.11	1.11	0.04
Alter's job knowledge codification	0.04	1.04	0.04				0.05	1.05	0.04
Ego's creative self-efficacy	0.38*	1.46	0.08				0.36	1.43	0.08
Alter's creative self-efficacy	0.00	1.00	0.00				0.02	1.03	0.08
Gender similarity	0.36**	1.44	0.12				0.31†	1.36	0.12
Department membership similarity	0.96***	2.61	0.16				0.44*	1.56	0.17
Location similarity	1.04**	2.82	0.22				1.07*	2.92	0.23
Rank dissimilarity	-0.40***	0.67	0.05				-0.43**	0.65	0.05
Tenure dissimilarity	0.02	1.02	0.01				0.02	1.02	0.01
Industry experience dissimilarity	0.02*	1.02	0.01				0.02	1.02	0.01
Ego's workflow ties	-0.01	0.99	0.01				0.08*	1.08	0.02
Alter's workflow ties	-0.01	0.99	0.01				-0.02	0.98	0.01
Workflow geodesic distance	-1.83**	0.16	0.40				-1.43*	0.24	0.42
(Workflow geodesic distance)^2	0.18*	1.19	0.05				0.13	1.14	0.05
Number of common third parties	0.05***	1.05	0.01				0.01	1.01	0.01
Independent Variables									
Latent structural value				0.02	1.02	0.01	0.10**	1.10	0.02
Latent relational value (reliance-based trust)				2.32***	10.16	0.12	1.28***	3.58	0.15
Latent relational value (disclosure-based trust)				0.98***	2.67	0.18	0.68**	1.97	0.21
Intercept	-5.43	0.00	1.03	-4.10	0.02	0.09	-5.83	0.00	1.08
Log-likelihood		-1218.91			-1711.97			-1155.50	
R^2		0.08			0.07			0.11	

[a] Number of participants = 141; Number of dyads = 15,094. Only includes the dyads where the ego and the alter have not had an existing workflow relationship.
$^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; two-tailed tests

Table 5. Descriptive Statistics and Correlations for Hypothesis 3 Predicting Individuals' Relative Preference between Tie Strengthening and Tie Formation

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Desire for tie strengthening and formation	0.07	0.32																		
2. Latent structural value	8.34	10.27	-.14***																	
3. Latent relational value (reliance-based trust)	0.14	0.35	.33***	-.33***																
4. Latent relational value (disclosure-based trust)	0.04	0.19	.25***	-.19***	.46***															
5. Ego's perceived workload	5.10	1.34	-.01	.15***	.06***	.03***														
6. Alter's perceived workload	5.10	1.34	.02*	-.07***	.07***	.06***	-.01													
7. Ego's experienced overcommitment	4.56	1.19	.02**	.13***	.07***	.02**	.60***	.00												
8. Alter's experienced overcommitment	4.56	1.19	.05***	-.05***	.05***	.04***	.00	.60***	-.01											
9. Ego's job knowledge codification	4.58	1.53	.05***	.04***	.04***	.03***	-.16***	.00	.06***	.00										
10. Alter's job knowledge codification	4.58	1.53	.03***	.01	-.01	-.01	.00	-.16***	.00	.06***	-.01									
11. Ego's creative self-efficacy	5.79	0.84	.02**	.09***	.05***	.06***	.35***	.00	.23***	.00	.05***	.00								
12. Alter's creative self-efficacy	5.79	0.84	.02**	-.03***	.04***	.05***	.00	.35***	.00	.23***	.00	.05***	-.01							
13. Gender similarity	0.48	0.50	.04***	-.01	.05***	.09***	.03***	.03***	.02*	.02*	.02**	.02**	.05***	.05***						
14. Department membership similarity	0.05	0.22	.15***	-.15***	.29***	.26***	-.01	-.01	-.02*	-.02*	-.01	-.01	.01	.01	.06***					
15. Location similarity	0.41	0.49	.21***	-.27***	.42***	.22***	.00	.00	-.05***	-.05***	-.03***	-.03***	.04***	.04***	.01	.26***				
16. Rank dissimilarity	0.00	1.47	-.08***	.18***	-.01	-.05***	.19***	-.19***	.16***	-.16***	.01	-.01	.17***	-.17***	.00	.00	.00			
17. Tenure dissimilarity	0.00	6.07	-.04***	.13***	.00	-.05***	.10***	-.10***	.05***	-.05***	.01	-.01	.07***	-.07***	.00	.00	.00	.61***		
18. Industry experience dissimilarity	0.00	11.31	.01	.11***	.01	-.02*	.04***	-.04***	-.03***	.03***	-.08***	.08***	.14***	-.14***	.00	.00	.00	.36***	.32***	
19. Number of common third parties	9.07	10.60	.26***	-.25***	.57***	.32***	.14***	.14***	.09***	.09***	-.02**	-.02**	.08***	.08***	.05***	.26***	.73***	-.00	-.00	-.00

[a] Number of participants = 141. Number of dyads = 16,512.
* $p < .05$; ** $p < .01$; *** $p < .001$; two-tailed tests

Table 6. Multinomial Logistic Regression Analyses Predicting Individuals' Relative Preference between Tie Strengthening and Tie Formation[a]

	Model 7			Model 8			Model 9		
	b	Odds ratio	Std err	*b*	Odds ratio	Std err	*b*	Odds ratio	Std err
Desire for tie strengthening vs. no desire for further collaboration									
Control Variables									
Ego's perceived workload	-0.25***	0.78	0.05				-0.26***	0.77	0.06
Alter's perceived workload	-0.12†	0.89	0.05				-0.11†	0.89	0.06
Ego's experienced overcommitment	0.22***	1.24	0.06				0.16*	1.17	0.06
Alter's experienced overcommitment	0.09	1.09	0.06				0.09	1.10	0.07
Ego's job knowledge codification	0.21***	1.24	0.04				0.07†	1.08	0.04
Alter's job knowledge codification	0.06†	1.06	0.04				0.11**	1.12	0.04
Ego's creative self-efficacy	-0.08	0.93	0.07				-0.08	0.92	0.08
Alter's creative self-efficacy	0.01	1.01	0.07				0.02	1.02	0.08
Gender similarity	0.30**	1.35	0.10				0.09	1.09	0.12
Department membership similarity	0.73***	2.07	0.13				0.01	1.01	0.15
Location similarity	1.48***	4.39	0.24				0.78**	2.19	0.27
Rank dissimilarity	-0.38***	0.68	0.04				-0.33***	0.72	0.05
Tenure dissimilarity	0.01	1.01	0.01				0.01	1.01	0.01
Industry experience dissimilarity	0.02**	1.02	0.01				0.01†	1.01	0.01
Number of common third parties	0.10***	1.10	0.01				0.03***	1.03	0.01
Independent Variables									
Latent structural value				0.07***	1.07	0.00	0.07***	0.93	0.01
Latent relational value (reliance-based trust)				3.46***	31.82	0.17	3.14***	23.19	0.24
Latent relational value (disclosure-based trust)				1.27***	3.55	0.11	1.20***	3.32	0.13
Intercept	-7.06***	0.00	0.62	-5.47***	0.00	0.15	-6.50***	0.00	0.75
Desire for tie formation vs. no desire for further collaboration									
Control Variables									
Ego's perceived workload	-0.20***	0.82	0.06				-0.23***	0.80	0.06
Alter's perceived workload	-0.26***	0.77	0.06				-0.26***	0.77	0.06
Ego's experienced overcommitment	0.22***	1.25	0.06				0.20**	1.22	0.06
Alter's experienced overcommitment	0.33***	1.39	0.07				0.35***	1.42	0.07
Ego's job knowledge codification	0.14***	1.16	0.04				0.12**	1.13	0.04
Alter's job knowledge codification	0.05	1.05	0.04				0.05	1.05	0.04
Ego's creative self-efficacy	0.40***	1.49	0.08				0.39***	1.48	0.08
Alter's creative self-efficacy	0.00	1.00	0.08				-0.02	0.98	0.08
Gender similarity	0.32**	1.38	0.12				0.29*	1.33	0.12
Department membership similarity	0.84***	2.32	0.15				0.68***	1.97	0.16
Location similarity	1.49***	4.42	0.21				1.71***	5.52	0.21
Rank dissimilarity	-0.42***	0.66	0.05				-0.46***	0.63	0.05
Tenure dissimilarity	0.01	1.02	0.01				0.02	1.02	0.01
Industry experience dissimilarity	0.02***	1.02	0.01				0.02***	1.02	0.01
Number of common third parties	0.05***	1.05	0.01				0.03***	1.03	0.01
Independent Variables									
Latent structural value				0.02***	1.02	0.00	0.04***	1.04	0.01
Latent relational value (reliance-based trust)				1.92***	6.83	0.12	0.99***	2.70	0.15
Latent relational value (disclosure-based trust)				0.69***	1.99	0.16	0.28	1.33	0.19
Intercept	-9.36***	0.00	0.71	-4.52***	0.01	0.09	-9.55***	0.00	0.73

Table 6. Multinomial Logistic Regression Analyses Predicting Individuals' Relative Preference between Tie Strengthening and Tie Formation[a] (Continued)

	Model 7			Model 8			Model 9		
	b	Odds ratio	Std err	*b*	Odds ratio	Std err	*b*	Odds ratio	Std err
	Desire for tie strengthening vs. desire for tie formation								
Control Variables									
Ego's perceived workload	-0.04	0.96	0.07				-0.04	0.96	0.08
Alter's perceived workload	0.14†	1.15	0.08				0.14†	1.15	0.08
Ego's experienced overcommitment	0.00	1.00	0.08				-0.04	0.96	0.09
Alter's experienced overcommitment	-0.24**	0.79	0.08				-0.26**	0.77	0.09
Ego's job knowledge codification	0.07	1.07	0.05				-0.05	0.95	0.05
Alter's job knowledge codification	0.01	1.01	0.05				0.06	1.06	0.05
Ego's creative self-efficacy	-0.48***	0.62	0.10				-0.48***	0.62	0.11
Alter's creative self-efficacy	0.01	1.01	0.10				0.04	1.04	0.11
Gender similarity	-0.02	0.98	0.15				-0.20	0.82	0.16
Department membership similarity	-0.12	0.89	0.19				-0.67**	0.51	0.20
Location similarity	-0.01	0.99	0.31				-0.93**	0.40	0.34
Rank dissimilarity	0.04	1.04	0.06				0.13†	1.13	0.07
Tenure dissimilarity	0.00	1.00	0.01				0.00	1.00	0.02
Industry experience dissimilarity	0.00	1.00	0.01				-0.01	0.99	0.01
Number of common third parties	0.05***	1.05	0.01				0.00	1.00	0.01
Independent Variables									
Latent structural value				-0.09***	0.92	0.01	-0.12***	0.89	0.01
Latent relational value (reliance-based trust)				1.54***	4.67	0.21	2.15***	8.59	0.27
Latent relational value (disclosure-based trust)				0.58**	1.79	0.18	0.92***	2.50	0.21
Intercept	2.30*	10.02	0.91	-1.00***	0.38	0.18	3.05**	21.13	1.00
Log-likelihood		-2864.50			-3249.33			-2060.06	
Model chi-square		1790.44***			2540.52***			2473.63***	

[a] Number of participants = 141. Number of dyads = 16,512.
† $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$; two-tailed tests

CHAPTER 5. POST-HOC ANALYSES

In addition to counting the number of structural holes closed, I tested the effects of network constraint (Burt, 1992) as an alternative measure of the latent structural value of ties. The logic behind using network constraint is that simply counting the number of structural holes that will be eliminated by forming a new tie or dissolving an existing tie does not account for potential differences in the relative importance of each structural hole to ego. For example, while ego forming new ties to Person A and Person B can close an equal number of structural holes, the tie to Person A might close more critical holes that are more constraining for ego. To address this, I estimated the potential change in ego's network constraint if a tie is newly formed or dissolved. Following the same analytical approaches in the main analyses, I measured the *potential change in one's network constraint if ego dissolves the tie* in the model predicting individuals' desire for strengthening their existing ties. An existing tie has greater latent structural value to the extent that dissolving the tie reduces the focal individual's network constraint. For the model predicting individuals' desire for building new social ties, I assessed the *potential change in network constraint that will be caused if the focal individual adds the tie*. A new tie similarly has greater latent structural value to the extent that forming the tie reduces the focal individual's network constraint.

The results showed that the potential change in an individual's network constraint did *not* have significant effects on individuals' desire greater collaboration with others. Neither the latent structural value of new ties (b = 1.68, p = 0.488), nor the latent structural value of existing ties (b = -0.66, p = 0.140) measured by potential change in the focal individual's network constraint were significantly associated with individuals' desire for

further collaboration. One plausible explanation is that individuals do not recognize or pay much attention to the structural underpinning of each structural hole *vis a vis* their entire egocentric network when they attempt to strengthen or build their social relationships. Instead, their view might only be at the dyadic or triadic level, but fail to account for how these dyads or triads fit into their broader portfolio of social ties. Employees might have only limited knowledge of the social network around them, and as a result, fail to make the most rational decisions in terms of reducing workflow dependencies.

In a second set of post-hoc analyses, I further delved into the question of whether there might be situational factors that might limit individuals' choices for building new ties or bypassing bottlenecking individuals. In my main analyses, I have assumed that both tie strengthening and bypassing strategies are available to employees, but this might not always be the case. For example, it would not be very helpful to detour around a bottlenecking individual and form a new tie to someone further upstream in the workflow network if the bottlenecking person has unique, non-redundant skills required to transform certain work inputs. This might occur if, for example, a fabricator is waiting on an architect's renderings to begin to move forward. Because the focal employee does not have the abilities to transform the inputs for oneself, that individual cannot take the bypassing approach to reduce workflow dependency, and expanding the relationship with the bottlenecking person would be the only viable way to secure reliable supplies of work inputs. Testing the interactive effects of ego's and alter's co-membership in a department and the latent structural value of the tie between them can suggest a preliminary answer to this question. Because the sample organization has a highly-specialized functional structure, it is very likely that employees in the same department possess common

knowledge and skills, while those in different departments do not. Thus, when an employee and the bottlenecking individual are in the same department, the focal employee might be less likely to take the tie strengthening strategy because the bypassing strategy is also available to him/her, as the focal employee has similar skills as the bottlenecking individual needed to process work inputs for oneself. Following the same reasoning, department co-membership with a potential new partner further upstream in the workflow network will strengthen the focal individual's motivation to use the bypassing approach. When an employee and the source of work inputs are in the same functional department, it is likely that the focal individual would possess the necessary knowledge to process the work inputs for himself/herself without relying on the bottlenecking individual.

The results testing this interaction, however, did not provide support to my predictions. The interaction between ego's and the bottlenecking alter's department co-membership and the latent structural value of the tie, while in the right direction, had only a marginally significant effect on the focal employee's use of the tie strengthening strategy (b = -0.02, p = 0.093). Also, the interaction between ego's and a potential new alter's department co-membership and the latent structural value of the tie did not affect the focal individual's use of the bypassing strategy (b = 0.01; p = 0.332).

Similar to the situation described above, employees might also be more willing to engage in the bypassing tactic when the bottlenecking individual and the potential new partner themselves are in the same functional department (even if that department is different than ego's department). As the focal individual has already been interacting previously with the bottlenecking person, it might be easier for the focal employee to process inputs received from an alternative partner in the same department as the existing

partner. To test this possibility, I examined the interaction between the size of the bottlenecking individual's department, which represents the number of potential substitute partners, and the latent structural value of the tie to the bottlenecking person. The focal employee would be less likely to employ the tie strengthening strategy when the existing partner has many teammates, because there are more alternative sources of work inputs to whom the focal individual can build a new tie. Once again, however, the results did not support this prediction; employees were not significantly less willing to use the tie strengthening approach even when the bottlenecking person had many teammates (b = 0.01, p = 0.112).

A possible explanation for these unexpected null results is that I used department membership as a proxy for the uniqueness of employees' skills. Although I assumed that employees in the same department would possess common knowledge and skills given the functional structure of the sample organization, department co-membership might be an imperfect reflection of the actual similarity among employees' skills. Therefore, future studies assessing individuals' actual skillsets and examining the effects of their uniqueness would allow more rigorous testing of the predictions.

In a third set of post-hoc analyses, I examined interactive effects between objective and subjective measures of the extent to which an employee is bottlenecking in the workflow network on dependent individuals' desire for tie strengthening and bypassing with regard to the focal bottlenecking person. While the network metrics used in the main analyses capture how much an individual's position in the workflow network is bottlenecking the flow of work inputs objectively, it is limited in measuring the individual's subjective experience of occupying the bottlenecking position. For example,

even if an employee is exchanging work inputs with many others, the "bottlenecking" individual might not perceive themselves to be actually bottlenecking the workflow because they see themselves as processing work inputs efficiently, and as a result, might not feel overcommitted or perceive that his/her job is overloading. Also, even if building a new tie would reduce one's dependency on a bottlenecking person, if a potential new partner is also feeling overcommitted, that might not solve the underlying problem. Under such situations, dependent employees who are constrained by bottlenecking others would not have a strong desire to reduce their dependency on him/her by strengthening their relationship with the person or bypassing and reaching out to someone in the further upstream in the workflow network.

To explore this possibility, I investigated whether the relationship between a tie's latent structural value and individuals' desire for tie strengthening and bypassing becomes stronger when the bottlenecking employee feels overcommitted or when the person's perceived workload is high. The results examining these interactions, however, did not support my predictions. In predicting individuals' desire to strengthen their existing relationships with bottlenecking others, neither the bottlenecking alter's subjective feeling of being overcommitted (b = -0.000, p = 0.50), nor the alter's perceived workload (b = 0.005, p = 0.19) had significant interactive effects with the ties' latent structural value. In addition, a potential new partner's feeling of being overcommitted (b = -0.004, p = 0.30) and perceived workload (b = -0.009, p = 0.104) also did not have significant interactive effects with the tie's latent structural value. These results, taken together with the findings from the main analyses, indicate that (a) individuals' desire to strengthen an existing tie is driven solely by the tie's latent relational value (i.e., ego's trust in the alter) and not by the

objective nor subjective measures of how the person is bottlenecking the workflow; and (b) individuals' desire to form a new tie to bypass bottlenecking others is influenced both by the tie's objective contribution to closing disadvantageous structural holes in the workflow network and by the alter's subjective feelings of overcommitment and perceived workload, but these effects do not interact multiplicatively to affect the focal individuals' desire for tie formation.

In the next post-hoc analysis, I explored an alternative strategy that employees can use to reduce their reliance on bottlenecking individuals – reaching out to others who are structurally equivalent to the bottlenecking others. Two individuals are structurally equivalent when they are connected to the same set of third parties (Borgatti et al., 2013). Structurally equivalent individuals play a similar role in a network, and thus are substitutable, because they exchange resources with the same other individuals. In the context of a workflow network, for example, when two employees receive work inputs from the same set of individuals, they can be considered as indistinguishable actors who possess equivalent work resources. Therefore, when an employee is highly constrained by a bottlenecking person in a workflow network, reaching out to someone who is structurally equivalent to the bottlenecking person can be an effective way to reduce one's workflow dependencies. Indeed, this variant of the bypassing strategy (i.e., the substitute bypassing strategy) might be more effective than reaching out to someone further upstream in the workflow network (i.e., the upstream bypassing strategy) because focal individuals can process the work inputs more easily as the new collaboration partners are similar to their existing workflow interaction partners.

To examine this possibility, I investigated whether an employee is more willing to

newly collaborate with an individual when the potential new partner is structurally equivalent to his/her existing work input providers. Specifically, I measured the *overall level of structural equivalence between a potential new collaboration partner and ego's every existing bottlenecking other* by the sum of profile correlations between them. For a given potential collaboration partner (*j*), his/her profile correlations with the ego's (*i*'s) all bottlenecking others (*k*s) were calculated from the workflow network. Higher profile correlation means that two individuals are receiving work inputs from a similar set of other employees in the organization, and thus, are more structurally equivalent. Then, the potential collaboration partner's overall structural equivalence score was generated by summing up the profile correlations; the higher the score is, the more structurally equivalent the potential partner is to ego's every bottlenecking other in general. The overall structural equivalence scores were then used to predict the ego's desire to collaborate with the potential partner in an LRQAP model. The results indicated that individuals were more willing to form a new collaboration tie to someone when the potential partner was more structurally equivalent to bottlenecking others ($b = 0.32$, $p = 0.001$). This finding suggests that employees were, in fact, using another form of bypassing (i.e., substitute bypassing) to reduce their dependence on bottlenecking individuals in the workflow network, which is to seek alternative sources of work inputs who can provide the similar resources to them.

Lastly, I checked the robustness of my findings regarding Hypothesis 2 by implementing a different analytical approach. Specifically, I used exponential random graph modeling (ERGM, Lusher et al., 2013) and investigated whether the results from the main analyses remain unchanged. ERGM has been utilized increasingly to examine dyadic level phenomena in social networks, such as tie formation. Similar to the QAP approach,

ERGM predicts the occurrence of network ties as the dependent variable while accounting for tie interdependence in network data. However, while QAP is a dyadic model that predicts a specific tie's formation or strength as a function of other dyadic variables of the tie of interest, ERGM is a whole network model that characterizes the overall pattern of the entire network as the result of a combination of micro-processes at the dyadic or higher levels (Lomi et al., 2014). In this study, ERGM was used to estimate the likelihood of individuals' desire to collaborate more intensely with their existing or new partners in the workflow network as a function of the network patterns related to various individual attributes (e.g., department) and network-endogenous patterns that accounts for tie interdependence (e.g., reciprocity).

More precisely, I used a bivariate approach to examine the workflow and desired collaboration networks simultaneously. While the main goal of the univariate approach is to investigate how a tie's occurrence is influenced by certain patterns of other ties in the same network, the bivariate approach allows researchers to analyze tie multiplexity and test whether a tie's occurrence in Network 1 can be predicted by certain structures of the ties in Network 2. Bivariate ERGM was used in this study to test whether certain structural patterns in the workflow network influences individuals' desired collaboration. In addition to the variables used in the main LRQAP analyses, a few other configurations were included in the bivariate ERGM model following ERGM specifications introduced by Snijders et al. (2006), including alternating in- and out-stars and alternating triangles. The significance of the parameter estimates was tested using a *t*-ratio (the estimated parameter divided by its standard error). Convergence of the estimation model was checked by ensuring that the absolute values of the "*t*-ratios for convergence" were less than 0.10

(Robins et al., 2007). Once the model converged, the model's Goodness of Fit (GOF) was assessed through simulation of the networks with the estimated parameters. Specifically, 1 million networks were simulated from the converged model, and then, a random sample of 1,000 simulated networks among them were compared to the observed network's characteristics. The deviations between observed and average simulated statistics, divided by the standard deviation of the simulated values, were used as the GOF statistics. The converged model is considered to have an acceptable level of GOF when all parameters not explicitly included in the model have GOF statistics less than 2 in absolute value (Robins et al., 2009). I used the bivariate XPNet program for model estimation (Wang et al., 2009).

Unfortunately, Hypothesis 1 could not be tested using the bivariate ERGM approach. The hypothesis suggested that individuals would be more likely to wish to collaborate further with their interaction partners in the required workflow network when there have already been trusting relationships between them. While examining this prediction requires taking three networks (i.e., workflow, trust, and desired collaboration networks) into account simultaneously, XPNet program allows only a bivariate model with two networks, and thus, cannot test the hypothesis directly. However, I conducted a preliminary analysis on Hypothesis 1 by testing whether an individual wished to collaborate with someone more intensely if the other party was providing required work inputs to the focal individual.

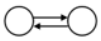
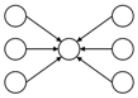
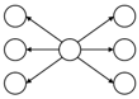
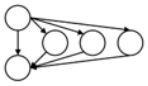
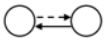
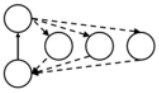
Table 7 demonstrates the results of the converged model from the bivariate ERGM analysis. An inspection of GOF statistics revealed that the values for five parameters exceed the recommended threshold of 2 in absolute value, indicating that these

characteristics of the network cannot be reproduced accurately based on the model. However, as emphasized by Robins and Lusher (2013), it cannot be expected that an ERGM fits all characteristics of an observed network, just as a regression model cannot be expected to explain 100 percent of the variance. The results supported Hypothesis 2, indicating that individuals were more likely to wish to build new collaboration relationship with someone when doing so closes disadvantageous structural holes in their required workflow network. When choosing their new collaboration partners, employees tended to have a stronger desire for more intense collaboration with someone if the new tie closes more structural holes (0.31, $p < 0.001$). The results also provided preliminary support to Hypothesis 1. The model showed that individuals were more likely to desire more intense collaboration with someone when they were receiving necessary work inputs from the other party (1.06, $p < .001$). In sum, the results of the LRQAP analyses were consistent with those in the bivariate ERGM, suggesting that the findings are robust. Individuals intended to reduce their workflow dependencies on others either by strengthening their relationships with the bottlenecking others or bypassing the bottlenecking people.

Table 7. Bivariate Exponential Random Graph Model Predicting Desired Collaboration Ties[a]

Parameter	Visualization	Estimate	Std. err.	Included to account for
Individual-Attribute Patterns				Tendency for individuals with a specific attribute to nominate others or to be nominated by others as desired collaboration partners
Ego's perceived workload		-0.06	0.03	
Alter's perceived workload		0.02	0.04	
Ego's experienced overcommitment		0.01	0.04	
Alter's experienced overcommitment		0.09*	0.04	
Ego's job knowledge codification		0.06**	0.02	
Alter's job knowledge codification		0.04	0.02	
Ego's creative self-efficacy		-0.03	0.05	
Alter's creative self-efficacy		0.03	0.05	
Tenure dissimilarity		0.03***	0.01	
Industry experience dissimilarity		0.00	0.01	
Gender similarity		0.03	0.08	
Department membership similarity		0.28*	0.12	
Location similarity		0.67***	0.16	
Rank dissimilarity		0.28***	0.08	
Ego's workflow ties		-0.01***	0.00	
Alter's workflow ties		-0.01*	0.00	
Dyadic Attribute Covariates				Tendency for desired collaboration ties to occur between individuals if a dyadic attribute is present
Reliance-based trust		1.21***	0.12	
Disclosure-based trust		0.68***	0.11	
Number of common third parties		-0.02***	0.01	

Table 7. Bivariate Exponential Random Graph Model Predicting Desired Collaboration Ties[a] (Continued)

Parameter	Visualization	Estimate	Std. err.	Included to account for
Network-Endogenous Patterns				
Arc (Arc-B)		-7.32***	0.50	Baseline tendency for desired collaboration ties to occur
Reciprocity (Reciprocity-B)		-0.40*	0.16	Tendency to reciprocate desired collaboration ties
In-ties spread (In-AS-B)		0.17	0.14	Tendency for variation in the degree to which individuals are nominated as desired collaboration partners
Out-ties spread (Out-AS-B)		0.53***	0.13	Tendency for variation in the degree to which individuals to nominate others as desired collaboration partners
Transitive closure (AKT-TB)		0.88***	0.07	Tendency for triadic closure in the desired collaboration network
Bivariate Relational Patterns				
Reciprocity (Reciprocity AB)		1.06***	0.12	Tendency for individuals to desire more intense collaboration to strengthen their relationship with bottlenecking others
Cyclic desired collaboration closure for two-paths of required workflow ties (AT-C-ABA)		0.31***	0.08	Tendency for individuals to desire more intense collaboration with a new partner to bypass bottlenecking individuals

[a] Dotted lines indicate required workflow ties, and solid lines indicate desired collaboration ties in the graphical representation of the parameters.
* $p < .05$; ** $p < .01$; *** $p < .001$; two-tailed tests

CHAPTER 6. DISCUSSION

Although a formal organizational structure enhances the organization's functioning by standardizing and encouraging communication and accountability among certain individuals, it also introduces ineffectiveness by constraining the natural flow of resources among employees. A major symptom of a formal structure that is not aligned properly with the organization's needs is the development of workflow bottlenecks, which constrain the job performance of employees around them. The current study predicted and found that employees were willing to leverage their informal social relationships to overcome the constraints caused by workflow dependencies in the formal organizational structure. Specifically, individuals were motivated to strengthen existing relationships or build new relationships based on their estimation of the latent value of the social ties in terms of reducing their workflow dependencies. Employees tended to desire more intense collaboration with a constraining existing tie when they trusted the person, because they believed that the partner would provide high-quality work inputs in a reliable manner once a stronger relationship is built (i.e., the tie has greater latent relational value). Building new ties was more likely to happen when it would reduce one's dependencies on others by detouring around the bottlenecking person and closing disadvantageous structural holes (i.e., when a tie has greater latent structural value); thus, the employee became more willing to collaborate more intensely with a new partner to realize the potential structural value of the tie.

Contrary to my prediction, however, the bypassing approach was more prevalent than the tie strengthening approach for reducing workflow dependencies when the structural value of each strategy is considered. While individuals tended to prefer the tie

strengthening approach when they take only the bottlenecking person into account and consider how reliable the person is, they preferred the bypassing approach when they pay attention to a broader workflow network and alternative sources of work inputs. One plausible explanation for this counterintuitive finding is that strengthening the relationship with the bottlenecking individual only ends up worsening the situation. If numerous dependent individuals use the strengthening approach on the same bottlenecking alter, for example, it will only worsen the situation for everyone involved as it puts further pressure on the bottlenecking individual. As a result, individuals might recognize the structural bypassing approach is more viable in the long term in spite of the greater costs involved inherently in this approach.

6.1 Theoretical Contribution

This study extends our understanding of network dynamics by directly examining individuals' motivations for strengthening and forming certain relationships. Although a number of studies have investigated how networks evolve over time (e.g., Ahuja et al., 2012; Burt & Merluzzi, 2016; Davis, 2010; Sasovova et al., 2010; Zaheer & Soda, 2009), researchers tended to infer social actors' motivations behind network changes from simply comparing networks observed at different time points (e.g., Burt, 2002). However, inferring social actors' network change motivations indirectly from observing only the outcomes of a process (i.e., tie formation and strengthening) has limited our knowledge of the complicated mechanisms that led to the observed network evolution. To address this limitation, this study examined the underlying cognitive motivations of individuals who actually engage in tie strengthening and formation. Specifically, I found that individuals

desired to collaborate more closely and frequently with certain others when doing so would reduce their workflow dependencies. This finding suggests that individuals perform implicit estimation of the potential social capital that will be generated from strengthening an existing tie or building a new tie, which influences their intention to change their networks to improve their positions.

The current study contributes to network change literature also by exploring the link between formal and informal social structures. While earlier work in organization theory has recognized the role of both formal and informal organizational elements, later studies have tended to focus on only one or the other aspect of organizations, and the interaction between the two components have been less likely to be examined (McEvily et al., 2014). Previous research on network evolution has not been an exception, and while most scholarly attention has been paid to individuals' attributes (e.g., self-monitoring personality; Sasovova et al., 2010, tertius iungens orientation; Obstfeld, 2005) and natural tendencies (e.g., homophily; McPherson et al., 2001) as the antecedents of changes in informal network structure, less is known about the impacts of formal organizational structure on informal networks (with notable exceptions; see, for example, Gargiulo, 1993). Suggesting a possible answer to this question, this study found that the interpersonal dependencies posed by the organizationally-mandated workflow network motivates individuals to develop their informal social relationships to overcome such constraints. Future research should further explore the relationship between formal and informal organizational structures, especially how the pattern of formal interactions affects the evolution of informal social structures.

6.2 Limitations

This study has several limitations, including using a cross-sectional survey to explore a network change process which is inherently a longitudinal phenomenon. Collecting longitudinal data would expand the findings of the current study by examining whether employees' network change motivations are actually realized, and how such changes affect their workplace outcomes. I also used a traditional multinomial logistic regression analysis to test Hypothesis 3 which required examining the complete profiles of desire for tie strengthening and formation at the same time. Analyzing social networks data using a traditional regression function should be avoided because it violates an important assumption that each observation (i.e., dyad) is independent of one another (Kilduff & Krackhardt, 1994; Krackhardt, 1988). Therefore, the reported results regarding Hypothesis 3 should be taken as suggestive, and future research should test the hypothesis again once a more rigorous dyadic level statistical analysis is developed. Also, the sample organization was a multinational company that operates in three different countries; employees might take different approaches to reduce their workflow dependencies in organizations where the geographic, language, and cultural boundaries are less significant impediments to collaboration.

6.3 Practical Implications

This study's findings carry meaningful practical implications for organizations. While organizations set up a required workflow structure to deal with complicated organizational problems, they tend to overlook the excessive workload and stress experienced by bottlenecking employees and the individuals who depend on them. Lack

of attention to workflow bottlenecks can lead to important individual outcomes that negatively affect the organization's functioning. For example, Soltis et al. (2013) found that employees who are central in the obligated workflow network tend to have stronger turnover intentions. While employees attempt to leverage their informal social relationships to deal with the inadequacies in the required workflow as shown in this study, the organization also should implement formal approaches to mitigate the negative impacts of workflow bottlenecks. For example, organizations need to identify bottlenecks and redesign the workflow to reduce the workload of those employees. They also should closely monitor the bottlenecking individuals and provide formal support, such as additional training to develop skills needed to perform jobs more efficiently.

In addition to this top-down approach to addressing the problem of workflow bottlenecking, the current study also suggests a bottom-up approach that organizations can implement to leverage individual employees' voluntary behavior. This study found that individuals are motivated to use their informal social relationships to reduce their workflow dependencies, especially forming new social ties to someone in the upstream in the formal workflow or substitutable others. In order to facilitate this voluntary mechanism through which bottlenecking problems are alleviated, organizations should utilize tools to surface the bottlenecking problems in the workflow. For example, organizations can implement a communication system where employees can notify others when they are overcommitted and suggest substitutable others to whom dependent individuals can reach out. Such tools might allow the organization to address workflow bottlenecking problems more effectively by letting employees to identify and solve the organizational problem for themselves.

CHAPTER 7. CONCLUSION

The present study demonstrates how workflow bottlenecks are related to individuals' motivation to change their networks. In order to reduce their workflow dependencies, employees take two different strategies: (1) strengthen the relationship with the bottlenecking person to receive work inputs more reliably; and (2) bypass the bottlenecking individual by forming a new relationship with an alternative source of work inputs further upstream in the workflow. Also, in spite of the greater costs of building a new tie, individuals tended to prefer the bypassing approach over the tie strengthening approach. I hope that this study will spur further research into individuals' network change motivations, especially with regard to their relationship with formal organizational structure.

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