

It's Not What You Know, It's Who You Know:

A Meta-Analytic Review of Social Networks

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Abstract

This study uses emerging meta-analytic methods to synthesize empirical studies that examine the correlates of social networks. This study draws upon a database of 208 samples from 88 studies spanning the period of 1975 through 2004. Specifically, the study examines the impact of 43 correlates of networks with an overall sample size of 251,580. Additionally, a multivariate generalized least squares (GLS) moderator analysis indicates that measurement factors and research design considerations in model specification significantly biases the observed effects within a given study. The study identifies surpluses and shortages in the empirical literature regarding the impact of social networks.

Introduction

Numerous studies in marketing, organizational theory, and strategic management have focused on studying the role of social networks within organizations. The network perspective views organizations as a system of objects that are joined together by relationships. These objects, including individuals, teams, and the organization as a whole, can be connected both directly and indirectly via these relationships (Tichy, Tushman and Fombrun 1979). Uncovering the drivers and outcomes associated with the various relationships is the central focus of network research.

Network analysis is unique in that it is able to effectively model significant organizational processes and phenomena at different levels of analysis (Tichy et al 1979). Because of this, the role of networks has been studied quite extensively in several different disciplines. For example, the marketing literature has begun incorporating network variables in the explanation of key marketing phenomena. The role of social networks has been a key variable in modeling marketing exchange relationships at different levels of analysis (See Rindfleisch and Moorman (2001) for a brief overview of these studies). Networks have proven to be very important within the channels literature and have been found as key drivers of channel member behavior in contractual relationships and alliances (Antia and Frazier 2001; Nygaard and Dahlstrom 2002; Wanthe and Heide 2004). Additionally, network connections have proven to foster effective knowledge transfer and necessary resources for new product development (Frels, Shervani and Srivastava 2003; Rindfleisch and Moorman 2001; Sivadas and Dwyer 2000).

Furthermore, organizational theory and strategic management disciplines have primarily focused on the interaction of organizational characteristics and processes in producing key strategic outcomes such as innovation and performance (Ahuja 2000; Burns and Wholey 1993; Ibarra 1993; Powell, Koput and Smith-Doerr 1996). While the focus for this discipline has been on organizational relationships, studies in organizational behavior have primarily focused on the individual. Studies within this area examine intraorganizational networks and their impact on job performance and career development (Collins and Clark 2003; Seibert, Kraimer and Liden 2001; Tsai and Ghoshal 1998).

While the importance of this domain has not gone unnoticed, there seems to be a lack of integration among the different disciplines investigating the role of social networks in firm-level phenomena. To further illustrate this point, scholars have pointed out that while several different disciplines make significant contributions to the conceptual development of the network perspective, these contributions have yet to be synthesized together in order to gain a more complete understanding of the research conducted and conclusions reaching regarding social networks (Grandori and Soda 1995; Fombrun 1982). Thus it becomes difficult to build a strong theoretical understanding of the nature of this phenomenon. Based upon this argument, there is a need to reevaluate and integrate the networks literature in order to account for new developments and advance the current knowledge base of the literature as a whole.

Not only has the network literature itself evolved, so has the meta-analysis methodology. Meta-analysis is a useful approach for creating an overall summary of a research domain, and serves as a systematic way to understand how research design impacts the results obtained in the literature, and to empirically address conflicting findings within the literature. Against this backdrop, the objectives of this article are: (1) to provide an up-to-date synthesis of the empirical literature on social networks including environmental, organizational, individual, and relationship level variables and (2) to aid in the understanding of the impact of network measurement and research design considerations on the empirical findings observed.

Overall Meta-Analysis of the Correlates of Social Networks

The primary objective of a meta-analysis examining correlations is to describe the relationship between independent and dependent variables, or in this case, between social networks and its correlates. However, often there is a substantial amount of heterogeneity present in the actual correlations, suggesting the presence of a moderator variable (Hunter and Schmidt 2004). Then the goal of the meta-analysis is no longer simply to summarize the correlations, but rather becomes a hypothesis-testing tool to examine these moderators (Mathieu and Zajac 1990).

In this study, the procedures for conducting a meta-analysis by Hunter and Schmidt (2004) were followed. Study correlations are open to statistical artifacts, such as sampling error and measurement unreliability. Once these artifacts are controlled for, then a chi-square test should be conducted in order to determine if sufficient variance remains in the results and justifies a search for moderator variables. Without sufficient variance, one can conclude that inconsistent findings are in fact completely explained by statistical artifacts.

Sampling Frame

Only studies that directly measure social networks are included in the meta-analysis. In order to identify these studies, the following procedure based upon Syzmanski, Bharadwaj and Varadarajan (1993) was used: (1) search of online bibliographic databases (ABI Inform Complete, UMI Dissertation Database, and Business Source Premier) using key words that referred to social networks, (2) manual search of management and marketing journals covering the period from January 1975 to May 2004 for studies on social networks¹, (3) references used in studies found in steps 1 and 2, and (4) authors that have studied networks in the past were contacted for working papers on the topic.

¹ Management (*Administrative Science Quarterly, Academy of Management Journal, Journal of Management, Management Science, Organization Science, Strategic Management Journal*); Marketing (*Journal of the Academy of Marketing Science, Journal of Marketing, Journal of Marketing Research*)

Sample Characteristics

Overall, a database of eighty-eight empirical studies, including two hundred and eight samples, measuring social networks was analyzed in this meta-analysis. The average sample size ranged from a high of 84,672 to a low of 15 with a mean of 1209.52 and standard deviation of 8,278.24. The sample size for the meta-analysis across all studies was 251,580 observations. Primary data was analyzed in one hundred forty-two studies, while fifty-five studies utilized secondary data to examine the impact of social networks. Seventy-two studies examined networks in a manufacturing context and seventy-four in service industries. Sixty-two studies aggregated network scores across multiple industries for the analysis. One hundred and thirty-four of the studies were cross sectional in nature while only seventy-four utilized a longitudinal research design. One hundred and sixty-four samples examined social networks with a sample from the U.S., while forty-four samples were based on international data. Several other study characteristics were also taken into account. Interorganizational network ties were the focus of one hundred and five samples and interorganizational ties accounted for one hundred and one samples. Seventy-two samples examined direct network ties, three samples focused only on indirect ties, and the remaining one hundred and thirty-three samples studied both direct and indirect ties.

Several different measures of network ties were also taken into account (See Table 1 for a description of network measures). Forty-eight samples used a measure of network size to examine social networks. Thirty-eight samples used *in-degree* centralization to measure networks, while eleven samples used *betweenness* centrality and nine samples used *closeness* centrality. *Strength of ties* was used as the network measure for thirty-one samples. Network *density* was explored in twenty-one samples and a *dichotomous* measure of network ties comprised eight samples included in the analysis. *Structural holes* were examined in four samples, while thirteen samples focused on network *diversity*. *Distance* was measured in thirteen samples and network *status* comprised five samples. Finally, a *Likert* scale was used in seven samples to access the network variable.

In addition, several studies distinguished among the relational content of the network ties. Five samples examined R&D ties in isolation, while one sample focused on non R&D ties. Sixteen samples examined work

information ties, while twenty-seven samples studied personal or friendship ties. Fourteen samples examined advice networks and three samples looked at adversarial ties.

[Insert Table 1]

Meta-Analysis Procedure

We followed the meta-analytical procedure as set forth by Hunter and Schmidt (2004). We first corrected each correlation for attenuation using the reliabilities reported for each measure, where reliability information is available². After the correlations are corrected for attenuation, the estimated true correlation (r_t) between each independent variable and the network construct is calculated. In order to calculate the mean r_t , each corrected correlation for a given study is weighted by the sample size and averaged across respondents and studies. The next step is to calculate the estimated population standard deviation (s_p^2) and finally, a chi-square statistic that allows for the assessment of the heterogeneity across the studies after correcting for statistical artifacts (Hunter and Schmidt 2004). A significant chi-square indicates the presence of moderator variables. It is also necessary to compute the 95% confidence interval around the mean correlations corrected for measurement and sampling errors. Moreover, a fail-safe N is calculated for each variable studied in order to assess the possibility of publication bias or the “file-drawer” problem in the analysis. This information given in the last column of Table 2 indicates the number of other studies that would have to be included in the analyses in order to change the correlation to $r < 0.01$, yielding confidence in the results of the meta-analysis (Hunter and Schmidt 2004).

[Insert Table 2]

Results from Overall Analysis

A summary of the meta-analysis is presented in Table 2. The antecedents of the network variables can be broadly grouped into Environmental, Organizational Capabilities, Organizational Demographics, Individual and Relational variables. Table 2 also provides a description of the effect size of the relationships between the antecedent variables and networks in accordance with the guidelines set forth by Cohen and Cohen (1983),

² Corrected $r_x = \text{uncorrected } r_{xy} \times \text{reliability } x \times \text{reliability } y$. We corrected for measurement error using Hunter and Schmidt's (2004) artifactual distribution approach, since Cronbach alpha values were not available in every study.

where correlations less than 0.10 are considered to be small, correlations ranging from 0.10 to 0.30 are medium, and correlations greater than 0.30 are large. The consequences, or outcomes of network variables, have been categorized into two types: (1) intermediate outcomes and (2) performance outcomes. Classifying variables as either antecedents or consequences provides a useful means for discussing the results (Mathieu and Zajac 1990)

³. The overall meta-analysis results are summarized in Figure 1.

[Insert Figure 1]

Environmental Factors. Overall findings indicate that both competition and market growth do not have a significant relationship with networks. However, environmental turbulence has a significant positive relationship with social networks. This finding suggests that when the environment is changing rapidly, organizations and individuals rely upon information from their network connections as a means of safeguarding against uncertainty.

Organizational Capabilities. The resource-based view of the firm argues that organizational capabilities provide the stimulus necessary to achieve a competitive advantage in the marketplace (Barney 1991). One potential mechanism through which superior performance can be obtained is through superior information. Therefore, it is expected that organizational capabilities will be related to network ties. Overall results suggest that an organization's emphasis on network building has the strongest relationship with network ties. In addition, dependence, product breadth, domain expertise, reputation, research/product development and resource levels are all positively related to social networks. Board composition, liquidity, and past performance have a negatively relationship with network variables.

Organizational Demographics. Organizational demographics are often collected as controls in network studies and are important to consider when examining the impact of social networks. The results of the overall analysis suggest that both organizational age, past experience, and size have a strong positive relationship with network variables. In addition, education level, tenure, gender, race, and cosmopolitanism are positively correlated with

³ Several variables included in the analysis (e.g. power, innovation, alliance, prestige, and knowledge) were modeled as both antecedents and consequences of network ties. In determining whether to place these variables in the model as either an antecedent or consequence, we followed the specification of majority of samples studying the variable in question.

network ties. Tenure dissimilarity, or diversity, is the only demographic variable that has a negative relationship with networks. Interestingly, geographic dispersion and an international presence do not yield a significant correlation with network connections.

Individual and Relational Variables. Overall results indicate that both autonomy and role clarity are positive correlates with network connections. Networks are also significantly correlated with relational variables including the presence of an alliance with actors in the network and variables relating to the task in a positive manner. Finally, communication between actors in a network and resource exchange both have a positive relationship with network variables.

Outcomes. The overall analysis supports the positive impact of social networks on both intermediate and performance related outcomes. Networks promote information access, influence, integration, power, and commitment. Additionally, network ties are positively related to financial performance, job performance, sales, and satisfaction. Consistent with expectations, network connections promote innovation through increased access to information that fosters the development of new ideas within an organization. Social networks have the strongest relationship with job performance in an organization and the weakest relationship with financial performance.

Moderator Analysis

As a follow up to the overall meta-analysis, we conducted several tests to check for the presence of moderators in our data set. The first indicator of moderators is to examine whether or not statistical artifacts explain the variance in observed correlations (Hunter and Schmidt 2004). The chi-square test (shown in Table 2) indicates that between-study variance is not due to statistical artifacts in the 43 variables examined, suggesting the presence of moderators of the network-variable relationship.

To examine the impact of moderators on the innovation-variable relationship, a generalized least squares regression (GLS) approach was taken. GLS can overcome the assumption of independence that is necessary in other multivariate analysis techniques. The correlations in this analysis cannot be treated as independent

because each sample in the meta-analysis provided more than one network pairwise correlation. Therefore it is necessary to model within-sample dependencies and in turn safeguard against samples that yielded more information biasing the results. In order to model these dependencies, it was necessary to calculate the block diagonal variance-covariance matrices for each sample and analyze them together in a single analysis (Raudenbush et al 1988). For each sample the variances and covariances were calculated (Becker 1992; Becker and Schram 1994) as:

$$Var(r_{net,x}) = (1 - \rho_{net,x}^2)^2 / n, \quad [11]$$

$$Cov(r_{net,x}, r_{net,y}) = [\frac{1}{2}(2\rho_{x,y} - \rho_{net,x}\rho_{net,y}) * (1 - \rho_{net,x}^2 - \rho_{net,y}^2 - \rho_{x,y}^2) + \rho_{x,y}^3] / n, \quad [12]$$

where $r_{net,x}$ is the sample correlation between network and variable x, $\rho_{net,x}$ is the corresponding population correlation, and n is the sample size. From these calculations, a matrix consisting of variance and covariance values for each sample was constructed (Σ_i), with the full covariance matrix for the meta-analysis denoted as Σ . In order to examine the impact of moderators, the following model was estimated

$$d = X\beta + e, \quad [13]$$

where d is the effect size of the network-correlate relationship, and the parameter β is estimated through GLS estimation. In order to estimate β , the following equation was used

$$\beta^* = (X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}d, \quad [14]$$

with the variance-covariance matrix of β^* being:

$$V_{\beta^*} = (X'\Sigma^{-1}X)^{-1}, \quad [15]$$

Four broad categories of moderators have been identified as critical in meta-analytic studies: (1) measurement method, (2) research context, (3) estimation procedure, and (4) model specification (Assmus, Farley and Lehmann 1984; Capon, Farley and Hoenig 1990; Farley, Lehmann and Sawyer 1995). However, in this study, since the effect size under consideration is the Pearson product moment correlation, it is not affected by either model specification or the estimation procedure. Consequently, we consider four measurement factors: (1) network measure, (2) network type, (3) network data (primary versus secondary), and (4) temporal nature of the data (cross-sectional versus longitudinal). In addition, we examine one research context moderator, namely, industry type. The rationale behind the impact of these moderators is provided in Table 3.

[Insert Table 3]

Moderator Results. The results from the generalized least squares regression are summarized in Table 4.⁴

Overall, the results provide support for our moderator hypotheses. A discussion of specific results follows.

[Insert Table 4]

Network Measure. The primary methods of measurement used in network studies are described in Table 1. With so many different ways of measuring networks, it is difficult to synthesize and interpret the findings of prior research without knowing the exact nature of their measure of the central construct, network connections. It is hypothesized that the network measure employed will significantly impact the correlations observed. In particular, Hypothesis 1 predicts that a dichotomous network measure (or measures bounded by 0 and 1) will exhibit lower effect sizes than samples using other network measures. The parameter estimate for the dichotomous measure is negative ($\beta = -0.475$, $p < 0.001$) thus supporting Hypothesis 1. Therefore we can conclude that dichotomous network measures negatively bias the observed effect size of network relationships. Additionally, the results indicate that the other measures also bias the observed effect sizes of network relationships. For example, measures of network centrality and diversity yield smaller effect sizes than network measures that are continuous in nature ($\beta = -0.075$, $\beta = -0.244$, $p < 0.001$, respectively).

Hypothesis 2 predicts that studies measuring direct network ties or indirect network ties in isolation will yield greater effect sizes than studies that pool direct and indirect ties together. Results support Hypothesis 2 and find that measuring direct and indirect ties in isolation inflates observed effect sizes ($\beta = 0.289$, $\beta = 0.073$, $p < 0.001$, respectively). Therefore, we can conclude that measuring network ties in isolation tends to inflate the effect size of relationships as compared to examining these same relationships with some combination of the two types of network ties.

Network Type. The focus of this moderator analysis is on the impact of studying interorganizational versus intraorganizational networks. The results of the moderator analysis find support for Hypothesis 3 and indicate that

⁴ The GLS regression only examined the impact of variables with a sample size of 15 or greater.

studying interorganizational or intraorganizational networks does bias the results obtained. In fact, studies focused on interorganizational networks will yield significantly larger effect sizes than studies examining intraorganizational networks. ($\beta=0.234$, $p<0.001$).

We also examine the impact of network content as a moderator. It is hypothesized that studies focusing on one type of network content (R&D, non R&D, friendship, advice, adversarial, or work information) will result in larger correlations than studies that do not discriminate between content. We find partial support for Hypothesis 4, and find that studies that focus solely on R&D ties, work information ties, friendship ties, and adversarial ties yield inflated effect sizes ($\beta=0.355$, $\beta=0.281$, $\beta=0.0213$, $\beta=0.634$, $p<0.001$, respectively). The opposite finding was found for advice network connections. Studying isolating advice networks result in negatively biased effect sizes ($\beta=-0.045$, $p<0.01$). We did not find support for non R&D ties as a moderator, indicating that studying non R&D ties in isolation does not yield significantly different correlations than studies examining a combination of content across network connections.

Network Data. Network studies also vary according to the data gathered for analysis. Hypothesis 5 predicts that there will be a significant difference between studies using primary data, secondary data, or some combination of both data types in the observed effect size of network relationships. Results support this prediction and in accordance with Hypothesis 5 find that using only one type of network data inflates observed correlations as compared with examining the phenomena with a combination of the two types of data ($\beta=0.300$, $\beta=0.096$, $P<0.001$, respectively).

Temporal Design. Hypothesis 6 predicts that examining networks either with a cross-sectional research design or longitudinally will bias the effect sizes observed. We find support for Hypothesis 6 ($\beta=0.233$, $p<0.001$) and results suggest that studying networks at one point in time will inflate the true effect size of these relationships as compared to examining the impact of networks over time. This finding indicates a need for researchers to be cognizant of the differences in studying social networks at one point in time versus longitudinally.

Industry Characteristics. Network connections have been examined in several different contexts. The objective of Hypotheses 7 and 8 is to investigate the impact of studying networks in manufacturing and service industries and across domestic and international settings. Specifically, Hypothesis 7 addresses the question: whether industry characteristics result in meaningful differences between the effect sizes found between the correlates of social networks. We find support for Hypothesis 7 and results suggest that studying networks in either a manufacturing ($\beta=0.518$, $p<0.001$) or service setting ($\beta=0.500$, $p<0.001$) inflates the effect size of network relationships as compared with studying networks with a pooled sample from both settings. Therefore studying network connections using pooled samples from multiple contexts (heterogeneous) will lead to weaker results than simply conducting the study within one context (more homogeneous). Furthermore, we find support for Hypothesis 8 indicate that the examination of networks with the U.S. setting inflates observed effect sizes as compared to studies that are international (multiple countries – heterogeneous) in nature ($\beta=0.212$, $p<0.001$).

Summary, Directions for Future Research, and Conclusion

The key objective of this study is to synthesize 30 years of social network research findings from organizational theory, strategic management, and marketing literatures and extend the current theoretical knowledge base in these domains through meta-analysis. In general, we provide empirical evidence of the nature of the relationship between network connections and its correlates, thus providing a clear snapshot of the current state of the social networks literature. The conclusions reached in the overall meta-analysis provide a more comprehensive understanding of the correlates of social networks as well as the implications associated with the phenomena.

What do we know about social networks? Networks are influenced by environmental, organizational, individual, and relationship-level variables. This study demonstrates that the role of environmental, organizational capabilities, organizational demographics, and individual and relational variables must be acknowledged when conducting research on networks. Additionally, overall results support the notion that network connections are a significant driver of different types of organizational performance, especially innovation.

How should we study networks? In addition, considerable support is also found for the presence of moderators in the networks literature. The network measure used can significantly alter the conclusions garnered from a particular study. Overall, a dichotomous measure of network connections and measures constrained to range from 0 to 1 negatively bias observed network correlations. Future research should seek to utilize the network measure best suited for the particular research question being addressed.

The network type also significantly impacts observed relationships. The results from this study strongly suggest that networks be examined in isolation of other classifications so as to gain a complete understanding of their nature. Interorganizational and intraorganizational network connections have different relationships with the same set of correlates. Additionally, the content of the network tie under investigation can lead to significantly different conclusions in understanding the role of social networks. It is imperative that these differential relationships are taken into consideration when designing future research studies. Along a similar line, social networks are a context-dependent phenomenon and research that seeks to generalize across multiple industries and sectors can result in attenuated effect sizes. Finally, our results indicate a significant difference in the conclusions reached from studies that are cross-sectional in nature with those that are longitudinal. These results indicate the necessity of taking both research design and measurement considerations into account when conducting future studies on innovation.

Surpluses and shortages in empirical research. Meta-analysis also provides a systematic means of pointing out the current gaps and surpluses in a particular domain. As evidenced by this study, the role of organizational demographics on social networks is well documented. While certain organizational capability variables are widely studied and well understood (such as resources and product breadth), there are other variables that are in need of attention. Additionally, the current literature on networks primarily focuses on only 2 environmental variables (competition and turbulence) and their relationship with network connections. Future research should explore this area further. In addition, the marketing strategy area as a whole could benefit greatly from incorporating the social network literature into current marketing strategy models.

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*References used in the meta-analysis are available upon request from the first author.

Table 1: Overview of Network Measures

Measure	Description
<i>Centralization – Betweenness</i>	A measure of information control an actor has within a network (Stevenson and Greenberg 2000). Any member linking two other members in a network has the potential to control, disrupt, or distort the flow of information between the members (Knoke and Kuklinski 1982). Betweenness centrality is calculated as all possible paths divided by the number of times the actor was on a path within the network (Stevenson and Greenberg 2000).
<i>Centralization – Closeness</i>	A measure of connectivity that captures independence from the control of others within the network (Freeman 1979; Powell, Koput and Smith-Doerr 1996). Closeness centrality can be calculated as the reciprocal of the sum of the degree distance between members in a network or the average distance between an actor and other members of the network (Perry-Smith and Shalley 2003). A high closeness score indicates less dependence upon others within the network.
<i>Centralization – In-degree</i>	A measure of connectivity, or activity, of a member within a network (Powell, Koput and Smith-Doerr 1996). Centrality is calculated as the proportion of the number of ties that occur within a network divided by the number of all possible ties within the network (Knoke and Kuklinski 1982)
<i>Density</i>	The average level of communication between members in a network (Reagans and Zuckerman 2001). Density is calculated as the proportion of interaction frequency between network members divided by network size (Reagans and McEvily 2003). Density ranges between 0 and 1.0 and represents the extremes of a totally disconnected network and a network completely connected.
<i>Dichotomous</i>	A 0/1 measure indicated the presence of a tie or connection between actors (Reagans and McEvily 2003).
<i>Distance</i>	The distance between a pair of actors in terms of dissimilarity in patterns of relations with other system actors. If interaction patterns are very similar, then the network distance is zero. Actors with very different interaction patterns yield higher network distance scores (Knoke and Kuklinski 1982). Distance is calculated using the Euclidean distance between members in a network.
<i>Diversity</i>	The average contact among members who are distant from one another in the network. This measure accesses the uniqueness of each contact in one's network (Rodan and Galunic 2004).
<i>Likert</i>	Assesses the actor's perceived network connections and utilization of these members for information exchange (Luo 2003; Wiesenfeld, Raghuram and Garud 2001)
<i>Size</i>	Total number of members in the network (frequency count) (Kraatz 1998).
<i>Status/Age</i>	Refers to the duration of the connection between actors within a network tie (Uzzi and Gillespie 2002).
<i>Strength of Ties</i>	Refers to the frequency of interaction, emotional intensity, intimacy, and reciprocal services comprising the relationship (Granovetter 1973). The intensity of a network connection can be measured as the product of emotional closeness and communication frequency between actors (Reagans and McEvily 2003).
<i>Structural Holes</i>	Structural holes refer to the members in an actor's networks that are not directly connected to one another (Ahuja 2000). A measure of holes in a network assesses the lack of redundancy within one's network. Structural holes are calculated as the ratio of nonredundant connections divided by the total number of connections (Burt 1992).

Table 2: Meta-Analysis Results of Social Network Correlates

Correlates	k	N	r	r _t	SD _t	95%CI		ES	χ^2	N _{fs}
Access to Information	21	3877	0.15	0.23	0.033	0.165	0.295	M	1089.00*	973.23
Age	41	35638	0.11	0.19	0.010	0.171	0.208	M	7111.62*	1540.96
Alliance	10	11927	0.22	0.26	0.033	0.194	0.323	M	2485.87*	524.32
Autonomy	7	818	0.28	0.25	0.053	0.150	0.357	M	316.90*	359.95
Board Composition	8	5432	-0.10	-0.09	0.010	-0.109	-0.068	S	396.64*	-150.43
Commitment	11	1699	0.16	0.16	0.011	0.138	0.181	M	217.06*	345.32
Communication	9	1281	0.04	0.04	0.019	0.003	0.079	S	227.08*	65.40
Competition	17	20981	-0.01	0.01	0.004	-0.003	0.013	S	3007.58*	0.03
Cosmopolitanism	8	1092	0.29	0.13	0.027	0.078	0.184	M	328.69*	204.04
Dependence	17	6305	0.13	0.10	0.010	0.077	0.114	S	1203.37*	308.62
Domain Expertise	28	4399	0.08	0.18	0.027	0.129	0.233	M	871.71*	1003.16
Education	32	6753	0.11	0.06	0.005	0.050	0.069	S	1079.71*	-350.45
Education Dissimilarity	7	728	-0.02	-0.02	0.015	-0.049	0.009	S	75.70*	-35.01
Gender	42	8361	0.13	0.04	0.002	0.038	0.046	S	1534.94*	308.69
Geographic Dispersion	9	2569	0.03	0.04	0.026	-0.005	0.095	S	417.24*	71.99
Influence	20	3156	0.34	0.26	0.022	0.213	0.299	M	1173.13*	1039.09
Innovation	44	19450	0.17	0.14	0.006	0.127	0.151	M	3875.59*	1189.00
Integration	19	5744	0.15	0.13	0.009	0.112	0.147	M	872.47*	477.84
International Presence	14	7540	0.04	-0.02	0.025	-0.065	0.033	S	2603.13*	-59.07
Job Performance	23	8137	0.18	0.38	0.062	0.256	0.499	L	1370.15*	1850.43
Liquidity/Slack	5	4980	-0.17	-0.17	0.004	-0.178	-0.162	M	105.62*	177.51
Market Growth	6	846	-0.05	-0.04	0.028	-0.089	0.019	S	160.21*	-48.21
Marketing Expenditure	5	5855	0.33	0.33	0.024	0.281	0.375	L	897.65*	342.21
Network Building	6	438	0.37	0.37	0.017	0.339	0.405	L	59.50*	474.41
Past Experience	14	18215	0.12	0.21	0.027	0.153	0.259	M	3151.21*	575.77
Past Performance	12	179641	0.05	-0.03	0.010	-0.047	-0.009	S	29282.77*	-79.38
Performance	63	32620	0.06	0.03	0.003	0.027	0.040	S	4735.28*	359.87
Power	16	1064	0.29	0.31	0.015	0.277	0.336	L	234.91*	1014.79
Product Breadth	31	188500	0.09	0.05	0.007	0.040	0.069	S	38426.19*	308.39
Race	21	1792	0.07	0.06	0.007	0.044	0.071	M	274.33*	221.82
Reputation	29	3149	0.29	0.27	0.009	0.250	0.286	M	838.77*	1585.43
Research/Product Dev.	22	22362	0.19	0.16	0.008	0.150	0.179	M	3683.90*	-711.77
Resource Commitment	25	13712	0.16	0.22	0.029	0.164	0.277	M	2596.84*	1105.65
Resource Exchange	10	2248	0.17	0.05	0.009	0.027	0.063	S	690.81*	80.23
Role Clarity	11	1852	0.11	0.14	0.020	0.098	0.175	M	272.38*	291.82
Sales	21	8931	0.14	0.27	0.052	0.167	0.370	M	2077.36*	-1150.11
Satisfaction	13	3060	0.07	0.06	0.008	0.045	0.077	S	427.46*	145.85
Size	70	217998	0.09	0.16	0.015	0.127	0.184	M	46066.96*	2129.28
Task	14	2100	0.11	0.11	0.011	0.089	0.132	M	324.64*	298.54
Technology Capability	18	8379	0.11	0.14	0.012	0.121	0.168	M	1640.32*	509.08
Tenure	34	4961	0.09	0.04	0.004	0.036	0.052	S	1013.40*	265.88
Tenure Dissimilarity	9	1176	-0.02	-0.02	0.007	-0.034	-0.007	S	78.01*	-45.48
Turbulence	5	1787	0.09	0.07	0.021	0.030	0.112	S	189.30*	65.94

k = the number of samples in each analysis; N = the total number of respondents in the k samples; r = the mean uncorrected correlation; r_t = the mean weighted corrected correlation; sd_t = the estimated population standard deviation; ES = effect size, where L is large, M is medium, and S is small (Cohen and Cohen 1983); χ^2 = a chi-square test for variance unaccounted for across the samples; N_{fs} = fail-safe N for each variable. * p<.01.

Table 3: Theoretical Rationale for Proposed Moderators of Network Research

Moderator Variables	Rationale
Network Measure	Prior research indicates that scales with larger range and number are more reliable. Consequently more attenuation should result from measurement error in a dichotomous scale, and therefore lower the effect size observed (Houston, Peter and Sawyer 1983). Additionally, network measures that range between 0 and 1 should also negatively bias the observed effect size. Prior research has also examined direct ties, indirect ties, or some combination of both. Studies that pool both direct and indirect ties face greater heterogeneity than studies focusing on only direct or indirect ties in isolation. Therefore we hypothesize that: <i>H1: Samples using a dichotomous measure of innovation or measures that range between 0 and 1 will exhibit smaller effect sizes than samples using continuous network measures.</i> <i>H2: There will be a significant difference in effect sizes observed between samples measuring direct ties, indirect ties, and a combination of both direct and indirect ties.</i>
Network Type	Networks can differ in terms of their content and type. Interorganizational networks examine relationships between actors and external members while intraorganizational networks occur within one organization. Additionally, the objectives associated with the relational content of network connections are different. Therefore, it is expected that network type will bias the effect sizes observed for the correlates of networks, however the direction of this bias is not known a priori. <i>H3: There will be a significant difference in effect sizes between samples studying interorganizational networks and intraorganizational networks.</i> <i>H4: There will be a significant difference in effect sizes between samples studying relational content of network ties in isolation than those that do not.</i>
Network Data	Network data can be collected directly from respondents or secondary data can be used to create measures of network variables. Studies that pool both primary and secondary data to examine the relationship between networks and its correlates face greater levels of heterogeneity than studies utilizing only on type of data. Therefore we hypothesize that: <i>H5: There will be a significant difference in network effect sizes between samples using primary data, secondary data, and a combination of both primary and secondary data.</i>
Temporal Design	In meta-analytical investigations, scholars often code for the temporal nature of studies investigating causal relationships (e.g. Hom et al 1992). It is probable that studies investigating networks at one point in time versus over a period of time are likely to yield different correlations between network variables and its correlates. Therefore we predict that the temporal design of the samples will bias the effect sizes observed with regards to network connections. However, the direction of this distortion is unknown a priori. <i>H6: There will be a significant difference in effect sizes between samples investigating networks with a cross-sectional design and samples investigating networks with a longitudinal design.</i>
Industry Characteristics	Due to the differences inherent between service providers and manufacturers, the impact of correlates on networks could be markedly different. Furthermore, studies with pooled samples from both industry sectors and in an international context face greater heterogeneity than studies focusing on only one sector. Therefore, studies that focus on only one industry will be better able to tease out the true impact of antecedents on networks and the relationship between network ties and performance as compared with studies that examine the phenomena in both industries. Therefore it is hypothesized that: <i>H7: Samples investigating networks within either a manufacturing or service context will yield different effect sizes than samples investigating networks across both industries.</i> <i>H8: Samples investigating networks within the U.S. context will yield different effect sizes than samples investigating networks in international settings.</i>

Table 4: GLS Moderator Results

Moderator	β	σ	z	Moderator	β	σ	z
<i>Network Measure</i>				<i>Correlates</i>			
Central	-0.075	0.013	-5.69*	Access to Information	0.340	0.018	19.48*
Strong	-0.126	0.016	-7.75*	Age	0.036	0.010	3.62*
Weak	-0.253	0.015	-16.55*	Alliance	1.939	0.019	101.64*
Strength	0.150	0.010	14.48*	Commitment	-0.383	0.047	-8.16*
Holes	0.205	0.016	13.12*	Competition	0.452	0.013	36.14*
Density	-0.285	0.012	-23.57*	Dependence	-0.570	0.019	-30.21*
Dichotomous	-0.475	0.017	-28.05*	Domain Expertise	-0.090	0.021	-4.38*
Size	-0.150	0.010	-15.02*	Education	0.318	0.019	16.94*
Closeness	0.242	0.013	18.18*	Financial Performance	-0.487	0.010	-47.83*
Betweenness	-0.017	0.020	-0.85	Gender	-0.341	0.017	-20.52*
Diversity	-0.244	0.010	-23.38*	Influence	-0.090	0.017	-5.31*
Distance	-0.300	0.038	-7.88*	Innovation	0.129	0.011	12.13*
Likert	-0.246	0.024	-10.40*	Integration	-0.492	0.017	-28.46*
Direct	0.289	0.009	31.64*	International Presence	0.776	0.018	43.49*
Indirect	0.073	0.015	4.83*	Job Performance	0.418	0.012	33.67*
<i>Network Type</i>				Past Experience	-0.938	0.018	-51.82*
Interorganizational	0.234	0.016	14.27*	Past Performance	-0.113	0.013	-8.94*
R&D Ties	0.355	0.020	17.74*	Power	0.366	0.033	11.27*
Non R&D Ties	-0.009	0.025	-0.36	Product Breadth	0.068	0.011	6.23*
Work Information	0.281	0.021	13.56*	Race	-0.758	0.021	-36.03*
Friend	0.213	0.010	21.81*	Reputation	0.046	0.017	2.80*
Advice	-0.045	0.018	-2.54*	Research	-0.034	0.014	-2.38
Adversarial	0.634	0.034	18.63*	Resource Commitment	-0.143	0.010	-14.15*
<i>Network Data</i>				Resource Exchange	-1.000	0.025	-40.24*
Primary	0.300	0.016	18.88*	Role Clarity	-0.407	0.045	-9.03*
Secondary	0.096	0.014	6.68*	Sales	0.019	0.012	1.60
<i>Temporal Design</i>				Satisfaction	-0.425	0.019	-22.33*
Cross-Sectional	0.233	0.010	23.99*	Size	-0.591	0.010	-58.84*
<i>Industry Characteristics</i>				Task	0.289	0.042	6.82*
Manufacturing	0.518	0.011	46.46*	Technology Capability	-0.505	0.017	-30.66*
Service	0.500	0.012	42.92*	Tenure	-0.250	0.015	-16.27*
U.S.	0.212	0.010	21.24*	Turbulence	0.612	0.023	26.68*

* p<.01.

Figure 1: Summary of Meta-Analysis Results

