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**KNOWLEDGE NETWORKS:
DIFFERENCES AND PERFORMANCE EFFECTS**

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ABSTRACT

A survey of 141 small & medium sized enterprise (SME) principals reveals two distinctly different types of knowledge networks based upon the principal's perception of whether or not networks provide a significant benefit to their firm. Significant differences exist in the type of information exchanged, the type of networks maintained, and how networking activities contribute to the competitive position and performance of the firm. Firms that see benefits to networking maintain intense and broad networks oriented towards potential knowledge. Assimilating this knowledge, they gain competitive advantage and maintain higher levels of performance. Those that do not see a benefit to networking activities maintain less intensive networks, exchanging experientially based information; information that is "tried and true" and which can be adapted to incrementally improve their operations.

INTRODUCTION

We are in the Information Age. Economic environments are changing at an unprecedented rate. New and emerging technologies are altering products, methods of production, and ways of doing business. The current economic environment is "A knowledge based system, wherein a knowledge is the most important resource," (Bergeron, Lallisch, & LeBas, 1998:733), and yet scarcity of resources is a problem for small businesses (Zacharakis, 1997; Gallant-Stokes, 1987). Networks have been argued as enabling small businesses to assemble scarce resources (Birley, 1985; Ostgaard & Birley, 1996) and enable their growth (Jarillo, 1989). Is beneficial knowledge a resource that small & medium size enterprises (SMEs) acquire through networks? If yes, what are the different types of knowledge-networks used by SMEs?

Networks: Social Structures That Facilitate the Exchange of Resources

Patterned relationships among people and firms create a social structure - a network - that can facilitate or constrain the actions of individuals, groups, and organizations (Aldrich & Zimmer, 1986). Networks enable small businesses to assemble scarce resources (Birley, 1985; Ostgaard & Birley, 1996), improve information acquisition (Peters & Brush, 1996), and facilitate their growth (Jarillo, 1989). Without external contacts, a small or medium size

enterprise's capabilities are limited to its own resources and abilities. As a result of network participation, small firms can successfully compete with large competitors while maintaining flexibility and innovativeness.

Pfeffer and Salancik's resource dependency theory asserts that a relationship between firms is affected by the importance of the resource (1978). Networks are the channels through which critical external resources can flow. An essential objective for resource poor small firms should be the building of network exchange relationships with others that potentially may either supply critical resources or serve as contacts for those that can (Larson, 1992). Access to, and the size of, a firm's network enables growth (Johannisson, 1990). While a firm's network development is influenced in part by the habits and social structure of the participants (Gulati, 1995), relationships between firms may be shaped and deliberately designed, especially to accelerate a firm's access to and ability to transfer knowledge (Lorenzoni & Liparini, 1999). Growing firms make more use of external resources (Jarillo, 1989; Zhao & Aram, 1995), have larger networks, and initiate more frequent contacts within their network.

Information alters or reinforces understanding, and becomes knowledge if it can be applied. Knowledge is a critical resource. The modern economy has been defined as a "knowledge-based system ... [wherein] knowledge is the most important resource and learning is the most important process" (Bergeron, Lallich, & LeBas, 1998:733). Networks, by emphasizing the flow of information, facilitate the capture and diffusion of technical and organizational knowledge, which can be classified according to the type of information being exchanged: (1) the buyer-supplier linkage, (2) the technical problem-solving network, and (3) the informal community network (Carlsson, 1997).

The community network is informal and relatively stable, characterized by personal contacts among individuals within a variety of industries and occupations, and can be both extensive and loosely knit. The community network may be influenced by shared values and emotional attraction from personal rather than a purely business perspective (Johannisson, 1996).

The technical problem-solving network (which frequently overlaps the buyer-supplier linkage), is based on participants having a shared issue or problem of a technical or technological nature. As a problem-solving linkage, it is the transfer of knowledge, rather than the exchange of goods and services that is central. The buyer-supplier linkage, on the other hand, focuses on information that will enhance the flow of materials, hence the exchange of goods and services.

Networking activity promotes resource acquisition and is related to competitive information scanning activities. Research has investigated the networking behavior of small and medium size enterprises from both the venture formation and the growth/competitiveness perspectives. The business planning process prompts founders to analyze the resources necessary for business success and to compare these with resources already owned or within the firm's control. This process prompts the founder to develop network contacts to identify missing resources, and to assist in the businessperson's search for sources where they can acquire the additional resources necessary for successful venture formation (Larson & Starr, 1993). Beyond resource acquisition, management is better able to define their competencies vis-à-vis competition by participation in networks (Provan & Human, 1999).

Research has studied networking structure and behavior in relationship to post-start-up performance measures (e.g., sales, employment) (Brunderl & Preisendorfer, 1998), however, results continue to be inconsistent (Ostgaard & Birley, 1996). Inconsistent results may be due to a focus on the networking process and structure rather than on the resources being exchanged. Most small and medium size enterprises do not participate in "structured"

relationships such as alliances or research and development partnerships. As the firm evolves, resource needs change, thus network ties must also change (Hite & Hesterly, 1999). Second, and more importantly, focusing on the process and structure of networking fails to test the underlying assumption of network theory, specifically that networks provide resources perceived to have an economic benefit to participants. Lene Foss has previously argued that research should focus on the resources being exchanged in addition to the network contact information (1993). Prior research has not looked at the knowledge transfer role of networking for SMEs, and has not asked whether the firm's network contacts provide these critical resources. This research probes this gap by assessing whether small & medium sized enterprise principals perceive a benefit to networking for the exchange of information and knowledge, and then analyzing their networking activities and its consequences.

Research Methodology

The two principal questions motivated this research: (1) Do networks provide knowledge that benefits SMEs and (2) if yes, what are the different types of knowledge-networks used by SMEs?

Specific questions and the composite scales for the performance, the firm and the environment have been compiled from previous research, are generally accepted in the field, and have been previously validated (Solymossy, 1998).¹ Performance outcomes are assessed by changes in overall sales, changes in employment levels, the income of the firm's principal, and the personal satisfaction of the principal. Firms are distinct in their competitive attitude, their strategic processes, their level of technology, and their network utilization. The environmental variables assess the competitive hostility, the dynamism (rate of change), the technological sophistication necessary to succeed, and the munificence (generosity) of the environment. Networking activity is measured by the average number of contacts per month, a simplified measure that has previously been used for identifying which resources can be tapped for key benefits (Hoang & Antoncic, 1999). Drawing upon Carlsson (1997), additional questions focused on the three types of knowledge: buyer-supplier, technical problem-solving, and community contacts, and further identifying the potential sources for this knowledge exchange. Prior research, e.g., Donckels and Lambrecht (1997) and discussions with other scholars and business persons suggested 7 categories of sources that might capture the scope of an SME's potential network: Academic institutions, research agencies, business assistance agencies, external consultants, trade shows and industry associations, other businesses, and relatives and friends. In addition, open-ended questions were utilized to inquire as to perceptions of economic benefit and crucial external linkages for each of the three types of knowledge.

A lengthy questionnaire was sent to 1250 northeastern Illinois² "for-profit" businesses having fewer than 300 employees. Eighty-two (7%) were returned by the post office, 32 (3%) were returned by recipients as being either not applicable or with refusals, and 141 completed

¹ Brevity precludes a detailed discussion of the individual questions and the scales, however, the reader is directed to Solymossy, (1998), pages 46-49 for performance measures, pages 64-72 for firm specific characteristics, and pages 73-77 for environmental measures.

² The list was acquired from Dunn and Bradstreet, comprised of a random selection of firms within the areas of Bureau, Carroll, Henderson, Henry, Jo Daviess, Knox, Lee, Mercer, Ogle, Peoria, Rock Island, Stark, Stephenson, Whiteside counties

responses were received, yielding an adjusted response rate of 12.5%. Given the complexity of the instrument, a low response rate was expected; and the responses were deemed to be sufficient for exploratory purposes. Respondents average 52 years of age, of which 83% were male, 17% female (Table 1). Ninety-six percent of the respondents are principals of the firm, either having founded the firm or owning 50% or more of the firm. The average age of the firms is 24 years. The sample represents a broad cross-section of industries, with a notable preponderance in the service industry (professional services, consumer services, or guest services). There is a relatively high representation of businesses in agricultural industries, but this is to be expected given the nature of the geographic area studied. Educational levels are also broadly distributed, with 71% of respondents having had at least some college (27% have pursued post-graduate education) (Table 1). Overall, respondents' descriptive information is comparable to reports from other SME research (e.g. Lee, Rogoff & Puryear, 1998; Van Auken & Neeley, 1998).

Table 1
PROFILES OF COMPANIES AND RESPONDENTS

Industry	n	Production	Services	Trade	Agriculture	Transpn./
						Constrn.
	139	4	60	20	29	26
		2.9%	33.2%	14.4%	20.9%	18.7%
Education	n	H.S. or less	Some College	Bachelor's	Post-Grad	
	141	41	41	32	27	
		29.1%	29.1%	22.7%	19.1%	
Ownership	n	Principal	Non-principal			
	136	130	6			
		95.6%	4.4%			
Gender	n	Male	Female			
	133	111	22			
		83.5%	16.5%			
Variable	n	Avg.	S.D.	Range		
Respondent's Age	139	51.9	11.3	24 - 81		
Age of Firm	137	23.6	18.4	2 - 87		
No. of Employees	131	4.6	7.1	0 - 50		

Findings

Seventy-eight percent (78%) of the respondents indicate that network contacts provide knowledge of significant benefit to their business (for simplicity, this group will hereafter be referred to as the BEN group). Twenty-two percent (22%) indicated that they did *not* see significant benefit to their firm (this group will hereafter be referred to as the NOBEN group).

No significant differences exist between the two groups in the ownership position, age, gender, education, or income level of the respondent. Likewise, no significant difference exists in either business age or industry. There is appears to be a difference in continuing education, with a larger proportion of the NOBEN group reporting having completed

supplementary, continuing education or training. While only permitting a tentative interpretation, due to the small sample size of the NOBEN group compared with the BEN group, this suggests that the NOBEN group will pursue knowledge with specific focus and intent, often acquiring this through formalized educational or training programs

Table 2
COMPARING PROFILES OF BEN AND NOBEN GROUPS
 Continuous variables (t-tests)

	"BEN" Group (Significant Benefit)				"NOBEN" Group (No Significant Benefit)				Group Differences	
	MEAN	MIN	MAX	S.D.	MEAN	MIN	MAX	S.D.	t-test	Sig (2-t)
Respondent Age	51.557	24.0	81.0	11.61	53.259	33.0	76.0	9.86	-0.762	0.450
Business Age	23.787	2.0	87.0	18.62	22.786	2.0	72.0	18.28	0.253	0.801

Categorical variables (non-parametric testing)

	"BEN" Group (Significant Benefit)			"NOBEN" Group (No Significant Benefit)			Group Differences			
	N	Mean Rank	Sum Rank	N	Mean Rank	Sum Rank	M-W-U	WilcoxW	Z	Sig (2-tail)
Gender	94	61.8	5809	27	61.8	1572	1194	1572	-0.741	0.459
Principal	92	58.8	5408	24	58.78	1378	1078	1378	-0.430	0.667
Education	98	63.2	6189	28	64.71	1338	1338	6189	-0.206	0.837
Continuing Education	96	59.3	5690	28	73.57	2060	1034	5690	-2.470	0.014
Income	96	62.5	6002	26	57.73	1501	1150	1501	-0.628	0.530

Based upon the differing perspectives on the benefits of networking, it was anticipated there would be significant differences in the types of knowledge shared and the type of contacts being maintained. Furthermore, since knowledge is believed to be a critical resource, differences are expected to be manifested in the firm's perceiving a competitive advantage because of their network usage. For simplicity and ease of interpretation, rather than displaying the full 21 cell matrix from the questionnaire (for types and sources of knowledge), the average number of information exchange contacts per month is collapsed to two summed scores. The type of knowledge (Buyer/Supplier, Technical, Informal Community Relationships--sums the responses from all seven sources for that type of knowledge) (Table 3, below), while the source(s) (sums the three types of knowledge within each of the seven source categories).

Differences in types of knowledge: Based upon contact intensity and frequency for types of knowledge, significant differences exist in the knowledge areas of buyer-supplier and informal community information. However, a significant difference does not exist in the average number of contacts for technical/problem solving networks. In examining the three types of knowledge, the firm that perceives a significant benefit from networking is more intensive in its networking activities. These firms maintain an average of 6 contacts per month more than

those firms that do not perceive a benefit (Buyer/Supplier = 3, Technical, problem solving = .6, Informal Community Information = 2.5) (See Table 3).

Differences in sources of knowledge: Contact frequency with the various sources of information also shows major differences between the two groups in six of the seven categories (all sources excepting for trade shows and industry associations). On average, the BEN group has 5.1 more contacts per month with friends and relatives, 2.7 more contacts per month with other businesses, and 1.2 more contacts with other consultants. Not a single NOBEN respondent indicated any contact with research institutes. Within the BEN group, there were up 3.33 contacts per month with research institutes. While an average difference of five contacts per month may not seem significant (five phones calls or personal visits may not be excessive), the magnitude of the differences are surprising. On average, the BEN group has 28.7 times as many contacts per month based on the three types of knowledge, and 18 times as many contacts per month with their sources of information and knowledge (see Table 3).

The question of whether an SME acquires economically valuable knowledge benefits from their networking activities is valid and meaningful.

Table 3
COMPARING TYPES AND SOURCES OF KNOWLEDGE
(Average number of contacts per month)

	"BEN" Group (Significant Benefit)				"NOBEN" Group (No Significant Benefit)				Group Differences	
	MEAN	MIN	MAX	S.D.	MEAN	MIN	MAX	S.D.	t-test	Sig (2-t)
<i>Buyer/ Supplier</i>	3.059	0.0	43.7	0.71	0.039	0.0	2.5	0.71	4.214	0.000
Technical	1.434	0.0	15.0	3.03	0.839	0.0	15.0	3.03	0.894	0.378
<i>Informal</i>	2.979	0.0	100.0	1.05	0.452	0.0	4.0	1.05	2.040	0.044
<i>Academic</i>	0.333	0.0	4.0	0.29	0.125	0.0	1.0	0.29	2.105	0.038
<i>Research</i>	0.241	0.0	3.3	0.00	0.000	0.0	0.0	0.00	3.451	0.001
<i>Bus. Agency</i>	1.127	0.0	20.0	1.00	0.240	0.0	5.0	1.00	2.357	0.020
<i>Consultants</i>	1.411	0.0	34.0	0.81	0.256	0.0	4.0	0.81	2.445	0.016
Shows/Assoc.	0.722	0.0	4.0	2.96	0.885	0.0	15.0	2.96	-0.278	0.783
<i>Businesses</i>	3.599	0.0	21.7	1.21	0.913	0.0	5.0	1.21	5.035	0.000
<i>Friends/ Relatives</i>	5.785	0.0	200.0	1.89	0.667	0.0	9.0	1.89	1.950	0.054

Differences in competitive advantage: Respondents rated themselves (from 1 to 5) in each of eight areas potentially offering a competitive advantage (Porter, 1985), with 5 corresponding to a level of competence that would yield a competitive advantage. Three areas exhibit significant differences; two related to technology, the third with accessibility to the market. While there is no difference between the BEN and NOBEN groups in the domains of price, quality, breadth of product offerings, or differentiation (either by focus or by higher levels of service), the BEN group, on average believe themselves to have a superior competitive position because of access to the market. This may be because they are more

actively involved in scanning activities, seeking information about the marketplace (note differences on the buyer/supplier knowledge). Because of this increased search, they are more confident in their evaluating themselves vis-à-vis the competition (Provan & Human, 1999). The NOBEN group, having less information and knowledge, may not be as able to compare themselves to the competition. (See Table 4)

There are also significant differences between the two groups in technologically oriented competitive advantage (both product and process). While no significant difference exists between the two groups in the technical/problem solving *type* of knowledge, significant differences exist in their *sources* for acquiring information and knowledge. The BEN group, having more intense contact with research agencies, consultants and other businesses, position themselves to receive more information. While quantity does not necessarily equate to quality, a greater frequency of contacts with different sources permits information acquisition to be more comprehensive. This translates into allowing unique production/process technology. By virtue of being "unique" knowledge, these firms assimilate information from

Table 4
DIFFERENCES IN COMPETITIVE ADVANTAGE
(5 = area of high competence, 1 = area of no, or low competence)

	"BEN" Group (Significant Benefit)				"NOBEN" Group (No Significant Benefit)				Group Differences	
	MEAN	MIN	MAX	S.D.	MEAN	MIN	MAX	S.D.	t-test	Sig (2-t)
Distinct / unique market niche	3.223	0.0	5.0	1.83	2.704	0.0	5.0	1.75	1.346	0.185
Access to market	3.274	0.0	5.0	1.65	2.519	0.0	5.0	1.81	1.953	0.058
Unique technology of product	2.117	0.0	5.0	1.72	1.462	0.0	4.0	1.45	1.956	0.056
Unique techn. in prod. process	2.102	0.0	5.0	1.82	0.846	0.0	4.0	1.12	4.335	0.000
Lower price	2.559	0.0	5.0	1.57	2.704	0.0	5.0	1.73	0.393	0.697
Significantly higher quality	3.820	0.0	5.0	1.34	3.481	0.0	5.0	1.67	0.968	0.340
Broad product / service lines	3.112	0.0	5.0	1.68	2.852	0.0	5.0	1.77	0.680	0.500
Higher levels of customer service	3.932	0.0	5.0	1.38	3.815	0.0	5.0	1.42	0.383	0.704

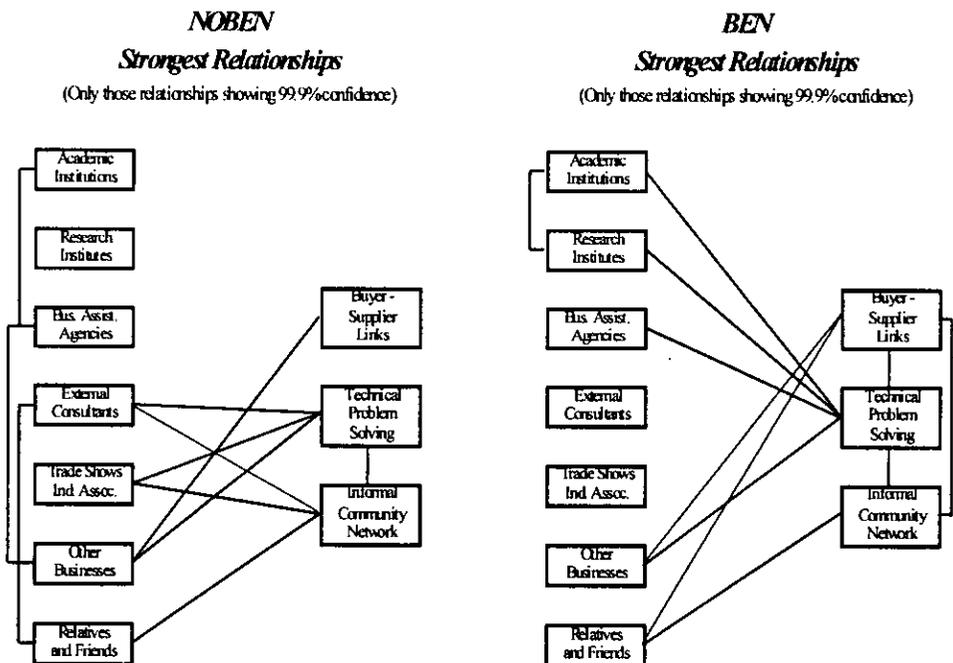
a variety of sources, innovatively combine using this information, and create unique knowledge which affords them a competitive advantage. Beyond the significant difference in their perception of competitive strengths in the two "technology" areas, it is noteworthy that "no respondents within the NOBEN group scored themselves a "5" in either of the technology areas. None felt themselves to have very strong competitive advantage in technology - in spite of 18% of the NOBEN group having advanced degrees (see Table 4).

Differences in network patterns: Numerous, pronounced differences have been discussed as being apparent between the groups that do, or do not, realize a significant benefit from their networking activities. There are even more pronounced differences in their network relationship patterns. To identify these patterns, correlation matrices were calculated showing the correspondence between the types of knowledge and the sources of knowledge. The

strongest relationships (at greater than the 99.9% confidence level) were diagrammed to identify the knowledge network patterns of each group (see Figure 1).

The knowledge network pattern for those who do not perceive a significant benefit from networking appears to be relatively constrained - relatively few, albeit fairly strong relationships, with very weak relationships between the types of knowledge. This suggests purposeful pursuit within a relatively structured set of knowledge networks. Keeping in mind that the separation of these two groups is based on their perception of benefit to the firm, it is helpful to analyze these differences based upon potential cognitive differences.

Figure 1
KNOWLEDGE NETWORK RELATIONSHIP PATTERNS



Research has shown that cognitive styles vary significantly among people. The KAI theory maintains that people differ on their approach to solving problems based on their cognitive type, with people being either adaptors or innovators (Kirton, 1976). Adaptors tend to be conservative, exploring solutions within generally accepted guidelines and frameworks. Innovators, on the other hand, see existing guidelines and frameworks as part of the problem, frequently incorporating radical processes or ideas as part of their solution. From a strategic perspective, the adaptive style focuses on doing things better, comfortable with incremental improvement, while the innovative style develops the ability to do things differently, frequently employing radically new solutions (Kirton, 1980 as cited in Brigham and Reed, 1999). The network pattern of the NOBENs suggests a comfort level in using "tried and true" knowledge by seeking sources that support this. There is no contact with research agencies, and minimal (not comparatively significant) contact with academics. These sources, being on the leading edge of new knowledge, would introduce new and different information requiring processing by the firm. These firms, however, do not appear to pursue change. They cope with it. While both groups exhibit one knowledge network with a singular linkage (type and source link), they are in entirely different areas. The NOBEN group networks with a single linkage is between buyer-supplier knowledge and other businesses. They rely on other

businesses, acquiring knowledge that is new to them, but not new to others within their business community. This affords them parity, but not superiority. Multiple sources are indicated for both the problem solving and informal information networks. These sources also indicate a reliance on practical experience, whether from friends and relatives, other businesses, trade shows or industry consultants. Being more "adaptive," the information and knowledge that is acquired through these networks supports the NOBEN group's need for learning what *is being* or *has been* done by others that could be applied to their current situation.

The BEN group, on the other hand, exhibits a broader and more inclusive knowledge network pattern. For example, their technical problem-solving network extends beyond other businesses to include academic institutions, research agencies and business assistance agencies. Likewise, the buyer-supplier network is broadened to include relatives and friends, affording the possibility of unexpected sources of valuable information.

Performance consequences: Perhaps the most meaningful (from a practical perspective) difference between the two groups is the significant relationships (at the 95% confidence level) between the knowledge networks and the performance measures exhibited by the BEN group. Those firms that perceive a benefit to their networks apply the information they acquire to generate new knowledge, subsequently converting this knowledge into a competitive advantage, which results in measurable, positive results to the firm.

A MANOVA analysis was conducted to investigate how knowledge networking activity affects the performance of the firm. This testing categorized firms by economic performance levels, and then sought to determine what differentiated the high performance firm from those that didn't perform as well. Sales growth of the firm is positively affected by contact frequency for exchanging technical knowledge and by the frequency of contact with consultants and friends and relatives. Both the SME principal's income and a composite measure of economic success (combining income, sales growth and employment growth) show statistically significant effects from networking activities (with 95% confidence). Contact with consultants corresponds to additional income for the SME principal (supporting the indications evidenced for sales growth). Increased economic success corresponds to increases in contact frequency in technical knowledge (as a type of knowledge) and with academic institutions and trade shows/industry associations as sources (see Table 5). This offers additional supports to earlier indications that firms which acquire and convert knowledge into a competitive advantage demonstrate improved economic results.

Table 5
RELATIONSHIP TO INCREASED PERFORMANCE

<i>Effect</i>	<i>Variable</i>	<i>F</i>	<i>Sig. of F</i>	<i>Power</i>
Sales Growth	KTECHN (type)	3.525	0.011	0.911
Sales Growth	KCONSULT (source)	2.252	0.072	0.749
Sales Growth	KFRIEND (source)	3.981	0.006	0.940
Principal's Income	KCONSULT (source)	4.622	0.012	0.854
Economic success	KTECHN (type)	2.785	0.031	0.837
Economic success	KSACAD (source)	2.004	0.101	0.702
Economic success	KSHOWS (source)	2.033	0.097	0.709

CONCLUSION AND IMPLICATIONS

This research finds that not all SME principals see networks as providing knowledge which benefits their firm, and as a result, network composition and intensity differs. Those firms not perceiving a benefit maintain less intensive networks, focus more on experiential information, and seek information about what *is* or *has been*. The knowledge acquired is adapted to the SME's particular situation, and used to improve operations. The benefits from networking are not, however, maximized, and consequently, networking's value is not recognized by the SME.

Those perceiving benefits from their networks maintain more intensive, wide-ranging and overlapping networks. While they also gather information from others regarding what is being done, this group actively maintains contacts with forward-looking expertise. This emerging knowledge base is most pronounced in technological and problem solving networks, supplementing experientially based information, and appears to focus on *potential*. The data suggests that firms who value networks are proactive in maintaining them, appear to convert information into new knowledge, and as a result, gain competitive advantage that is subsequently reflected in the performance of the firm.

These findings have potentially significant implications for both businesses and providers of services and support to SMEs. For the business practitioner, the findings are relatively clear: it doesn't matter whether you perceive benefits from networking or not, there *are* measurable benefits to networking provided the firm is disposed to capitalize on the information/knowledge capacity of networks. Institutions, agencies and policy makers must likewise realize that there are two different types of knowledge required by SME firms, and programs cannot "be-all, to-all."

While these findings are statistically significant and meaningful, they must be used with some caution. This study explores new veins of inquiry with a moderate sample size. The indications provided by this research are meaningful since the study is focused specifically on a single class of resource exchange within networks, and has sought to not only clarify the nature of information and knowledge as a resource but to assess its value from both a perceptual and an outcome perspective. Future research could explore these relationships further, expanding upon the basic framework presented, and would be more suitable to rigorous statistical analysis, allowing improved generalizability.

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