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Information Sharing: As a Type of Information Behavior

Abstract: The paper proposes a general definition of information-sharing behavior, which illuminates the characteristics of information-sharing behavior in comparison to other types of information behavior. The paper proposes an approach to measure the level of information sharing in supply chains by integrating its six underlying indicators into a composite index.

Résumé : Cette communication présente une définition générale du comportement de partage de l'information, laquelle met en relief les caractéristiques du comportement de partage de l'information comparé à d'autres types de comportements informationnels. Cette communication propose une approche pour mesurer le niveau de partage d'information dans les chaînes d'approvisionnement par l'intégration de six indicateurs sous-jacents à l'intérieur d'un indice composé.

1 Introduction

In recent years, information-sharing behavior has attracted increasing attention among researchers and practitioners in library and information science. Despite a growing body of literature in this area, few studies have attempted to define information-sharing behavior and to explore its relationship with other types of information behavior. The nature of information-sharing behavior in information science is still unclear. In addition, there is no measure available to observe information-sharing behavior, especially its key components, information transfer and exchange, from a comprehensive and quantitative perspective. Although some indicators, such as frequency, level of detail, etc., have been used in previous research to measure the activity of information sharing, each of these indicators only reflects a certain facet or dimension of information-sharing behavior. No previous studies have attempted to investigate all these indicators at the same time or to synthesize them into a composite measure. As an exploratory study, the purposes of this study are 1) to explore the theoretical foundations of information-sharing behavior, which illuminates the characteristics of information-sharing behavior in comparison to other types of information behavior, and 2) to measure the level of information sharing in supply chains by combining its underlying indicators to form a composite index.

2 Defining information-sharing behavior

This section aims to review the literature on information-sharing behavior from different perspectives and combine all these perspectives to provide a definition of information-sharing behavior.

2.1 Information-sharing behavior as a type of collaborative/collective behavior

Tajla (2002) defined information sharing as an umbrella concept that covers a wide range of collaborative behaviors from sharing accidentally encountered information to collaborative query formulation and retrieval. Collaboration means that information sharing is not an individual behavior but a collective and collaborative effort occurring in social networks (i.e., communities of practice or communities of sharing). The author

suggests that information sharing is a phenomenon that is affected primarily by factors other than individuals' attitudes, attributes, and information-seeking styles. Shaw (2000) identified three types of coordination in the supply chain, such as simple information exchanges (e.g., vendors and their customers exchange information unique to their businesses on a transaction basis), formulated information sharing (e.g., a firm provides its suppliers with demand parameters and priorities, or a "formula", to guide restocking), and modeled collaboration (i.e., two supply-chain partners share operational models so that each has a real-time view of the other's capability, factory load, on-hand inventory, and committed orders).

According to Activity Theory, collaborative activities can be classified into three levels, i.e., co-ordinated, co-operative, and co-constructive activity (Bardram 1998). In a co-ordinated activity, various actors work on a common object but do not related to the common objective of their activity. In a co-operative activity, actors not only act upon a common object but also share a common objective of the activity. A co-constructive activity focuses on re-conceptualizing or re-constructing the common object collectively and restructuring the organizations and interactions in relation to the shared object. Therefore, a collaborative behavior means that: 1) different actors work together in an activity; 2) they work on a common object; 3) they may (or may not) share a common objective in that activity. Information-sharing activity always involve two categories of actors: information providers (or informants/disseminators/sharers) and information receivers (or seekers/recipients). The common object on which the two parties work in the activity is information being transferred. Therefore, *from the perspective of collaboration, information-sharing behavior can be defined as a type of activity in which the information provider and information seeker work together to achieve the transfer of a certain type of information from the former to the latter*. By this definition, information-sharing behavior refers to the entire process of information transfer which includes information-seeking and information-providing behavior. The central problem of the process is how the two parties of actors collaborate. Similarly, we can further classify the level of collaboration in information-sharing activity by using the criterion: *sharing of common objective or not*. In information-sharing activity, sharing of common objective means that the two parties of actors have the same goal to reach through their actions of information providing and information seeking. From the perspective of collaboration, information-sharing behavior can be divided into the following three levels (see Table 1):

Level of Collaboration	Definition		Examples
	Common Object	Common Objective	
Level I	*Yes*	*No*	Sharing of encountered information between colleagues, informal exchanges of opinions in academic conferences
Level II	*Yes*	*Yes*	Information sharing in cooperative R & D, information sharing in group decision-making
Level III	*Re-conceptualized, re-constructed*	*Yes*	Information sharing to achieve VMI and JIT, institutionalized knowledge sharing

Table 1: Collaborative Level of Information-Sharing Behavior

At the first level, actors of information-sharing activity transfer and exchange information between each other. However, they do not have the intention to reach a common goal through such actions. Information-sharing behavior at this level often occurs occasionally, randomly, or informally. For example, colleagues share encountered information with each other; scholars exchange their opinions in academic conferences, etc. At the second level, actors share information in order to achieve a common objective. At this level,

information usually is shared routinely and formally. For example, researchers of two companies in a cooperative research and development project exchange information sources and ideas; members of a group within a company share their opinions in order to make a decision, etc. At the third level, information being shared is collectively redefined; organizational structure and workflows in relation to information sharing are reorganized or reengineered in order to facilitate collaboration and reach the common goal. At this level, information sharing usually is supported by long-term formal arrangement/mechanisms. For example, in order to achieve VMI (Vendor-Managed-Inventory) and JIT (Just-In-Time production), businesses along the supply chain must establish an industry-wide information-sharing mechanism to share real-time information seamlessly, which requires businesses integrating their information systems, reengineering business processes related to inventory management and production schedule, and retraining relevant employees, etc. It must be emphasized that an information-sharing behavior cannot be considered to exist on only one level of collaboration alone. This means that a single type of information-sharing behavior may involve different levels of collaboration simultaneously.

To sum up, as a type of collaborative behavior, (1) information-sharing activity is undertaken by two groups of actors, i.e., information providers (or informants/disseminators/sharers) and information seekers (or receivers/recipients). In studies on information behavior in LIS, a user-centered perspective is adopted. These studies place more emphasis on information users (or seekers/receivers) and users' information needs. In contrast, less attention has been paid to information providers; typically, information providers are simplified as "information sources" or "information systems". However, information providers are indispensable players and often initiators in information-sharing activity. (2) In addition, the two parties of actors engage in information-providing and information-seeking activity respectively and collaborate to transfer information from one party to another. Collaboration (or interactions) between information providers and information receivers may vary at various levels. Obviously, in many cases, actors in information-sharing activity can be information providers and receivers at the same time and hence information transfer (information exchange) between actors is a two-way process.

2.2 Information-sharing behavior as a type of mutual-benefit behavior
With regard to motivations of actors engaged in information-sharing activity, it is relatively easy to understand why information seekers/users look for information and a huge body of literature has investigated information needs and information use. In contrast, studies on information sharing primarily focus on why people share information with others. In information-sharing activity, information provider's behavior is not passively driven or solicited by information needs of the user; without information provider's motivations of sharing, information-sharing behavior will not happen. Researchers explored providers' motivations of sharing information from various perspectives. The research conducted by Constant, Kiesler and Sproull (1994) is a preliminary step towards understanding attitudes about information sharing in organizations. They constructed a framework based on *social exchange theory*. This framework treats information-sharing behavior as a kind of social exchange behavior motivated by rational self-interest and interdependence. Palmer (1991) explored the motivations behind information sharing in a case study consisting of on-site observations in two Maine harbors of information sharing about the location of lobsters by lobstermen. The author found that both *economic models* based on individual hedonism and

evolutionary models using only simplistic concepts of kin-selection and reciprocal altruism failed to explain information-sharing behavior of lobstermen because they ignored the crucial social aspect of *human descendant-leaving strategy* that leads to the advantages of maintaining a complex web of social relationships. Kalman, Monge, Fulk and Heino (2002) investigated motivations for resolving communication dilemmas regarding the use of a shared database, which is a multi-user database designed to help people to share ideas and knowledge voluntarily. Communication dilemmas exist whenever the interests of a collective entity (i.e., team, organization, interorganizational alliance) demands that people share privately held information, while their individual interests instead motivate them to withhold it. Four beliefs and attitudes were tested in the study: organizational commitment (identification and involvement with an organization), connective efficacy (an expectation that information contributed to the database will reach other members of the collective), organizational instrumentality (an instrumentality that links successful collective information sharing to broader organizational gains), and information self-efficacy (the self-perceived value of a contributor's information to other database users). The research shows how organizational commitment and expected outcomes predict motivation to contribute, thus providing a resolution of the communication dilemmas. Results of the study support the view that organizational commitment works in conjunction with connective efficacy expectation to motivate specific work-related behaviors. There is no contribution to the model's performance by organizational instrumentality, and survey data do not show a role for information self-efficacy in predicting motivation.

In conclusion, the motivations of information providers to share information vary from pursuing economic and rational interests to seeking psychological and social benefits. This is also true to information seekers/users according previous studies. Therefore, both groups of actors participate in information-sharing activity in order to gain certain types of benefits based on individual or common interests. Talja (2002) conceptualized information sharing as a two-way process in which senior and junior scholars both benefit from the results of each other's searches and have mutual interests and goals. Talja named the behavior of information transfer without mutual interests and benefits as *information giving*. From this perspective, *information-sharing behavior can be defined as collaboration between two groups of actors in order to exchange information with the purpose to achieve their individual or common interests.*

This definition indicates that motivations/interests/benefits of actors on both sides should be considered simultaneously when information-sharing activity is investigated. Then, what are specific benefits that both groups of actors can gain from information-sharing activity? Based on the literature review, we summarize the values that actors can benefit from information-sharing activity as follows: (1) *Process-related values*: values that are added in the process of information exchange, e.g., ease of use, noise reduction, quality. These values can be created by services of information providers, by using a certain type of channels or systems, or through a certain type of communication patterns. (2) *Use-related values*: values that are related to information use, i.e., values that are created when users utilize information or after information is utilized. Use-related values can be further divided into two subcategories: values that information added to the decision-making/problem-solving process and ultimate values created after information is utilized. (3) *Relationship-building values*: values that information-sharing behavior brings to relationship building and maintaining in a community/social network. Relationship-building values are brought by the behavior of information sharing itself

regardless of the content of information being shared and the outcomes of information use (see Table 2).

Categories	Sub-categories	Examples
Process-related values	**Values added by information providers**	ease of use, noise reduction, quality, adaptability, time savings, cost savings
	Values added by Channels & systems	efficiency, ease of use, comfort, cost savings, time saving
	Values added by communication patterns	quality of communication (relevant, timely, and reliable); efficiency and responsiveness; completeness, credulity, timeliness, adequacy, efficacy
Use-related values	**Values added to problem-solving/ decision-making process**	problem reformulation, legitimacy, validation, solutions, and meta-knowledge ; improved purchasing knowledge and skills; optimal decision-making on purchasing, outsourcing, and production capacity allocation
	Values created after information use	improved inventory management performance, system/chain cost saving; enhancement of profitability and customer service level and satisfaction
Relationship values	system wide coordination; encourages alliances, strategic relationships between channel members; relationship commitment and trust; participant satisfaction or team commitment and cohesion; relationship or community building; friendship, family support, trust, commitment; establishing mutual awareness, developing rapport, educating or raising consciousness, demonstrating knowledge of the recipient's unique interests	

Table 2: Values Added by Information-Sharing Behavior

The three types of values are added/created in different phases of the overall information-sharing process; in turn, each type of values initiates or affects corresponding information behaviors in that phase. For example, values added by information products/services may in turn affect receiver's choice of information providers (or products/services) or influence provider's decision of information products/services supply; values added by channels and systems may affect receiver's adoption of communication channels or influence provider's decision on IT investment. In particular, values created by information use and relationship-building values have influence on the overall information-sharing process. Both information providers and receivers may benefit from those values. The two types of values usually act as the common objectives or ultimate goals of the information-sharing behavior and hence, determine such a behavior happen or not. In contrast, process-related values and values added to problem-solving/decision-making process are intermediate values and usually benefit information receivers/users only.

In summary, as a type of mutual-benefit behavior, (1) information-sharing behavior is driven by mutual interests/benefits. Actors participate in information-sharing activity in order to achieve their individual or common interests. (2) From this perspective, information-sharing behavior is also a value-adding/creating process which may benefit each party.

2.3 Information-sharing behavior as a type of relationship-based behavior
As a type of collaborative behavior, information sharing is not an individual behavior but a collective and collaborative effort occurring in social networks, i.e., communities of practice or communities of sharing. Information-sharing behavior is supported and facilitated by social networks that connect information providers and receivers. In supply chains, entities are connected by buyer-supplier relationships. Huang, Lau and Mak (2003) identified five types of supply chain structure, i.e., dyadic, serial, divergent, convergent, and network supply chain. The structure of the supply chain is primary factor affecting the sharing of production information among supply chain members. Talja's study (2002) reveals that the social aspects of information seeking cannot be captured in a framework

that views individuals as functioning independently but adhering to social and cultural norms. The study suggests that further research on information sharing is needed to develop concepts and frameworks that start from the assumption that users are not individuals working in isolation but communities of sharing engaged in joint tasks. The study conducted by Constant, Kiesler and Sproull (1994) shows that attitudes toward social and organizational norms mediate the relationship between self-interest and attitudes toward information sharing. Organizations should develop clear policies regarding sharing of information. Hersberger, Rioux and Cruitt (2005) presented an analytical framework for examining information sharing in online social networks based on McMillan and Chavis' (1986) model of community. The framework emphasizes that information-sharing behavior is critical in building critical relationships in online communities. The framework is conceptualized as a four-tier pyramid. The foundational first tier consists of the basic building blocks of community identified by McMillan and Chavis' (1986) model of community: 1) membership, 2) influence, 3) integration and fulfillment of needs and 4) shared emotional connection. The second tier expands on the above basic underpinnings, bringing in the concepts of social networks as information networks. Relationships between community members can be well analyzed by using social network analysis methods. In order to understand social networks as information networks, this study focuses on the concept of "tie strength", which can be measured by duration and frequency of contact, emotional intensity, etc. The third tier of the framework addresses information exchange within communities, i.e., how current theories and models of information needs, information seeking, and particularly the act of information exchange can be used to explain the ways in which online relationships are developed. The fourth and final tier of the framework specifically examines information-sharing behaviors. This tier is primarily based on Rioux's (2004) information acquiring-and-sharing concept.

On the other hand, information-sharing activity is a type of relationship- and community-building activity (Talja 2002). Marshall and Bly (2004) explored how people share information that they encounter in their everyday reading, especially sharing intentionally retrieved materials. The study finds that the person sharing the material is more apt to be sharing it for reasons associated with strengthening social ties than passing on content with a known use; in fact, the content itself may have little immediate value to the recipient. Four types of social values of sharing encountered information are identified in this study: sharing to establish mutual awareness, sharing using common interests to develop rapport, sharing to educate or raise consciousness, or sharing to demonstrate knowledge of the recipient's unique interests.

In summary, as a type of relationship-based behavior, (1) information-sharing behavior is supported and facilitated by relationships (or communities of practice/social networks) that connect two groups of actors. The particular relationship between the two groups of actors is the primary environmental factor of information-sharing behavior. Different levels of relationship strength are required to support information-sharing behavior with different levels of collaboration. For example, information sharing with level I collaboration requires a community/culture/weak tie of sharing but not necessary a formal mechanism. Information sharing with level II collaboration requires a tentative organization (e.g., project teams, research groups, conferences). Information sharing with level III collaboration requires an institutionalized long-term mechanism. Moreover, together with actors' internal characteristics and other environmental factors, such relationships determine the distribution of benefits gained from information sharing and the specific patterns/strategies that actors adopt in information-sharing behavior. (2)

Information-sharing behavior itself and its outcomes in turn affect the relationship that connects actors; in another word, information-sharing behavior is a relationship- and community-building activity.

Based on above discussions, information-sharing behavior is characterized by three major features: collaboration, mutual benefits, and supported relationships. Therefore, we propose a general definition of information-sharing behavior: *information-sharing behavior is a type of information behavior in which two groups of actors who are connected by a certain type of relationship collaborate to exchange information in order to achieve individual or common interests.*

3 Measuring information-sharing behavior

To obtain in-depth understandings of information-sharing behavior, it is necessary to investigate such a behavior empirically and quantitatively. Information-sharing behavior is often difficult to observe directly considering the various actors involved and the diversity of instances in which it may take place. In order to assess whether actors are involved in information-sharing behavior and the extent of their involvement, one approach consists to measurethe level of interactions between actors involved in information-sharing activity. Actually, the level of interactions indicates the level of information sharing between actors. In many cases, although there is a certain form of information-sharing mechanism between organizations, it may only exists on paper or just as a "policy" and may fails when there is a crisis (or may even contributes to that crisis). A typical example is the 9/11 attacks on the U.S.A. Before and on the 9/11 attacks, lots of failures happened on information sharing between the CIA, the FBI, the Federal Aviation Administration, the executive administration, and military departments although there were formal arrangements of information-sharing mechanisms between these agencies according to bylaws. In fact, the 9/11 commission gave the U.S. government D's for its efforts to improve the information-sharing regime (The 9/11 Commission, 2004). Without measuring the level of interactions between actors of information sharing, it is difficult to evaluate how active, efficient, and effective an information-sharing mechanism/activity actually is. Indicators of information-sharing level may vary when different types of information are shared in different contexts. This exploratory study focuses on measuring the level of sharing operational information in supply chains.

3.1 Indicators of the Level of Operational Information Sharing in Supply Chains

A *supply chain* is the linked set of resources and processes, consisting of suppliers/vendors, manufacturers, distributors and retailers interconnected by transportation, information and financial infrastructure (Sahin and Robinson, 2002). *Operational information* in this study refers to sales data, inventory data, order status, and shipping information which are required for daily business operation. It is extremely important for survival and development of enterprises to keep close and strong relationships with suppliers/customers. The level of information sharing with suppliers/customers indicates how strong the relationships with suppliers/customers are and how firmly an enterprise has established its position in the industry. In supply chains, information sharing is proposed as a primary coordination mechanism to mitigate bullwhip effects, which are created when supply chain members process the demand forecast from their immediate downstream member in producing their own forecasts; that is, making sales data at a downstream entity available to the upstream entity. Hence, both entities can update their forecasts with the same raw data. The lack of accurate and timely information flow across supply chain partners also results in inefficiency, such as

inaccurate forecasts, excessive inventory, low capacity utilization, and inadequate customer service (Lee, Padmanabhan and Whang, 1997).

Based on the literature review, three groups of major indicators of the level of operational information sharing in supply chains are identified: 1) indicators reflecting the *content dimension* of sharing (number of types of information being shared, level of detail), 2) indicators reflecting the *spatial dimension* of sharing (distance of sharing, width of sharing), and 3) indicators reflecting the *time dimension* of sharing (frequency, timeliness). For each indicator, the level of information sharing in supply chains is defined as shown in Table 3.

Indicator / Level		No Information Sharing	Partial Information Sharing	Full (Complete) Information Sharing
Content Dimension	*Number of Types of Information*	Only actual orders placed by immediate customers or product information of immediate suppliers are shared	Some types of operational-level information (not including actual orders or product information of immediate chain partners) are shared	All types of operational-level information are shared
	Level of Detail	No information (except for actual orders or product information of immediate chain partners) is shared	Generic (or aggregated) information (e.g., inventory control policy, production scheduling rules, etc.) is shared	Specific (or in-depth) information (e.g., inventory level, POS data, etc.) is shared
Spatial Dimension	*Distance of Sharing*	None of any tiers in a supply chain is involved	A part of tiers in the supply chain is involved	All tiers in the supply chain are involved
	Width of Sharing	None of any enterprises in a given tier of a supply chain is involved	Some enterprises in a given tier are involved	All enterprises in a given tier are involved
Time Dimension	*Frequency of Sharing*	No information sharing activity occurs	From seldom to frequently	Real time (or day-to-day, 24 ×7),
	Timeliness of Sharing	No information sharing activity occurs	Share with some degree of delay	Share without any delay

Table 3: Indicators of the Level of Operational Information Sharing in Supply Chains

Indicators of the content dimension: (1) *Number of types of information being shared*, the number of specific types of operational information that are shared between supply chain members is one of the most frequently adopted indicator of the level of information sharing between supply chain members in previous studies (Sahin and Robinson 2002); (2) *Level of detail*, it can be defined as the extent to which the amount of details is included in a given piece of information being shared (Huang, Lau and Mak 2003).

Indicators of the spatial dimension: (1) *Distance of Information Sharing*, it refers to the number of tiers in a supply chain into which a specific type of information is disseminated (Goecks and Mynatt 2004); (2) *Width of information sharing*, that is, the number of enterprises in a given tier with whom a specific type of information is shared (Huang, Lau and Mak 2003) (see Figure 1).
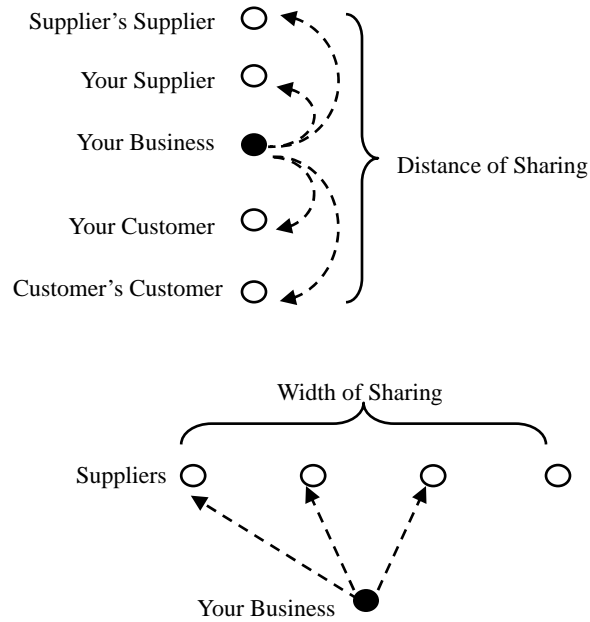
Figure 1: Distance and Width of Sharing in a Supply Chain

Indicators of the time dimension: (1)*Timeliness of sharing*, it can be defined as the interval between the time when the newly updated information is acquired and the time when it is provided to trading partners (i.e., the delay of updating) (Lee, Padmanabhan and Whang 1997); (2) *Frequency of sharing*, i.e., the number of times an enterprise disseminates or receives a specific type of information within a given tier of a supply chain over a certain length of period (Lee, Padmanabhan,and Whang 1997).

3.2 Measuring the Level of Information Sharing in Supply Chains
(1) *Number of types of information being shared*. Three types of operational information are investigated in this study: demand information (including order information and sales data), inventory information (including inventory level, inventory replenishment decisions, and inventory control policy about raw materials and/or products), and order status (including order processing and shipping information). A four-point scale is developed to measure this indicator: 0 for none of the three types of information is shared, 1 for one of the three types of information is shared, 2 for two of the three types of information are shared, and 3 for all of the three types of information are shared.

(2) *Level of detail*. In this study, respondents report the average level of detail when they share a specific type of information with their supply chain partners. Respondents' estimations about the average level of detail are measured by a five-point scale: 0 for no information is shared; 1 for generic information is shared, e.g., inventory control policy, rough estimations about sales, and policy about order processing and shipping; 2 for aggregated information is shared, e.g., simple sales report that only provides summed figures such as total price and total quantity, simple description of work-in-process, or rough estimation about the shipping location and date without any further details or real-time tracking methods, and rough estimations of in-stock quantity; 3 for most details in the original information are shared with minor revisions or simplifications, and 4 for all details in the original information are shared, e.g., itemized point-of-sales data, complete order information (including order quantity, order batch size, due date, total price, and customer information, etc.), complete inventory information (including in-stock quantity by specific product category, next reorder point, on-hand and backlog

order, order-in-process, etc.), detailed and updated information about order processing status (including date, time, processing phrase description, person in charge, etc.) and shipping information (including date, time, item name, quantity, carrier, current location, activity, tracking number, person in charge, etc.).

(3) *Distance of information sharing*. In this study, respondents report the specific tier(s) into which they disseminate a given type of information (demand information/ order status/ inventory information): 0 for do not share this type of information with any chain partners, 1 for share this type of information with chain partners in only one tier of the supply chain, 2 for share this type of information with chain partners in two tiers of the supply chain, 3 for share this type of information with chain partners in three tiers of the supply chain, and 4 for share this type of information with chain partners in all four tiers.

(4) *Width of information sharing*. In this study, respondents are asked to give an estimation of the proportion of chain partners with whom they share a specific type of information to the total number of chain partners linked with them by the buyer-supplier relationship within a given tier of the supply chain. A five-point scale is developed to measure this indicator: 0 for do not share this type of information with any of your customers (suppliers/customers' customers/ suppliers' suppliers), 1 for only share this type of information with some of your customers, 2 for share this type of information with about half of your customers, 3 for share this type of information with most of your customers, and 4 for share this type of information with all of your customers.

(5) *Timeliness of sharing*. In this study respondents are asked to report the length of time for them to send a specific type of information to trading partners after such information is newly updated. These estimations about timeliness of sharing are measured by a five-point scale: 0 for several months later or even longer, 1 for several weeks later, 2 for several days later, 3 for several hours later, and 4 for immediately.

(6) *Frequency of sharing*. In this study, respondents report the average frequency of sharing a specific type of information within a given tier of a supply chain. A five-point scale is developed to measure respondents' estimations of the average frequency of sharing: 0 for nearly never, 1 for quarterly, 2 for monthly, 3 for weekly, and 4 for daily.

(7) *Measuring the overall level of operational information sharing in supply chains.* According to the above discussion, obviously, the level of information sharing in supply chains is a multi-dimensional construct. In order to investigate the overall level of information-sharing behavior, all these indicators should be taken into consideration at the same time. Therefore, besides measuring each indicator of information-sharing level, this study construct a composite measure by combining all of these indicators together in order to provide a tool to observe the overall level of operational information sharing in supply chains:

$$V = \bar{T} + \bar{L}_{..} + \bar{D} + \bar{W}_{..} + \bar{F}_{..} + \bar{M}_{..}$$

V = the overall level of information sharing; $\bar{T}$ = the overall average score of types of information being shared; $\bar{L}$ = the overall average score of frequency of sharing; $\bar{D}$ = the overall average score of distance of sharing; $\bar{W}_{..}$ = the overall average score of width of sharing; $\bar{F}$ = the overall average score of level of detail; $\bar{M}_{..}$ = the overall average score of timeliness of sharing.

4 Methodology

The method of data collection in this study is a cross-sectional web-based survey. The target population of this survey consists of small Canadian enterprises with minimal electronic connectivity. To be included in the survey, enterprises in the above-mentioned sectors must have (1) 50 employees or fewer, and (2) at least the minimal level of IT infrastructure, i.e., access to email applications and the Internet. Top executives in these enterprises are invited to complete the online questionnaire with respect to their activities of sharing information with their suppliers and customers. Invitation letters were distributed through emails, discussion groups, online bulletin boards for small businesses, etc. The counter on the web page of the online survey recorded 295 hits by March 6, 2007. Total 29 responses were acquired. Among the 29 responses, 22 are usable.

5 Data Analysis

Respondents of the survey are manufacturers/ wholesalers/retailers of computers, books, drugs, gas, apparel, grocery, childcare products, building materials, and home electronics, and business service provider. Other characteristics of respondents are summarized as follows: *Company size by number of employees*: no employees: 15%; 1-5 employees: 55%; 6-20 employees: 15%; 21-50 employees: 5%; more than 50 employees: 10%. *Years in business*: less than 1 year: 18%; 1-3 years: 45%; 4-6 years: 14%; 7-9 years: 9 %; more than 10 years: 14%. *Role in the industry*: manufacturer: 5%; manufacturer, wholesaler and retailer: 10%; wholesaler: 10%; wholesaler and retailer: 35%; retailer: 30%; service provider: 10%. *Level of company IT infrastructure*: level I (traditional manual-based communication technologies): 10%; level II (Simple semi-manual information technologies): 50%; level III (automated technologies): 25%; level IV (integrative technologies): 5%; level V (extend integrative technologies): 10%. *Relationships with trading partners*: suppliers: 80%; customers: 100%; suppliers' suppliers: 15%; customers' customers: 20%.

A major concern of the survey is how variables proposed in the conceptual framework are correlated with each other. It should be emphasized that the body of the data collected so far in this survey is relatively small and hence the following discussions about relationships between variables are based on trends identified only tentatively and that may be different as more data are collected.

(1) No statistically significant relationships are found between the major contextual factors, i.e., number of trading partners (suppliers/customers/suppliers' suppliers/customers' customers), the level of company IT infrastructure, company size (number of employees), years in business, and the six indicators of the overall level of information sharing (see Table 4).

	Number of suppliers	Number of Customers	Suppliers' suppliers	Customers' customers	Company IT level	Number of employees	Years in business
Width	-0.21901	-0.21406	0.17014	-0.18845	-0.17003	-0.17616	-0.00384
Distance	-0.29808	-0.08990	-0.04974	-0.17814	0.09551	0.03250	0.03250
Frequency	-0.20655	-0.12435	0.31354	-0.17274	-0.24299	-0.12411	0.02170
Timeliness	-0.20265	-0.08167	0.30622	-0.14439	-0.12930	0.03984	0.12217
Detail	-0.21257	-0.11639	0.07549	-0.15522	-0.17245	-0.12052	0.02505
Type	-0.37018	-0.16177	-0.02211	-0.16478	0.03909	0.03936	0.14632
Total	-0.31037	-0.14992	0.15513	-0.18761	-0.11587	-0.02881	0.12658

Table 4: Matrix of Pearson Correlation Coefficients between Contextual Factors and Indicators

(2) Indicators of information-sharing level are positively correlated with two of respondents' perceptions about information sharing to some extent, i.e., the perceived level of sharing and the perceived benefits of sharing. However, the perceived strength of relationships between respondents and their suppliers/customers does not show significant correlations between indicators of information-sharing level (see Table 5).

	Detail	Type	Distance	Width	Frequency	Timeliness	Total
Perceived level	0.44153	0.34424	0.29387	0.59586	0.52586	0.58079	0.53016
Perceived strength	0.03593	-0.11831	-0.19852	0.09787	0.06713	0.13036	-0.05715
Perceived benefits	0.39262	0.23060	0.16737	0.38794	0.38807	0.46294	0.36008

Table 5: Matrix of Pearson Correlation Coefficients between Contextual Factors and Indicators

(3) There are positive interrelationships existing among the six indicators (see Table 6):

	Width	Distance	Frequency	Timeliness	Detail	Type
Width	1.00000	0.55071	0.92922	0.89406	0.93684	0.61314
Distance	0.55071	1.00000	0.49064	0.45773	0.68377	0.84459
Frequency	0.92922	0.49064	1.00000	0.97404	0.93187	0.56516
Timeliness	0.89406	0.45773	0.97404	1.00000	0.89329	0.56593
Detail	0.93684	0.68377	0.93187	0.89329	1.00000	0.68939
Type	0.61314	0.84459	0.56516	0.56593	0.68939	1.00000

Table 6: Matrix of Pearson Correlation Coefficients between Six Indicators

The time dimension of sharing, i.e., the frequency and timeliness of sharing, is positively correlated with the width of information sharing and the level of detail. Meanwhile, the frequency and timeliness of sharing has a significant positive correlation. In addition, the width of sharing is positively correlated with the level of detail; while the distance of sharing is positively correlated with the number of types of information being shared (see Figure 2).
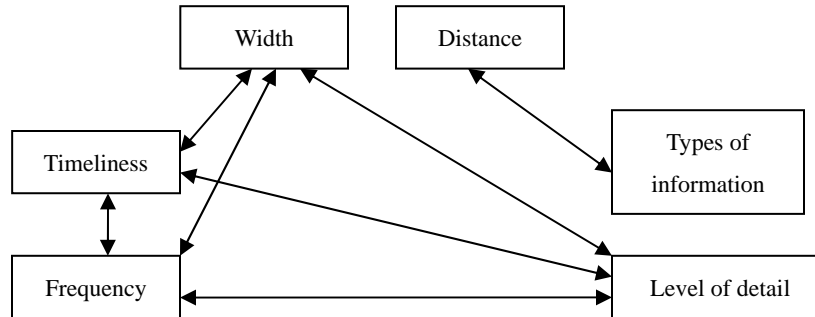

Figure 2: Correlations between Indicators of Information-Sharing Level

6 Conclusions

This paper explores the theoretical foundations of information-sharing behavior and proposes a general definition of information-sharing behavior: it is conceptualized as a type of community-based collaborative behavior driven by mutual benefits. This study also measures the level of information sharing in supply chains by integrating its six underlying indicators into a composite index. Results of the online survey show little relationships between major contextual factors and the information-sharing level; while the six underlying indicators of the information-sharing level are positively correlated at different degrees. This means that information-sharing behavior may be a type of self-reinforced behavior rather than a type of context-driven behavior: the behavior of information sharing itself is one of the most important driven forces to promote further improvement of information-sharing activity.

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There are also some limitations of this exploratory research that should be solved in future study. First, the body of data collected is relatively small; more data should be acquired in order to reveal more reliable and stable trends. Furthermore, the composite index for measuring the overall level of information sharing in supply chains is constructed by simply summing up its six underlying indicators. In fact, further analyses may reveal that a more sophisticated measurement model should be used to conceptualize this index since the six underlying indicators are formative indicators.

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