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# ***Spatial Data Sharing: A Cross-Cultural Conceptual Model***

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## ABSTRACT

In order to make full use of spatial data infrastructures, spatial data sharing (SDS) is essential. Various authors indicate that the attitudes both of individuals and of organizations toward SDS are quite often problematic. For various reasons and motivations, SDS is far from optimal. However, research on individual and organizational behavior in SDS is in its infancy and presents a challenge for new theory development. The objective of this paper is to shed light on the interaction between individual and organizational SDS behaviors and their social and cultural aspects. A new theoretical model is proposed. This model integrates concepts from multiple theories: theory of planned behavior, culture (grid-group) theory, and Hofstede's cultural dimensions. The relationships within the model are formulated in 23 hypotheses. The hypotheses have not yet been tested. Knowledge about relationships among individuals and organizations derived from the emerging model may provide insights into the attitudes of individuals and organizations toward SDS.

## INTRODUCTION

Many countries are developing spatial data infrastructures (SDIs) in order to better manage their spatial datasets (Rajabifard and Williamson 2004) for supporting various applications. The development of these datasets is often done with little coordination among various organizations, and as a consequence duplication of effort and wasting of resources occur (Warnecke et al. 1998; Wehn de Montalvo 2003a; Omran et al. 2006). In order to reduce this duplication, spatial data sharing (SDS) is essential. In many instances individuals and organizations are unwilling to share data across and within organizations. SDS behavior is strongly related to sociocultural context. Understanding and changing individual and organizational behaviors could be the key to improving spatial data sharing.

Individual spatial data sharing behavior has not received adequate attention in either research or practice. Even when social issues are considered, the focus is mainly on people as participants in the implementation process (Eason 1993), political issues (Buchanan 1993), or better design of decision support tools (Medyckyj-Scott and Hearnshaw 1993) rather than on psychological factors related to data sharing. Based on sociocultural theories, personal factors that strongly influence the individual decision to share data include attitudes, experiences, self-confidence, empathy, fatalism, motivation, behavior, trust, ability to cope with uncertainty, and incentives. In our assessment, the influences of these factors on SDS have not been sufficiently investigated. The current study was motivated by the question, “What factors influence individual SDS behavior?”

Another issue germane to spatial data sharing is the question of organizational resistance to sharing data. Resistance to share data may be due to a lack of motivation. Organizations are motivated by organizational needs and capabilities (Calkins and Weatherbe 1995), the advantages of synergisms (Craig 1995), and appeals to professionalism and common goals (Obermeyer 1995). These common or “superordinate” objectives are among the noneconomic reasons for sharing (Tjosvold 1988; Pinto and Onsrud 1995). Appropriate organizational motivation is required for data sharing; incentives can also motivate the organizations to share their data. The current study was also motivated by the question, “What factors influence organizational SDS behavior?”

To answer these two questions, Tayeb (1988) proposed two lines of research. The first line is institutionalism, which deals with structural aspects of organizations. The second line is “ideationalism,” which focuses on the intentions, attitudes, and values of organization members. The relationship between individual and organizational behaviors and data sharing is very complex (Dueker and Vrana 1995).

Many sociocultural theories (e.g., theory of planned behavior and culture theory) can be used to characterize individual and organizational behaviors and describe relationships between them. Hofstede (1991, 2001) and Hofstede and Hofstede (2005) argue that five dimensions can be used to classify societies according to their culture: power distance, uncertainty avoidance, individualism/collectivism, masculine/feminine, and long-term/short-term orientation. Power distance (PD) represents the extent of adherence to formal authority and the degree to which less powerful members will accept unequal distribution of power. This dimension addresses how a society handles inequalities among people. Uncertainty avoidance (UNA) refers to how much people feel threatened by ambiguity, as well as the felt importance of rules and standards. This dimension addresses how a

society reacts to the fact that the future is unknown, for example, whether it tries to control the future or lets it happen. Power distance and uncertainty avoidance have consequences for the way people build their institutions and organizations. Individualism/collectivism refers to the basic level of behavior regulation. It refers to the degree of interdependence a society maintains among individuals. In an individualistic society, the ties between individuals are loose. In a collectivist society people integrate into strong, cohesive groups and tend to do what is best for the group. Masculine cultures emphasize work and material accomplishments. In contrast, feminine cultures put human relationships at the forefront, and work is seen as a way to support the more important things in life. A long-term orientation (LTO) means that people are more concerned with the long-term effects of their decision. A short-term orientation (STO) tends toward consumption and maintaining materialistic status.

Although Hofstede made a major contribution to the study of organizations within a cultural setting, he did not empirically investigate the relationships between the five dimensions and the attitudes and behaviors of individuals and organizations. So, it is important to discern in what ways individuals and organizations are influenced by Hofstede's dimensions. How does national culture influence the attitudes of individuals and organizations toward SDS?

Although the bulk of the literature focuses on technical aspects of spatial data sharing, the emphasis of this paper is on individual and organizational aspects. The objective of this paper is to develop a conceptual model that describes the willingness of individuals and organizations to share spatial data. Data sharing by individuals and organizations in a sociocultural context serves as a starting point. The approach is to ground the assessment of variables in well-accepted theories. The innovative aspect of the model is the integration of different theories and concepts. Such a model increases our insight into the SDS behaviors of individuals and organizations and might potentially be used to explain differences between societies and organizations.

After an overview of SDS concepts and gaps, we propose an SDS model, describe the theoretical foundation and hypothesis development, and discuss the merits of the model.

Spatial data sharing is generally considered problematic. A considerable number of SDS relationships have failed to meet their founders' expectations. Porter (1987) and Park and Ungson (1997) report that the failure rate in interorganizational relationships is approximately 50 percent. Organizations, however, continue to form these relationships, and as a result failures are expected to continue or even increase (Miles and Snow 1992).

Calkins et al. (1991) present factors that could influence institutional data sharing: bureaucratic procedures, cooperation, organizational structure, corporate culture, and political environment. Kevany (1995) explores factors that may create a sharing environment and identifies opportunities, incentives, impediments, and resources as the main factors that influence SDS. Pinto and Onsrud (1995) state that, under conditions of resource scarcity, organizations tend to be driven by the desire to maintain some form of control over other organizations.

As risks increase, so does the need for trust. Trust is mostly connected to risks and risk taking (Mayer et al. 1995; Coulter and Coulter 2002) and influences both individuals and organizations (Doney and Cannon 1997).

Most of the SDS frameworks in the literature are based on the authors' experiences with data sharing. An exception is the work done by Wehn de Montalvo (2001; 2003a,b), who proposed a model of SDS perceptions and practices in South Africa from a social psychological perspective. Also, Nedović-Budić et al. (2004) proposed a model that includes the motivation behind sharing. These two examples move towards a more widely grounded theoretical approach to SDS. However, if we consider all the literature on SDS, the following research gaps are still observed:

1. No comprehensive theory-based framework for analyzing relevant factors exists.
2. The relationships between factors have not been adequately investigated.
3. The proposed experimental frameworks have not been verified.
4. Sociocultural aspects of SDS have not been adequately considered.
5. No systematic analysis of SDS between individuals and organizations has been performed.

The literature identifies uncertainty, incentives, resource scarcity, autonomy, rules, and similar factors within particular sociocultural settings as explaining, predicting, or modeling SDS. However, the integration of such factors in an overall model is missing, and little is known about the influences of these factors on the reasons that individuals and organizations are willing or not willing to share data. Sociocultural perspectives provide a useful point of departure for exploring this issue.

Interactions among and between individuals and organizations are a complex phenomena, and SDS behaviors across contexts cannot be described by a single theory. Our proposed model integrates insights from three theories: theory of planned behavior (Ajzen 1991), culture (grid-group) theory (Douglas 1970; Thompson et al. 1990), and Hofstede's (1980) culture dimensions. These theories are strong candidates for developing a more generalizable approach to assessment of SDS because they have already been investigated and identified by other researchers as having relevancy in this domain. These theories have received strong empirical support in the social sciences, having been widely applied and tested with considerable proven explanatory and predictive value for the behaviors of individuals, organizations, and even countries. We expect that these theories can also be used for modeling spatial data sharing, both for individuals and for organizations.

**Overall model.** Figure 1 shows the main components of the proposed SDS model. SDS is influenced by individual and organizational behaviors. Individual behavior (micro level) is analyzed by employing the major concepts of the theory of planned behavior (TPB). Organizational behavior (macro level) is studied by using the culture (grid-group) theory. The individual and the organizational levels are linked within the model in two ways: by the cultural dimensions

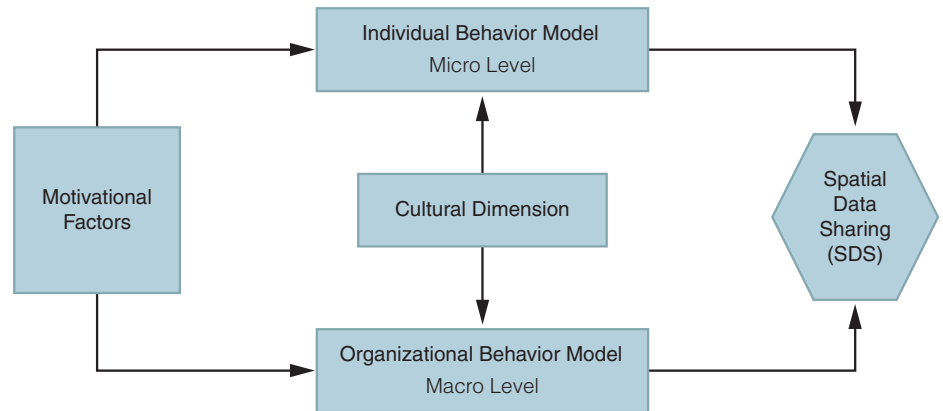


Figure 1. Main components of the SDS model.

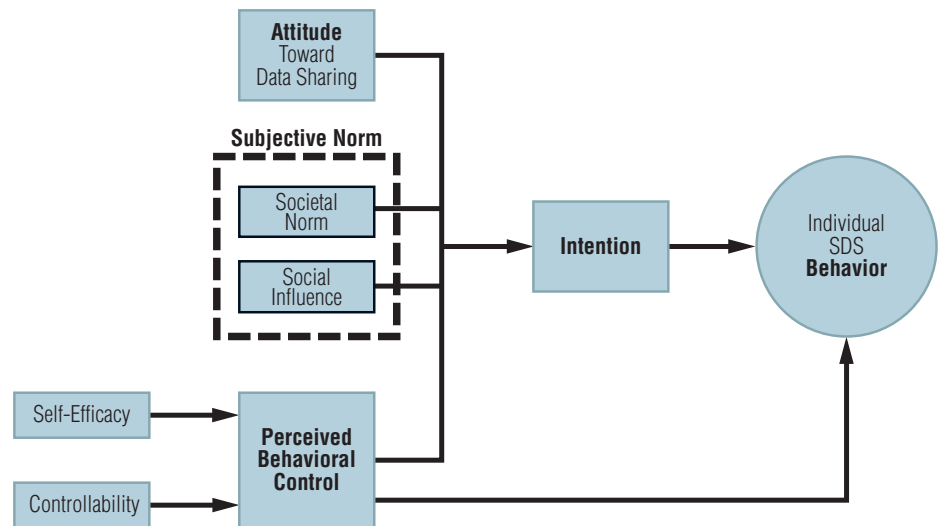


Figure 2. Individual-behavior submodel.

of Hofstede and by motivational factors derived from literature. Nakata and Sivakumar (2001) argue that Hofstede's cultural dimensions serve as the most powerful culture theory for social research. In addition, there are potential motivational factors (trust, uncertainty, incentives, resource scarcity, rules, and autonomy) that affect individual and organizational SDS behaviors. We argue that cultural dimensions in combination with motivational factors could be used as a link between the two submodels described below.

**Individual-behavior submodel (micro level).** The individual submodel is based mainly on TPB (figure 2). Ajzen (1991) and Ford et al. (2003) indicate that TPB has been developed with individuals as units of analysis. Ajzen (1991) argues that a central factor in TPB is the intention of individuals to demonstrate a particular behavior. The intention of individuals to engage in SDS is closely linked to actual behavior. Ajzen (1988, 1991) proposes that intentions are assumed to capture the motivational factors that influence a behavior. The stronger the intention

for a particular behavior, the more likely is the behavior itself. At the level of the individual, we measure willingness to share spatial data. Ajzen (1985, 1988, 1991) argues that the behavioral, normative, and control beliefs are influenced by a wide variety of cultural, personal, and situational factors.

The intention of each individual is based on the attitude, subjective norm (SN), and perceived behavior control (PBC) relative to data sharing. In order to predict the spatial data sharing intention of an individual, we need to predict these three underlying factors. Attitude is defined as the degree of positive or negative value for SDS. Subjective norm is defined as the social pressure for sharing felt by the individuals. Subjective norm is based on societal norm and social influence. Societal norm refers to norms of the larger societal community, while social influence reflects opinions from family, friends, and peers. PBC is the extent to which the individual controls the sharing procedures for a particular spatial dataset. PBC is influenced by the individual's judgment of his own capabilities (self-efficacy) and by his confidence in the data sharing process (controllability). By understanding and estimating these three factors, we can assess an individual's intention for SDS.

**Organizational-behavior submodel (macro level).** The organizational submodel is based on culture theory. Thompson et al. (1990) propose that any organizational setting consists of two dimensions: grid (action) and group (identity) (figure 3). Adapting the theory to SDS requires specific definitions of the grid and group concepts. "Grid" refers to the degree of individual freedom in SDS and rules of authority that limit how people behave toward one another. In cultures with strong grids, everyone has a well-defined place in his or her organization. Institutions classify individuals and restrict their transactions. Moving away from a strong grid, dependence decreases and autonomy, control, and competition open up (Douglas 1978). This paves the way for freedom of transactions. "Group" refers to the degree to which individuals are member of groups or networks (social boundedness). The more an individual is incorporated into bounded units, the more his choice is subject to group determination (Douglas 1978). In combination, these two key dimensions can produce four organizational settings for SDS—hierarchy, egalitarianism, individualism, and fatalism (always potentially present in any group or organization).

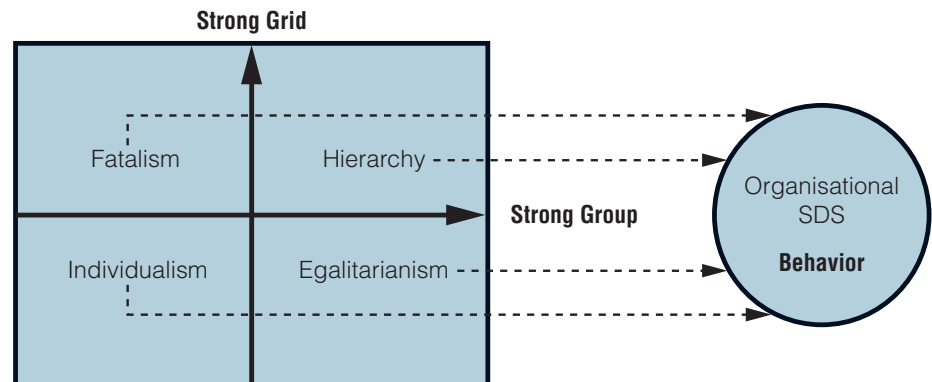


Figure 3. Organisational-behavior submodel.

**Linkage between the individual- and organizational-behavior submodels.** The proposed model combines Hofstede's cultural dimensions with the motivational factors to link the two submodels.

First, Hofstede's cultural dimensions play an important role in combining the individual and organizational submodels. For the individual-behavior model, we assume that cultural dimensions influence the values and weights of the predictors for intention (attitude, SN, and PBC). Ajzen (1991), Straub et al. (1997), and Ford et al. (2003) expect that national culture influences the weighting of the predictors of intention in TPB. For example, in a culture that is more individualistic, the effects of subjective norms are low and the effects of attitude and perceived behavioral control are high (i.e., the individual's own opinions are more important). Likewise, in the organizational behavior model, egalitarianism within organizations is expected in such a culture.

Second, motivational factors (e.g., trust) can influence individual and organizational behaviors. For example, Weick et al. (1999) argue that the relationships between individuals and organizations based on trust are characterized by strong ties. These strong ties lead to a more cooperative attitude towards spatial data sharing. Another important reason for adding motivational factors is that the cultural dimensions of Hofstede probably do not explain all relations. The exact relationship between Hofstede's cultural dimensions and motivational factors on the one hand and the variables in the model on the other has not yet been empirically tested. Hypotheses on the nature of these relations are discussed below.

The proposed model and the hypotheses are presented in figure 4. The theoretical foundation and hypothesis development are presented in the next part based on Hofstede's cultural dimensions and motivational factors.

**Hofstede's cultural dimensions.** The individualism/collectivism dimension represents a continuum. Hofstede and Hofstede (2005) explain that in an individualist society people are expected to look after themselves. In contrast, a collectivist society finds people integrated into strong, cohesive groups. Hofstede and Bond (1988) demonstrate that collectivistic societies have strong relations within in-groups. In-group relations focus on maintaining harmony (Bond and Smith 1996). Once collectivistic societies have established a positive attitude toward data sharing, they tend to internalize it and take it into their in-group circle. Pavlou and Chai (2002) found that the relationship between attitude and transaction intention is stronger in collectivist societies than in individualist societies. Thus, we would expect that a higher level of collectivism leads to a more positive attitude towards SDS. **Hypothesis 1:** The positive relationship between attitude and the intention for SDS is stronger in collectivist cultures than in individualist cultures.

The intentions of people to engage in data sharing are a function of societal norms and social influence. Hofstede (1991) argues that members of individualistic societies prefer self-sufficiency while those in collectivistic cultures acknowledge their interdependent nature and obligations to the group. Hofstede and Hofstede (2005) indicate that an individualist culture is one in which the ties between individuals are loose. **Hypothesis 2:** The positive relationship between

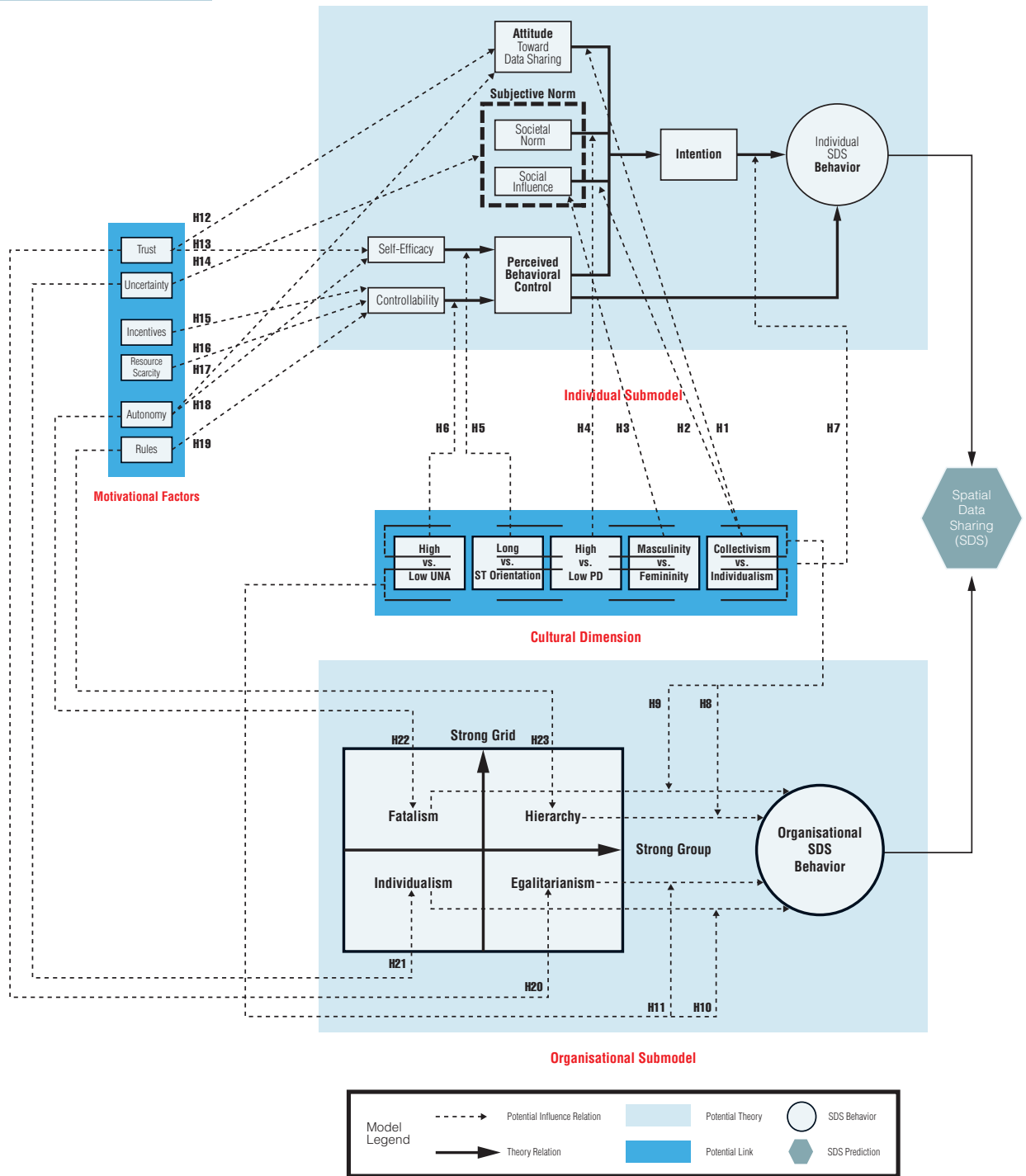


Figure 4. Detailed SDS model.



social norms and the intention for SDS is stronger in collectivist cultures than in individualist cultures.

The cultural dimension of masculinity/femininity relates to one's self-concept: who am I, and what is my task in life? A society is called masculine when emotional gender roles are clearly distinct. In feminine cultures, emotional gender roles overlap (Hofstede and Hofstede 2005). We see the influence of cultural masculinity in the emphasis on competitiveness and SDS success. In highly masculine environments, individuals are driven toward cooperation and innovation in order to prove their worthiness. This creative energy can be expected to result in higher levels of SDS. Chiasson and Lovato (2001) report that a subjective (social) norm is a significant antecedent of the intention for information system adoption. The higher the level of cultural masculinity, the higher the intention for SDS. **Hypothesis 3:** The positive relationship between social norms and the intention for SDS is stronger in masculine cultures.

The second relevant cultural dimension is power distance (PD), which is the extent to which people accept a hierarchical system with an unequal power distribution. In cultures high in power distance, SDS decisions are made by superiors without consulting their subordinates, and employees fear disagreements with their superiors (Hofstede 1980, Hofstede and Hofstede 2005). Superiors tend to be autocratic, and subordinates willingly do as they are told (Hofstede 1991). Thus, PD is closely related to societal influence. Cultures higher in PD are likely to impede SDS. Lower-level employees tend to wait for instructions. In contrast, cultures low in power distance have a more cooperative relationship between superiors and subordinates. Pavlou and Chai (2002) found that the relationship between subjective norm and online transaction intention is stronger in cultures with high power distance. Thus, high PD can be expected to result in lower levels of SDS. **Hypothesis 4:** The negative relationship between societal influence and the intention for SDS is stronger in cultures with high power distance.

Ajzen suggests (1991) that PBC reflects beliefs regarding access to resources and opportunities required to facilitate a behavior and emphasizes (2002) that PBC denotes a subjective degree of control over a behavior (e.g., the perceived ease or difficulty of sharing data). Mathieson (1991) showed that behavioral control influences the intention to use an information system. A positive relationship between control and intentions was found by Taylor and Todd (1995) for users in a computer resource center. Pavlou (2002) found the same results for e-commerce behavior. High PBC should have a positive effect on SDS intentions—since individuals do not fear opportunistic behavior from bosses—and is likely to reduce barriers to SDS.

According to Hofstede and Hofstede (2005), LTO plays an important role in day-to-day decisions, giving people more control over their actions. Cultures with LTO focus on future rewards. Pavlou and Chai (2002) found that the positive relationship between perceived behavior control and transaction intention is stronger in societies characterized by long- versus short-term orientation. Therefore, an LTO environment would foster the intention for SDS. The higher the level of LTO, the higher the intention for SDS. **Hypothesis 5:** The positive relationship between PBC (self-efficacy) and the intention for SDS is stronger in long-term-oriented cultures.

Uncertainty avoidance (UNA) is “related to anxiety, need for security and dependence upon experts” (Hofstede 1980). Under conditions of high levels of uncertainty, individuals avoid unfamiliar situations and tend to develop a conservative attitude. A culture that is high in uncertainty avoidance would exhibit a rule orientation and employment stability. In such a society, change and innovation are not valued. SDS would not be sought or welcomed. As a result, individuals are likely to have no incentive to share spatial data. Individuals feel that “what is different is dangerous.” **Hypothesis 6:** The negative relationship between PBC (controllability) and the intention for SDS is stronger in cultures characterized by high uncertainty.

All of the above cultural dimensions influence an individual’s intention for SDS. Ajzen (1988, 1991) assumed that intention captures the motivational factors that influence behavior, which indicate how much effort individuals plan to exert to perform the behavior. Cultures high in individualism are likely to value personal time and personal accomplishments, whereas cultures high in collectivism value group integration more than individual desires. Collectivist cultures believe that it is best for the individual if the group is cohesive (Hofstede 1980; Hofstede and Hofstede 2005). In addition, cultures with high PD are likely to impede SDS by weakening the two-way communication between individuals that is necessary for high levels of SDS. In high-PD cultures, employees tend to wait for instructions from managers, who do not welcome innovative ideas about data sharing from below. In contrast, low-PD cultures allow for a more participative and egalitarian relationship between superiors and subordinates. Karahanna et al. (1999) found that the high intention of top management, and supervisors significantly influenced adoption of technology. So, the stronger the intention to engage in an SDS, the more likely should be its achievement. **Hypothesis 7:** The positive relationship between intention and SDS behavior is stronger in cultures high in collectivism, masculinity, and LTO and low in PD and uncertainty avoidance.

Thompson et al. (1990) propose that any organizational setting falls into one of four types: hierarchy (strong grid/strong group), egalitarianism (strong group/weak grid), individualism (weak group/weak grid), and fatalism (strong grid/weak group). In a hierarchy, an individual has strong binding internal regulations and strong group boundaries. In individualism, members have a loose personal network and no strong binding to any group. An egalitarian organization is a closed sectarian community that has elaborate rules for keeping individuals equal (Rayner 1988); because of strong boundaries between groups, members have no external contacts other than in or via the group. In fatalism, individuals have fewer social resources for participation, and the isolation creates dependency on others (Gross and Rayner 1985). SDS behavior depends on organizational culture. **Hypothesis 8:** The negative relationship between hierarchical organizations and SDS is stronger in cultures low in collectivism, masculinity, and LTO and high in PD and UNA. **Hypothesis 9:** The negative relationship between fatalistic organizations and SDS is stronger in cultures low in collectivism, masculinity, and LTO and high in PD and UNA. **Hypothesis 10:** The positive relationship between individualistic organizations and SDS is stronger in cultures low in individualism, femininity, PD, and UNA and high in LTO. **Hypothesis 11:** The positive relationship between egalitarian organizations and SDS is stronger in cultures low in individualism, femininity, PD, and UNA and high in LTO.

**Motivational factors.** Trust in data sharing is a behavioral belief that directly influences attitude, and it indirectly affects behavioral intentions for SDS. The relationship between trust and attitude can be explored by viewing trust from the perspective of TPB as a behavioral belief (Pavlou 2002). Trust is related to positive feelings, beliefs, and attitudes (McKnight and Chervany 2002; Adobor 2005, 2006). Trust creates positive feelings towards SDS. Moreover, trust in SDS creates confidence in the behavior of another party. Trust does not directly influence control through self-efficacy (SE), but it can be a facilitating condition. Bandura (1986) defines SE as individual judgment of a person's capabilities to perform a behavior. Self-efficacy beliefs could influence choice of activities, effort expended, as well as thought patterns and emotional reactions (Bandura 1982, 1991). The concept of SE can be applied to an individual's judgment of his capabilities to engage in SDS. Trust gives the individuals perceptual resources (trust beliefs) to gain control over their activities. A belief that a person will behave in accordance with expectations is likely to increase SDS behavior. **Hypothesis 12:** Trust positively influences favorable attitude toward SDS. **Hypothesis 13:** Trust positively influences perceived behavioral control for SDS.

According to Hofstede (1980), some cultures foster greater uncertainty in people than others do. Societal rules, rituals, religious orientations, and technologies are cultural forces that shape an individual's response to uncertainty. The more uncertain the task, the harder it is to schedule work activities in advance and the greater the reliance on ad hoc arrangements. Smith (1973) points out that social influence plays a role as people seek to reduce uncertainty. Oliver (1990) and Pfeffer and Salancik (1978) argue that individuals and organizations try to establish relationships in order to achieve stability. **Hypothesis 14:** Uncertainty positively influences subjective norms for the intention for SDS.

SDS is encouraged where an incentive for sharing exists. This argument captures the question frequently asked before a person makes a commitment: "What's in it for me?" (Pinto and Onsrud 1995). From this perspective, an organization or its key members must expect a payment or some other incentives for the establishment of an SDS relationship. Craig (1995) sees "institutional inertia" as a major problem. If everyone is focused on the mission and mandates of the agency, there may be no incentives for activities like sharing data. So, the willingness of an organization to participate in SDS is directly related to the perceived reward (e.g., money, access to data, and so forth). Economic exchange relationships between organizations can stimulate SDS. **Hypothesis 15:** Incentives for individuals have a positive influence on SDS.

Ajzen (2002) defined controllability as individual judgment about the availability of resources and opportunities to perform the behavior. Resource scarcity motivates individuals and organizations to cooperate with one another. When resources are scarce and organizations are unable to generate them, the organizations are more likely to establish ties with each other (Molnar 1978). Pfeffer and Salancik (1978) argue that resource scarcity prompts organizations to attempt to exert power, influence, or control over organizations that possess the required scarce resources. Thus, perceived resource scarcity is likely to influence the intention for SDS in a positive way. **Hypothesis 16:** Perceived resource scarcity has a positive influence on the intention for SDS.

Any decision to engage in SDS influences the autonomy of the stakeholders. Organizational reluctance to share data due to loss of autonomy and control over information sources and organizational power is widely acknowledged (Azad and Wiggins 1995; Meredith 1995; Provan 1982). Spatial data can be viewed as a form of power. Individuals and organizations are less likely to share their data if they are losing power in the relationship. **Hypothesis 17:** Autonomy negatively influences attitudes towards SDS. **Hypothesis 18:** Autonomy negatively influences perceived behavioral control for SDS.

Enhancement of organizational legitimacy has been cited as a motivation for organizations to cooperate. Galbraith and Nathanson (1978) demonstrate that rules and procedures are central to any interorganizational cooperation. McCann and Galbraith (1981) also discuss rules and procedures as techniques for coordinating activities, controlling behavior, and maintaining organizational structure. Ruekert and Walker (1987) report that written or formalized rules and procedures have a significant positive relationship with the perceived effectiveness of organizational relations. **Hypothesis 19:** Organizational rules positively influence perceived behavioral control for SDS.

Organizational trust is “the subjective belief with which a population of organizations performs transactions according to their confident expectations” (McKnight and Chervany 2002; Bhattacharya et al. 1998; Doney and Cannon 1997). Trust is a driver for cooperation (Morgan and Hunt 1994; Adobor 2005, 2006) and contributes to organizational performance by enabling people to share valuable information with each other (Mayer et al. 1995; Kramer and Tyler 1996). Tulloch and Harvey (2006) argue that institutions share data with people they know and trust. The groups have strong boundaries between them, and individuals have no external contacts other than in or via the group (egalitarian structure). **Hypothesis 20:** Trust positively influences egalitarian organizations to share spatial data.

Organizations have different objectives when they participate in interorganizational relationships, and these relationships can therefore take different forms (Bensaou and Venkatraman 1995; Grandori 1997). Uncertainty can affect organizational relationships by keeping institutions small and stimulating organizational individualism. Individualistic organizations have loose personal networks, without strong binding to any group. Bradley and Nolan (1998) argue that the high pace of change has pressured organizations to cooperate more and demands more rapid information sharing. **Hypothesis 21:** Uncertainty positively influences individualistic organizations to share spatial data.

Autonomy limits relations between organizations (fatalism). Fatalists operate in isolation, and as a consequence they have a more negative attitude towards data sharing (Gross and Rayner 1985). Organizational reluctance to share data due to a fear of losing autonomy and control over information sources is widely acknowledged (Pinto and Azad 1994; Meredith 1995). **Hypothesis 22:** Autonomy negatively influences fatalistic organizations in sharing spatial data.

It is important to distinguish between the concept of bureaucratic control and the effects of bureaucracy on SDS. With strong bureaucratic control, organizations tend to become protective and to actually inhibit the flow of information across organizational borders. However, bureaucracy overall may have a positive effect

on the sharing of information. Deshpande and Zaltman (1987) and Moenaert and Souder (1990) suggest that increased formalization produces a more harmonious influence on the development of cooperation and information sharing. **Hypothesis 23:** Organizational rules positively influence hierarchical organizations to share spatial data.

## DISCUSSION

Many decisions are based on spatial data. The development and maintenance of these data have become large cost components in the use of technology to address today's problems. Billions of dollars are invested annually in producing and maintaining spatial data. Sound spatial decision making often requires integration of spatial datasets. An organization may need access to external spatial data, and data sharing is essential for efficient and effective decision making. Proper functioning of spatial data infrastructures requires a positive attitude towards data sharing. Therefore, understanding the mechanisms behind spatial data sharing is crucial.

Understanding spatial data sharing is much more complicated than simply determining how data created by one organization or individual can be used by other organizations or individuals. Although interactions among strangers on the Web suggest certain models for sharing, in many traditional government and business contexts the sharing of spatial data requires existing relationships. The ability of different individuals and organizations to cooperate determines what spatial data is available.

This paper presents a conceptual model for spatial data sharing and its social and cultural aspects. A model is always an abstraction of reality, and no one model applies equally well to all situations. Quiun (1988) indicates that overemphasizing one model will only lead to failure. Scott (1987, 1992) recommends integration of valuable insights from different theories. The proposed model is based on three theories—TPB, culture theory, and Hofstede's cultural dimensions—which provide valuable insights into SDS.

The model makes a clear distinction between individual and organizational SDS behaviors. The individual and organizational submodels are linked through 5 cultural dimensions and 6 motivational factors. In the model the relations between all the factors are presented in the form of 23 hypotheses. These hypotheses describe expected relations between sociocultural factors and spatial data sharing. The formulation of the relations is based on evidence from the literature and our own reasoning. Some of the formulated hypotheses are clear and well supported by literature, while for others the relations are not so obvious. For instance, the positive effect of trust on spatial data sharing has been documented by many authors; the influence of cultural factors on SDS, however, might not always be as clear as stated in the hypotheses. The hypotheses may need to be reworded, qualified, and retested. Are the proposed relations really there?

A questionnaire designed to test the hypotheses has been administered in Egypt and in the Netherlands. The primary results provide support for most of the proposed hypotheses (Omrán et al., submitted for publication), emphasizing the influence of cultural differences and motivational factors on the individual and organizational SDS. The model is valid in Egypt and the Netherlands, where it

explains 79 percent and 77 percent, respectively, of the variation in SDS behavior at the individual level. However, at the organizational level, the model explains 39 percent of the variation in SDS behavior in Egypt and 70 percent in the Netherlands. In Egypt, hierarchy and fatalism were the dominant organizational patterns. In the Netherlands, the dominant patterns were hierarchy, individualism, and egalitarianism.

SDS is essential for spatial data infrastructures. Future research should investigate actual SDS behavior and test the validity of the proposed model.

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