

# **An Empirical Investigation of E-business Standardization Initiatives: Enablers and Barriers of Industry-Wide Collaboration in Industry Standard Consortia**

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## **Abstract**

*E-business standards are a critical infrastructure underlying electronic commerce. In many industries, e-business standards are collaboratively and voluntarily developed in a neutral industry standard consortium. To a larger extent, the sustainability of an industry standard consortium depends upon its members' financial and technical contribution and support. Therefore, it is imperative to understand factors that motivate or hinder firms' collaboration in e-business standards consortia. In this paper, we propose an organization-industry standard consortia-environment framework to investigate enablers and barriers of industry-wide collaboration in industry standard consortia. After completing a pilot study, we are collecting survey data from members of multiple neutral e-business industry standard consortia. We expect our study to make both theoretical and managerial contributions. Theoretically, we can better understand firms' motive behind the private provision of a public good, as many e-business standards provided by industry standard consortia are freely available to all potential users and thus exhibit public good properties. Managerially, our study will help consortia find effective ways to encourage firms' contribution and help firms to value their consortia membership.*

**Keywords:** E-business standards, vertical standard consortia, participation motivation

## **1. Introduction**

To remain competitive in today's global economy, firms increasingly rely on e-business applications to extend their focus beyond the efficiency of their internal operations to that of the collaboration with their trading partners and managing a cooperative and interoperable supply chain network. As a result, they have come to understand the value of having common standards for e-business transactions in a supply chain, as standardization enables electronic interchange to be repeated with a set of partners easier, faster, and less costly. An indispensable infrastructure underlying today's electronic commerce, e-business standards "delineate formats of electronic data and information communication" within and across firms' boundaries (Zhao, et al., 2005) and "address product identification, data definitions, business document layout, and/or business process sequences" (Wigand, et al., 2005). In many industries, developing common standards to facilitate interfirm information sharing has been recognized as the foremost issue to tackle in order to increase efficiency in supply chain management. ZapThink, an IT consultancy, predicts that expenditures on e-business standards will reach over \$8.3 billion by the end of 2005 and more than \$43 billion by 2010 (TowerGroup Survey, 2005). Furthermore, e-business standardization is an important research topic in information systems. E-business standards play an important role in creation and adoption of information systems, however, "the role has been understudied in the MIS area" (West, 2003). Researchers have realized the gap between MIS and

standard research. Several leading MIS academic journals, such as *MIS Quarterly* and *Electronic Markets*, have devoted special issues to standard research in the MIS area.

There are three basic standardization mechanisms, de facto standards, de jure standards, and standards developed by consortia (David and Greenstein, 1990). In many industries, e-business standards are collaboratively and voluntarily developed and promoted in a neutral industry standard consortium. Examples include MISMO in the mortgage industry, ACORD in the insurance industry, RosettaNet in the hi-tech industry, and CIDX in the chemical industry (Nelson, et al., 2005). The popularity of consortium-based e-business standardization reflects the need of inter-firm information sharing and collaboration in the networked economy. For example, in the travel industry, travelers are increasingly booking their trips online. Due to the travelers' expectation to book everything including air tickets, car rentals, tours and show tickets, etc. in a one-stop fashion, a travel site must be able to integrate such information from different travel operators seamlessly. Consortium-based standardization also mitigates confusion and costs of the technical selection among competing standards in the market.

While industry standard consortia have become a leading force in e-business standardization initiatives in many industries, they are frequently subject to poor performance and high instability. To a large extent, the sustainability of a standard consortium depends upon its members' financial and technical contribution and support. Many industry standard consortia obtain most of their funding from their members through membership fees. In addition, member's knowledge and experience in information technologies and e-business processes are key inputs for collaborative standard development in the consortium. In return, standard consortia make sure that their standard specifications address the majority's needs and preference by carefully designing the consensus-seeking procedure to encourage firms' contribution to the standardization effort, which is essential to help the standard to achieve the critical mass needed for wide adoption.

Therefore, as one of the important success factors for industry standard consortia, it is imperative to examine firms' motivation to participate and collaborate with one another. In this paper, I propose to empirically examine firms' motivations to participate in the consortia and how they are affected by the characteristics of the firm, the standard consortium, and the external environment. For example, we know from anecdotes and industry reports about various strategies employed by consortium members. Some firms actively participate in standard working groups and choose to lead the development process. Others act passively and meet the minimum requirement of going to meetings and membership dues. Still others "free-ride" by observing the consortium's activities and rarely get involved (Spring and Weiss, 1994). However, it is unclear why firms choose different strategies working in standard consortia and how factors such as firms' technical capabilities and standard consortia' management affect the decision. It is necessary to empirically examine such issues to understand the real incentives to participate (or not).

To the best of our knowledge, our proposed study is the first empirical investigation that explores enablers and barriers of industry-wide collaboration in industry standard consortia. In the IS field, researchers have begun to analyze the impacts of standard consortia on e-business standards adoption (Teo, et al., 2003). Their findings suggest that the existence of standard consortia

improves the adoption and diffusion of e-business standards. However, very little is known about the impact of standard consortia on the development of e-business standards. This study will fill the gap by investigating how consortia will affect firms' strategic choice at the development stage.

## **2. Literature Review**

### ***2.1 IT Standardization and Standard Consortia***

David and Greenstein (1990) suggest that firms' strategic choices within the consortium depend on the standard, firms' capability to influence the process, and the internal operations of the consortium. The internal management efficiency of the consortium affects firms' motivation to work in it, since they want to work in consortium that is responsive to technological changes and commercial developments.

In an empirical study of technological choice in standard consortia, Weiss and Sirbu (1990) find that larger firms have more power in consortia and technical specifications sponsored by larger firms are more likely to be selected. Firm size matters in the collective standardization process.

Extensive IT standardization studies have discussed the importance of network effects in influencing firms' standard adoption decisions (Katz and Shapiro, 1986; Zhu, et al., 2006). Network effects also play an important role in affecting firms' strategies in developing the standard. Investments in the standard consortium are irreversible. Firms expect to adopt the standard in the future in order to justify their participation in the standard consortium. With significant network externalities exist among standard adopters, expectations about the ultimate size of the network are crucial at the development stage (Besen and Farrell, 1994). Firms must expect positive market reactions to standards developed by the consortium, in which they decide to invest. If firms perceive that a consortium faces a higher uncertainty in the market, they will have less incentive to invest in the consortium.

### ***2.2 Cooperative R&D Consortia***

Standard consortia can be viewed as a special form of cooperative R&D and a catalyst of industry coordination (Simcoe, 2004). Thus, literature about formation of cooperative R&D consortia can shed light on our study of e-business standard consortia.

From participating in R&D consortia, firms can enjoy both benefits directly associated with R&D activities, such as enhanced productivity, and benefits unrelated to R&D activities, including risk sharing and partnership opportunities (Sakakibara, 2002). Analogously, firms can obtain both direct and indirect benefits from standard consortia activities. Direct benefits include understanding the direction of the standard setting, accumulate standard related expertise, and choose preferred standard specifications (Farrell, 1996; Spring and Weiss, 1994). Indirectly, consortium participants enjoy the opportunity to interact with their peers. They can share knowledge and learn from one another, since there is a lot of industry knowledge embedded in e-business standards (Wigand, et al., 2005). There are potential partnership opportunities exist in the consortium, and firms can improve market access through partners (Sakakibara, 2002).

While participants can benefit each other by collaborating in the consortium and develop the standard collectively, they also face competition and conflicting interests inside the consortium

and out. In their study of coalition formation of standard consortia, Axelrod et al. (1995) find that firms hesitate to join a consortium with the presence of their rivals, especially close ones. The rivalry concern arises from conflicting interests regarding to standard specifications, the risks of disclosing trading secrets to competitors, and potential intense competition in the similar market segmentation. According to a recent case study of U.S. home mortgage industry (Markus, et al., 2006), vertical e-business standardization leads to complex industry structure changes. Based on their types and standard implementation strategies, firms face different levels of competition caused by e-business standards.

### ***2.3 Collective Action***

Consortium-based standardization is a form of collective action (Olson, 1971), where many firms work together in the consortium in the pursuit of a common collective good: standards that facilitate Web-based data exchange and process sharing with each other. Collective action theory can help us study e-business standard consortia phenomena since it focuses on incentives behind firms' participation and resource contribution and group dynamics that coordinate the achievement of common goals. Collective action theory also suggest the importance to study participants' resource contribution, since it is directly associated with the success of collective action.

Olson (1971) suggests that either positive or negative selective incentives must exist to "stimulate a rational individual in a latent group to act in a group-oriented way" (p.51). Marvell and Oliver (1993) also suggest "the major predictors of participation are the level of subjective interest in the collective good" (p.7). In this study, we will identify subject interests firms have to participate in VSCs.

Marvell and Oliver (1993) further indicate that individuals' contribution level in a group depends on their belief in the efficacy of the group. Thus, how efficient the group, or the standard consortium in our case, organizes its activities will affect firms' participation in the collective action.

Markus et al. (2006) have applied collective action to study the standard consortium MISMO in the U.S. residential mortgage industry. They find that firms' interests in standard development are heterogeneous and depend on their specific industry sectors. Consequently, their willingness to join the collective development of the standard is different. Their study identifies two major organizational motivations for participating in MISMO standard development: "ability to influence the standard" and "new business opportunities" (p.450). The case also carefully analyzes tactics MISMO adopts to solve the prisoner's dilemma occurring at the development stage. MISMO employs efficient policies and procedures, such as lowering participation costs and promote open communication, to encourage broad participation. MISMO's experience also shows a clearly defined IPR policy is a must to encourage firms' contribution in the consortium. Markus's case study provides industry level analysis and focuses on only one industry, whereas our study is conducted at the organizational level across industries. It is almost impossible to conduct comprehensive cross-industry study with industry as the unit of analysis. The case study is valuable in understanding the phenomenon as it is relatively new, but to gain a real understanding we have to look past the industry-specific factors and focus on generic factors. And unlike what appears to be the case, efforts in standardization in different industries share

many common issues than people originally thought, based on our interaction with executives in the VSCs.

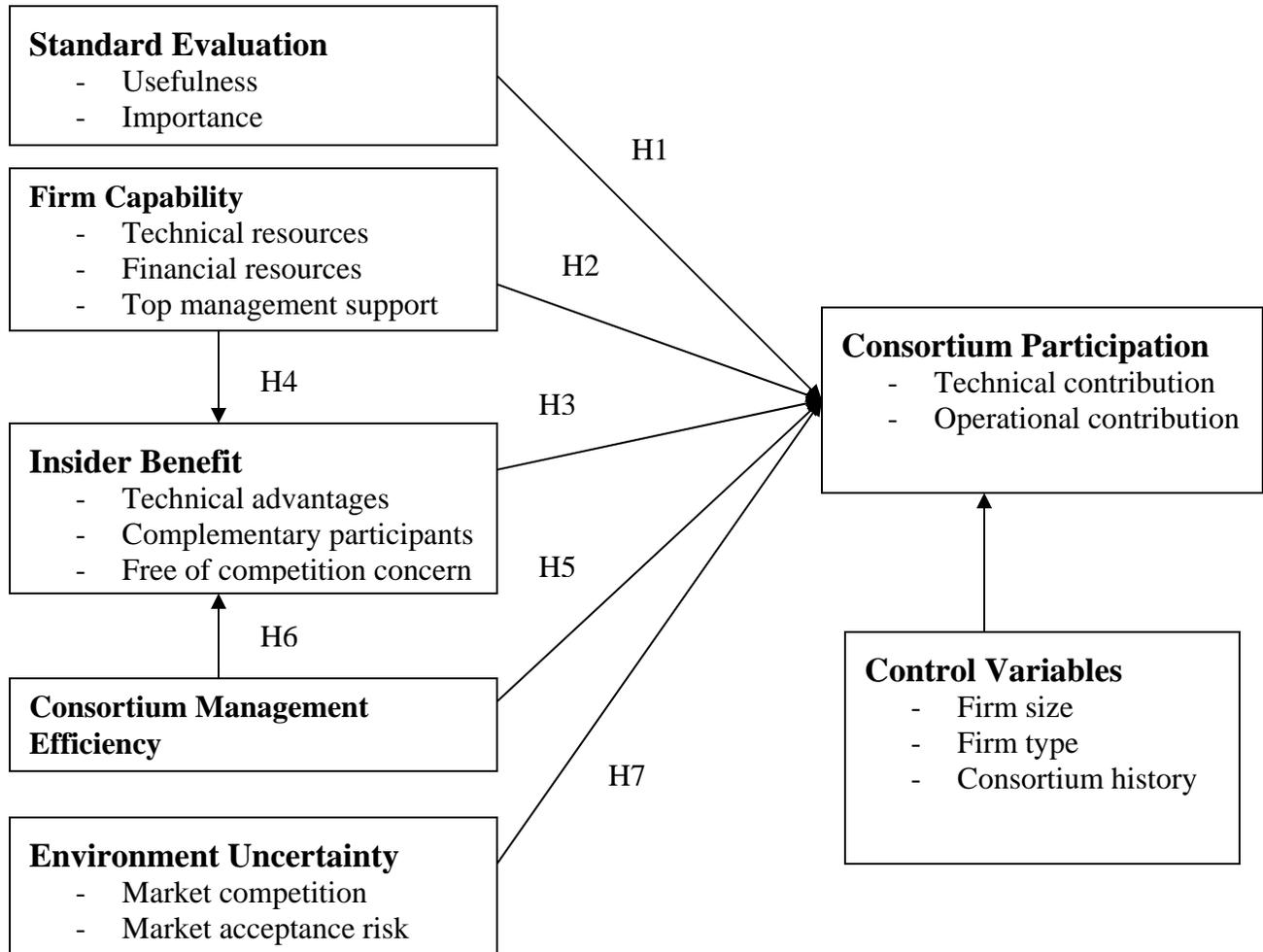


Figure 1: A Conceptual Framework

### 3. A Conceptual Framework

To study why firms join the consortium to develop e-business standards collectively and voluntarily, we choose firms' participation level within the consortium as the dependent variable. Based on multiple theoretical foundations we have reviewed, we identify five major factors that can lead to firms' resource expenditures in the collaborative development of the standard: standard evaluation, firm capability, insider benefit, consortium management efficiency, and the environment uncertainty faced by the consortium (Figure 1). These five independent constructs cover standard-specific, firm-specific and consortium-specific characteristics.

Expected benefits are a major determinant of the adoption of e-business standards (Zhu, et al. 2006). We expect that perceived benefits of the standard are also directly associated with firms' intention to develop the standard. Firms develop the standard because they believe in the importance to have an industry-wide standard to increase the interconnectivity. They expect to

adopt the standard in the future to justify ex ante investment at the development stage. Firms want to develop the standard faster and better if they expect the standard to be more useful and important for them. With strong vested interests in the standard, firms tend to devote resources in the consortium to influence the process in directions favorable to them. Benefits and positive experience from implementing the standard can further encourage firms to collaborate in consortia and develop standard specifications to cover more and more digital business processes. Thus, we propose the following hypothesis:

H1: Firms' involvement in the consortium is positively related with their evaluation of the standard.

While firms are willing to join various consortia activities, their capabilities will constraint the level of their participation. Standard specifications are technically complicated and incorporate both technical and business knowledge (Markus, et al., 2006). Firms cannot effectively participate in proposing, revising and reviewing the standards without related technical capabilities. As David and Greenstein suggest (1990), "the [standard] debate often bogs down in arcane technical issues that are inaccessible to many others, including some representatives of the user community" (p.25). In addition to technical resources, firms also need sufficient financial resources to pay for substantial standardization costs in the consortium. Standardization costs spent by participating organizations include but not limited to membership fees, travel, the cost arising from preparatory work, and R&D expenditures (Spring and Weiss, 1994). To commit both technical and financial resources to a project, top management support is essential (Chatterjee, et al., 2002). This leads to our second hypothesis:

H2: Firms' capability will positively influence the extent of organizational involvement in a standard consortium.

Standard consortia provide value to participants just for the interactions that occur in the process. We name these benefits as insider effects. Insider effects come from three sources: technical advantages, complementary participants, and competition concern. Technical advantages come from receiving advance knowledge of the direction of standard setting, accumulating standard related expertise to achieve a smooth future adoption (Spring and Weiss, 1994), and skewing the standard towards their individual preferences (Farrell, 1996). Standard consortia also provide firms opportunities to learn from others and obtain potential partnership or business opportunities. For example, technical vendors can reach potential users of their standard compliance solutions in the consortium. However, when firms try to reach agreements over competing standard ideas, the war of attrition might happen. Firms may have conflicting interests and viewpoints (Simcoe, 2004). Information leakages exist that firms may disclose trading secrets and proprietary technologies to competitors and even potential ones. The competition concern causes negative insider effects to consortium participants. Therefore, we hypothesize as follows:

H3: The insider benefit will positively influence the extent of organizational involvement in a standard consortium.

While firms' capabilities limit the level of their consortium participation, these capabilities also have impact on how many insider effects a firm can expect from working in the consortium.

According to the concept of absorptive capability developed by Cohen and Levinthal (1989), firms' prior related knowledge provides them the ability to recognize, acquire, implement, and commercialize external information. Firms' technical know-how helps them absorb standard-related knowledge and learn from peers through social network ties in the consortium. The experience of participation in other standard consortia enables firms to handle technical, economic, and political interactions in the focal consortia and recognizes new partner opportunities (Sakakibara; 2002) Firms can only gain insider benefits via working in the consortium, such as joining the consortium meetings and working groups, submitting technical proposals, and lobbying other participants (Weiss and Sirbu, 1990). All these require financial resources. Therefore, we propose the following hypothesis:

H4: Firms' insider benefit is positively influenced by their capabilities.

The efficiency of a standard consortium's management and internal processes is helpful to achieve coordination among members (Farrell, 1996), reduce the duration of the standard setting processes, and increase participants' satisfaction. Members are more likely to reach consensus when the consortium has neutral and fair procedures, and provides sound intellectual properties rights (IPR) protection (Simcoe, 2004). Firms need to understand the goal of the consortium to align it with their proprietary interests. Firms are more likely to devote their resources to a more efficient standard consortium. Thus, we expect the following hypothesis:

H5: The more efficient a standard consortium management is, the more resources a firm will contribute to it.

Insider effects, as a firm-level measure, capture business value obtained from involving in the development process. It will be affected by consortium management efficiency, a consortium-specific characteristic. Open procedures can assure that firms can freely express their views and encourage technical discussion among members (Markus, et al., 2006). A neutral and independent consortium will grant all members the ability, such as voting rights, to influence the final result of the standard setting (Zhao, et al., 2005). A well-managed consortium can facilitate inter-firm learning and knowledge sharing within the SDO. Firms' conflicting interests in standards can also be mitigated by consortium governance and coordination (Markus, et al., 2006), such as frequent meeting, early standardization, sound IPR protection, and carefully designed voting roles (Farrell, 1996). This leads to our hypothesis:

H6: Firms' insider benefit is positively influenced by consortium management efficiency.

The investment in standard consortia is highly risky since firms can only fully achieve economic value from standard effort after the successful diffusion of the standard in the market. Even standards that are successfully developed may fail in the diffusion stage (Greenstein, 1992). The competition faced by the consortium increases the complication and difficulties of firms' participation decisions. Some consortia have to compete with rival consortia or proprietary specifications sponsored by influential user companies or vendors. For instance, several consortia including PPDM and POSC are working in the same oil and energy industry. Consortia competition makes the participation choices more complicated, aggravates suspicious towards the future market acceptance of the standard, and hinders the overall standards environment. The

perceived risk of standard consortia is high even without competition. Vertical e-business standards intend to increase industry-wide interconnectivity. They cannot win industry acceptance without support from all relevant user groups and technical vendors (Markus, et al., 2006). Successful e-business standard consortia prevail over a long time due to the progressing standardized business scope and new technologies (Zhao, et al., 2005). Firms want to commit resources to consortia that are likely to serve the industry for a long time. These lead to our final hypothesis:

H7: the environment uncertainty faced by the consortium will negatively influence the extent of organizational involvement in a standard consortium.

Our model will control for firm and consortia differences that might affect firms' consortium participation decisions. We expect firm size to be positively related to participants' involvement in the consortium, since larger firms have more resources to invest in the consortium, and they have more power in determining the future diffusion of the standard. It's also because the cost of not participating is larger for larger firms than smaller ones (Weiss and Sirbu, 1990). Vendors and future users of e-business standards differ in possible resources contribution and interests in the forthcoming standards (David and Greenstein, 1990; Markus, et al., 2006). We introduce the firm type variable to control the difference. Finally, the history of the consortium may be positively related to firms' effective participation. Standard consortia, which have worked in e-business standards for many years, have established interorganizational routines and are trusted to handle cooperation and coordination among members (Zollo et al., 2002).

#### **4. Operationalization of Constructs**

We will briefly discuss the operationalization of our constructs in this section. Our hypotheses focus on relationship between second-order constructs (i.e., standard evaluation, firm capability, insider benefit, consortium management efficiency, environment uncertainty), which are formed by first-order constructs. Then detailed questionnaire items are developed to measure these first-order constructs.

We define firms' consortium participation level as the extent of resources contributions firms have devoted to the consortium. We measure the construct at two interrelated dimensions: technical contribution and operational contribution (Spring and Weiss, 1994). Technical inputs indicate firms' involvement in proposing, selecting, reviewing, and testing the technical specifications of the standards. From operational perspective, firms can choose whether or not to join the steering committee, and to what extent they want to involve in the administrative activities in order to control the strategy and direction of the consortium. They also exert various levels of efforts to promote the consortium and its standards in the industry.

Drawing upon the IOS literature, we can conceptualize firms' evaluation of e-business standards into both direct benefits and indirect benefits (Iacovou et al. 1995). Direct benefits refers to the usefulness of the standard, since firms expect to improve the operational efficiency within and across firm boundaries from implementing standardized digital business processes. E-business standards help firms improve process automation, reduce errors, and improve relationship with trading partners (Zhu, et al., 2006). Indirect benefits assess the competitive advantage firms can obtain by developing standards in the consortium.

Firm capabilities refer to firms' technical and financial resources that are necessary to consortium participation, and the extent of top management support to invest in the consortium. Technical resources indicate firms' expertise in both standards and consortia activities.

We define insider benefit as benefits firms can obtain by just working in the standard consortium and interact with other members. There are three first-order constructs forming the insider benefit: technical advantages, complementary participants, and competition concern. Technical advantages indicate technical benefits directly related to standard development activities in the consortium. By joining the consortium, firms have opportunities to choose standards they prefer, such as these require minimal changes of their existing processes (David and Greenstein, 1990; Farrell, 1996). Complementary participants refer to benefits obtained from social networking in the consortium, which are indirectly related to technical development. Competition concern measures the potential loss of competitive advantages if firms collectively develop standards in the consortium. In order to have positive relationship between all three first-order constructs and the second-order construct (i.e., insider benefit), we measure free of competition concern in the model.

The construct consortium management efficiency measures how efficient the standard consortium coordinates collective development of the standard and governs the mix of political and economic interactions among participants.

In the survey, respondents will indicate their types (i.e., technical vendors versus users). We use the annual sale as a proxy of the firm size (Weiss and Sirbu, 1990; Grover, 1993). The history of the standard consortium comes from secondary source (e.g., the Website of the consortium).

## **5. Method**

We choose a survey method to validate the proposed research model for a number of reasons. First, many constructs incorporated in the model are perception-based, and no secondary data are available. Second, this study intends to explore the factors that motivate or hinder firms' involvement in VSCs, and a large statistically testable sample enables us to find the relevance and significance of these variables (Grover, 1993). The survey data obtained from multiple organizations and VSCs also increase the generalizability of the results.

### ***5.1 Conceptual Validation and Pilot Study***

Questionnaire items were developed based on a comprehensive literature search. The questionnaire was carefully reviewed by IS faculty and doctoral students in our group. Changes were made where appropriate and a Web-based survey was built upon a secure university Web server. We then conducted two activities to field test the Web-based survey. First, we administered a pilot survey among members of two VSCs that we had known before and collected 19 responses. Respondents provided comments on cover letter, instructions, and general survey instruments design. We also tested the feasibility to distribute the survey through VSCs and the reliability and accessibility of our survey Web site. Second, two VSC executives examined our questionnaire design in terms of the item interpretation and the overall objectives of the research. We revised our questionnaire accordingly to clarify certain ambiguous items and provide additional instructions.

### **5.2 Current Status of the Survey**

We test the proposed model among members of e-business VSCs, which are standard consortia that develop and promote industry-specific e-business standards. To control the heterogeneity of the sample, we select VSCs that fit the following criteria. First, the mission and objective of the organization is to develop standards for users in a specific industry. Members choose to join the VSC mainly to develop standard specifications. We exclude consortia that develop industry-neutral standards, such as OASIS. We also exclude organizations, such as a trade association, where standard development is only a part of their overall functions. Second, the standard specifications are industry-focused and are used to facilitate Internet-based data and information sharing among diverse platforms (Markus, et al., 2006). Third, candidate VSCs are non-profit and use procedures that incorporate the attributes of openness, balance of interests, due process, and voluntary consensus. Fourth, candidate VSCs have a large number of members ( $\geq 50$ ). Group size matters in collective action (Marwell and Oliver, 1993). Members' contribution is more noticeable in small groups, therefore group dynamics is different in large and small groups.

We identify candidate VSCs through two major sources. The first is XML.org, a portal for industries to submit e-business standards in order to minimize overlap and duplication of efforts (Nelson and Shaw, 2003). The second is consortium and standards list that is provided by ConsortiumInfo.org, a list includes descriptions and links for 460 consortia that develops and/or promote standards. We also found VSCs via referrals of participating VSCs.

We contacted candidate VSCs and requested them to distribute the survey among their members. Only the consortium has the most updated information of their members, and they can locate representatives from members who understand the overall relationship between their firms and the consortium. Furthermore, most VSCs do not want to disclose their member mailing lists due to policy restrictions or concerns to lose important organization information. We prepared survey cover letter and developed a project Website (<http://citebm.business.uiuc.edu/standard/standard.htm>) to provide detailed project information for participating VSCs and their member companies. Each consortium will distribute the initial survey request and two follow-up reminders among their members (Fowler, 2002). Currently, we have collected over 200 responses from 8 VSCs (Table 1).

<b>VSC</b>	<b>Industry</b>	<b>VSC</b>	<b>Industry</b>
ACORD	Insurance	FPL	Securities Transactions
MISMO	Mortgage	OGC	Geospatial
papiNet	Paper	PISCES/OSCRE	Real Estate
STAR	Auto Retails	XBRL	Accounting

### **5.3 Research Plan**

We will systematically validate instruments used in the model to ensure the rigor of the research. Content validity was stressed in the conceptual validation and pilot study phased. The next step is to perform reliability, convergent validity, discriminant validity tests for measurement items (Straub, 1989), and validity of the second-order constructs (Chin, 1998; Zhu, et al., 2006).

We will use PLS-based structural equation modeling (SEM) to test the statistical conclusion validity of the model. We choose PLS-based SEM for the following two reasons. First, the model incorporates formative constructs and PLS “maps formative observed variables” (Gefen, et al., 2000, P.10). Second, the proposed study is exploratory in nature. Previous empirical study examining firms’ motivation in standard consortia is rare, and this study is a preliminary effort to test enablers and barriers of industry-wide collective action. PLS is suited for theory building and exploratory research (Gefen, et al., 2000; Zhu, et al., 2006).

## **6. Expected Contribution**

We expect our study to make two theoretical contributions. First, it will shed light on understanding industry-wide collective action, as industry standard consortia are “a forum of collaborative technology development and a catalyst of industry coordination” (Simcoe, 2004). Secondly, we expect to better understand firms’ motive behind the private provision of a public good, as many e-business standards provided by industry standard consortia are freely available to all potential users and thus exhibit public good properties (e.g., MISMO specifications and RosettaNet PIPS). For public goods jointly supplied by individual members, free riding is a common concern. As we have discussed before, firms choose various tactics in industry standard consortia. While free riders may exist, there are firms who devote financial as well as technical resources to develop standards. This study is helpful to differentiate firms’ strategic choices in standard consortia and explain rationale behind their choices.

This study will also provide managerial guidelines for both industry standard consortia and individual firms. The result on motivations of participation will help consortia find effective ways to encourage firms’ contribution to the consortium in order to achieve continuous development and success. This study will also aid consortia initiators and managers to identify potential interested parties and contributors in the industry. For individual firms, the research will provide a framework to guide companies’ strategic decision in participating in e-business standard initiatives, as standard choice and standards adoption have become a critical part of managing a firm’s IS function. It will also help firms to better understand the value of their standard consortium memberships.

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