Understanding the "Boundary" in Information Sharing and Integration

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Abstract

The definition of "boundary" in the context of multi-organizational information sharing and integration initiatives is developed in the paper. Both current literature and a case study of the product safety inspection environment are used to drive the development of a dual-directional, multi-dimensional and non-linear framework for understanding the meaning of "boundary". The two directions are the vertical and horizontal directions and the multi-dimensions include organizational, geographic, personal, development phase, and process. The framework can be used both as a theoretical model for researchers and a comprehensive analytic tool for practitioners.

1. Introduction

1.1. Why Cross-boundary information sharing and integration?

Cross-boundary information sharing and integration has long been recognized as a critical enabler for enhancing organizational effectiveness and efficiency. Better strategic decisions and improved problem solving can be achieved with aggregated information and knowledge [1]. Cross-boundary information sharing and integration can lead to significant cost savings and data reuse without duplicated data collections [2-6].

In the public sector, information sharing is defined as exchanging or otherwise giving other agencies access to information [4]. Information sharing and integration can help government agencies to provide better public services and to solve critical public problems through facilitating inter-organizational collaboration. Today, the delivery and management of public services increasingly relies on complex networks of interdependent organizations to deal with ambitious or complex issues [8], because networks of organizations can solve problems that cannot be achieved, or achieved easily, by single organizations [9]. A reciprocal and voluntary collaboration between two or more government agencies or between public and private or non-profit entities is necessary to deliver government services [10]. With the development of information and communication technology, interorganizational networks and external alliances have become more common [11], and consequently sharing and integrating information across government organizations has become more attractive and practical as well [4, 12].

1.2. What is cross-boundary information sharing and integration?

Harris [13] asserted that information integration means different things to different people in different contexts. Barki and Pinsonneault [14][15] also claimed that despite the widespread interest regarding the topic, the concept continues to be poorly conceptualized. They defined cross-boundary information sharing and integration as the collaboration or interconnection of different information systems or telecommunication technologies to share data with a common conceptual schema between entities such as groups, departments, and organizations [14, 15]. Gil-Garcia, Pardo and Burke [16] also identified and provided preliminary definitions of four components of cross-boundary information sharing, and thus provide a foundation for discussions about cross-boundary information sharing to seek other undiscovered core components of the phenomenon. The four components are: 1) trusted social networks; 2) shared information; 3)

integrated data; 4) interoperable technical infrastructure.

1.3. What are the "boundaries"?

However, so far, there is still no explicit, in-depth and comprehensive definition of the "boundary" in cross-boundary information sharing and integration, nor have various nuanced meanings under the umbrella "boundary" been identified clearly yet. While cross-boundary information sharing and integration is attracting more attention, it is important to define what "boundary" means. Does it mean organizational boundary, geographic boundary, and/or other type of boundaries? This study begins to fill this gap.

The paper intends to develop a definition of "boundary" in the context of multi-organizational information sharing and integration initiatives. Both current literature and a case study of the product safety inspection environment in China are used to drive the development of a framework for understanding the meaning of "boundary".

2. Current research regarding the "boundaries"

2.1. Organizational boundary

Researchers have studied information sharing and integration across different departments, organizations and functional areas from both vertical and horizontal directions. Weber claimed that ideal bureaucracy is an efficient and fair organization with laws and administrative regulations established [17]. However, information problems are rooted in the organizational structure of bureaucracy. Hierarchy, specialization and centralization are recognized as major sources of distortion and blockage of intelligence [18]. Vertical hierarchical structure can be barriers to information-sharing [19, 20]. Departmentalization could impede information sharing among various horizontal departments or governments. [21, 22]. Gil-Garcia and Pardo [5] found that the complexity of cross-boundary information sharing gradually increases from the organizational level, the inter-organizational level, to the intergovernmental level.

In addition, the literature seems to assume that vertical information integration is less complex than horizontal integration by arguing that vertical integration is easier to solve and could be overcome before horizontal integration [23, 24]. Klievink and Janssen [23] argued there is an urgent information-sharing need for horizontal integration of information systems operated by various government agencies to promote more integrated services. A stage model is proposed in figure 1 to conceive the e-government collaboration from a single organization level to a nation-wide level. According to the model, horizontal integration is assumed to be more difficult than vertical integration, and vertical stovepipes integration should happen earlier than horizontal integration [23].
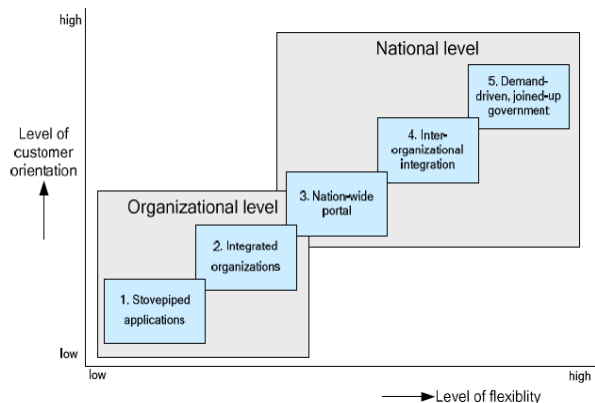

Figure 1. Stage model for e-government [23]

According to Layne and Lee, vertical integration also occurs earlier than horizontal integration (See Figure 2). They noticed that many state agencies interact more closely with their federal and local counterparts than other agencies in the same level of government [24].
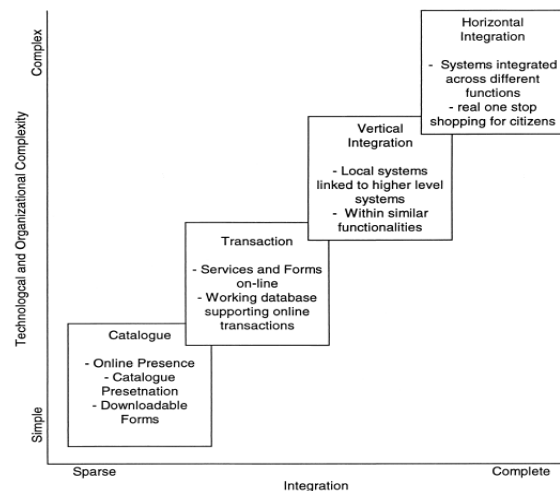

Figure 2. Dimensions and stages of e-government development [24]

2.2. Personal boundary

Besides organizational boundaries, personal boundaries also play an important role. Kolekofski and Heminger proposed that interpersonal

relationships influence attitudes and intentions to share information [25]. Informal relationships, such as personal networks and team work that are not arranged and defined by hierarchy and regulation, can result in more intense and effective information sharing between departments in an organization [19, 21]. Wheatley also claims that information can grow from social networks where exchange is common and information is not accumulated only by individuals but shared with others [26].

2.3. Geographic boundary

Geographic boundaries also matter in cross-boundary information sharing and integration. Organizations may be spread in various geographic areas. Pardo et.al. claim that the geographical origin of data poses myriad challenges in ensuring the quality of the integrated data [12, 27]. Espinosa et al. also note that geographic boundaries accompany factors such as different cultures and time zones can cause difficulty in collaboration work [28]. Distance is also considered a factor in inefficient communication, misunderstanding, and conflict as well [28-30].

2.4. Being specific about boundaries

What are the "boundaries" in multi-organizational information sharing and integration? Until now, there is no specific and comprehensive definition of boundaries when cross-boundary information sharing and integration is discussed. Current literature, in general, has focused on organizational boundaries, geographic boundaries and personal boundaries. Furthermore, in the literature, the vertical boundary between different hierarchical levels is assumed to be less complex than the horizontal boundary among departments or organizations.

A set of research questions then emerges:
1. Have we discovered all nuances about the "boundary"? Have we identified all types of formal or informal boundaries?
2. What is the relationship among these boundaries?
3. Is the vertical boundary indeed easier to manage than the horizontal boundary?

3. Research design and methods

A case study of a cross-boundary information sharing and integration initiative was conducted to investigate the research questions. According to Yin [31], case study design is employed to answer how and why questions.

The selected case study focused on information sharing and integration in China's product quality inspection environment. Data was collected through in-depth interviews and government documents. More than 20 semi-structured interviews were conducted in April 2008; each lasting between 1-2 hours. A snowball sampling method was used to identify and select individuals for interviews based on the relevance of the persons' expertise and involvement in the information sharing and integration initiatives to be studied. Interviewees included people from multiple sectors, different functional agencies, different levels of government, and different professional backgrounds, in order to gain a variety of perspectives on the case. Participants can be categorized into three groups: 1) Public-sector participants: government leaders, department heads, program managers, professionals who are directly working in the field of product quality and food safety; 2) Private-sector interviewees: general managers, department heads, program managers, and professionals who are working in the contractors and users companies of relevant e-government applications; 3) Third-party interviewees: experts and observers working in independent institutes or non-profit organizations that are not directly involved in the initiatives but could provide objective observation and general viewpoints of the issue in China.

In addition, secondary documents were collected from websites of related agencies and public newspapers to not only ask the subjective perceptions of the participants, but also to observe relatively objective indicators of variables. Those documents include: 1) organization missions and objectives, and structures; 2) relevant laws, policies and regulations; 3) government plans, strategies, reports, and meeting minutes. 4) Public news reports on the initiatives.

Grounded theory is by far the most prominent framework for analyzing qualitative data. It is defined as deriving theory from systematically gathered and analyzed data through research. [32, 33]. Data collected was transcribed and coded to identify common patterns with an inductive approach. A theoretical framework based on the coding and analysis was then developed.

4. Introducing the case
4.1. AQSIQ

Information sharing and integration initiatives in China's product quality and food safety policy domain are mainly the responsibility of the General Administration of Quality Supervision, Inspection and Quarantine of China (AQSIQ). AQSIQ is a ministerial administrative agency under the direct leadership of the State Council of China (the Cabinet). The responsibilities of the administration include product quality supervision, inspection on import-

export commodity, inspection and quarantine clearance, entry-exit health quarantine, entry-exit animal and plant quarantine, and safety inspection on import-export food. AQSIQ has nineteen in-house functional departments and fifteen direct affiliates, which provide technical support for AQSIQ programs such as the Information Center.

Two major units of AQSIQ are directly in charge of product quality and food safety issues: the Exit-entry Inspection and Quarantine unit and the Supervision of Quality and Technology unit. The Exit-Entry Inspection and Quarantine unit is responsible for inspection of the quality and safety on commodities exported to or imported from other countries. The Supervision of Quality and Technology unit is responsible for supervision of the quality and safety of commodities circulated exclusively in the domestic market.

At the provincial and local levels, AQSIQ also sets up 35 direct Exit-Entry Inspection and Quarantine Bureaus (CIQ) covering 31 provinces, nearly 300 branches and over 200 local offices alongside the seaports, land ports, airports, and other commodity-distribution centers. Those CIQs are under the direct vertical leadership of AQSIQ, and serve as the local agencies of AQSIQ. Similarly, under the Supervision of Quality and Technology unit, there are also thirty-one provincial Bureaus of Quality and Technology Supervision (BQS) with more than 2,800 administrative divisions affiliated. However, unlike CIQs, BQSs are administered by their corresponding provincial governments, and AQSIQ only provides them with business guidance and has no direct vertical leadership over them.

4.2. AQSIQ's information sharing and integration initiatives

AQSIQ began to explore technology to support its business processes in 2001. In 2004, "Three New E-applications" were launched, namely E-Declaration, E-Supervision, and E-Discharge.

E-Declaration refers to the electronic inspection declaration process of export and import commodities among AQSIQ, CIQs and private companies. E-supervision refers to AQSIQ's supervision of manufacturing processes within firms. E-Discharge application is made up of two components: E-Certificate transmission and E-Custom clearance. E-Certificate transmission refers to the electronic transmission of inspection permits among CIQs in different provinces (cities). E-Customs clearance refers to the electronic transmission of customs clearance permit between AQSIQ and the General Customs of China.

Other cross-ministry information sharing initiatives include: information sharing between AQSIQ and the Ministry of Agriculture with regard to entry-exit animal and plant quarantine; information sharing between AQSIQ and the Ministry of Environmental Protection with regard to waste raw material import; and information sharing between AQSIQ and China's central bank as one component of the project of establishing a national credit system.

All these initiatives are aimed to accelerate the speed of clearance, lessen the burden for both AQSIQ and corporations, enhance working efficiency, as well as strengthen the enforcement of supervision and inspection. They have the potential to improve the efficiency, effectiveness and accountability of AQSIQ's businesses.

4.3. Various information sharing and integration relations

The case involves multiple stakeholders and includes various information sharing and integration relations. Along the vertical axis, the case consists of information sharing between China's State Council (the Cabinet) and various ministries, a national ministry and its local agencies throughout the country, and between a provincial government and its various agencies. Along the horizontal axis, the case embraces information sharing among different nations, among different ministries of the State Council, among different departments of a ministry, among counterpart agencies in various provinces, as well as information sharing between the public sector and the private sector.

5. Findings

5.1. Vertical direction

Boundaries along the vertical axis refer to those between the higher-level and lower-level organizations. Four dimensions are identified:

5.1.1. Hierarchical boundary. From the organizational perspective, the case study finds that hierarchical levels constitute explicit boundaries between higher level and lower level government organizations in information sharing and integration.

The study identifies two kinds of higher level government organizations: functional departments in a higher level government, such as AQSIQ; and local governments where local functional agencies are located in, such as Shanghai municipal government. It seems that both kinds of higher level government are interested in building up centralized systems. Those centralization efforts then put local agencies

under two pressures simultaneously. When local CIQs are required by AQSIQ to integrate their systems with the national centralized system; meanwhile they are also asked by their respective local governments to join the provincial platforms.

Furthermore, the case study also finds two kinds of hierarchical administrative relationships: vertical administrative relationship and non-vertical administrative relationship. Vertical administration relationship refers to the arrangement that a local functional agency serves as the local office of a functional department in a higher level government, and the former reports directly to the latter. For example, a CIQ is under the direct vertical administration of AQSIQ and does not report to a provincial government. On the contrary, non-vertical administrative relationship refers to the situation that a local functional agency reports directly to its respective local government rather than to a functional department in a higher level government. For example, a BQS reports directly to its provincial government and has a non-vertical relationship with AQSIQ.

In a vertical administrative relationship, a local functional agency has a wider boundary with its respective local governments than with its functional departments in a higher level government. In a non-vertical administrative relationship, the situation is opposite. The case indicates that when working on information sharing and integration initiatives, a vertical administrative relationship is more favored by a functional department in a higher level government; and a non-vertical administrative relationship is more favored by a local government.

5.1.2. Personal boundary. Other than boundaries created by formal or organizational arrangements, the case also demonstrates an informal personal boundary between individual leaders, managers and staff of different organizations. The case indicates that personal boundary could sometime further aggravate and complicate formal organizational boundaries. When personal boundary does not exist, the degree of the formal boundary could also be alleviated. A leader in AQSIQ used to work in a provincial CIQ before he was promoted. As a result, his personal influence on people in that particular CIQ is much greater than those in other provincial CIQs. Meanwhile, people in this provincial CIQ also have greater influence on this leader in AQSIQ than people in other CIQs.

5.1.3. Geographic boundary. The case also exhibits a geographic boundary between a higher level and a lower level organization in information sharing and

integration. The complexity of an information sharing initiative seems to increase with the degree of the vertical geographic boundary. AQSIQ seems to have better communication and relationship with Beijing local agencies than other provincial agencies (especially those which are far away from Beijing). Beijing agencies receive more direction from AQSIQ and at the same time have more opportunities to influence AQSIQ's policymaking than other, more geographically distant local agencies. However, for remote local agencies, due to communication difficulty and information asymmetry, the effectiveness of both top-down control and bottom-up influence seem to be weaker. Several interviewees used an old Chinese saying to describe the situation in a remote province: "The sky is high, and the emperor is far away."

5.1.4. Development phase boundary. The case study also identifies a new kind of boundary, development phase boundary. The concept is related to the notion of digital divide, but focused on the organizational level rather than the individual level. Development phase boundary refers to the gap between organizations in terms of not only technological capacity, but also managerial, personnel and economic capabilities.

As a developing country, the disparity among regions in China is significant. In the case, the technological, economic, personnel, and managerial capabilities of local agencies in relatively developed regions are much more advanced than those which are in underdeveloped regions. As a central government agency, AQSIQ's development phase seems to be between the two regions. A vertical development phase boundary appears between higher-level organizations and lower-level ones.

Overall, the complexity of an initiative increases with the degree of the vertical geographic boundary. Also, it is more likely for an organization at a lower development phase to follow the instruction of an organization at a higher development phase. For local agencies in less developed regions, AQSIQ's development phase is more advanced. Those local agencies have to rely heavily on AQSIQ's technological, financial, personnel and managerial support, and thus are more willing to follow the instructions of AQSIQ rather than its respective local government. However, local agencies in more developed regions are usually at a more advanced development phase than AQSIQ. These local agencies get more support from their respective provincial governments which are also at higher development phase. Thus, these agencies tend to resist the request from AQSIQ; instead, they prefer to

follow the instructions of their own provincial government.

5. 2. Horizontal direction

Boundaries along the horizontal axis refer to those among organizations on the parallel level. Under this direction, five dimensions are identified.

5.2.1. Departmental boundary. Departmental boundary could impede information sharing and integration among organizations on the same level. The case study finds that when the span of the initiative expands from cross-department, to cross-unit, to cross-ministry, and to cross-government, the complexity of an information sharing initiative also goes up.

5.2.2. Personal boundary. Personal boundaries exist along the horizontal direction as well. The complexity of an initiative goes up with the degree of the horizontal personal boundary. The case finds that some information sharing initiatives were made possible mainly because people, especially leaders, of parallel organizations have developed good relationships with each other for various reasons, such as they all went to the same university, they used to travel aboard together, and they used to be colleagues in the same agency. Some other initiatives failed largely because people from different organizations do not get along with each other.

5.2.3. Geographic boundary. Geographic boundary also exists along the horizontal direction in the case. The scale of horizontal geographic boundary could increase from within-the-same-building, to cross-building, to cross-city, to cross-neighboring province, to cross-distant province, and to cross-national. However, it seems that the complexity of an information sharing initiative does not necessarily go up when the scale of the geographic boundary expands. The relationship between them is not simply linear. The case study finds that while sometimes geographic proximity could make an initiative easier due to better communication and relationship, in other times it could also make things more complex due to conflict of interests and competition for resources and attentions.

5.2.4. Process boundary. The case study finds a boundary between organizations that share business processes or are connected in a supply chain and organizations that are not. It seems that, even when there is an organizational boundary between them, information sharing among organizations that share a business process is more likely to happen than those that are not.

In the case, the Exit-entry Inspection and Quarantine Function of AQSIQ and the General Customs are considered the same business process, because they are all related to international trade. According to law, AQSIQ inspection is conducted earlier in the process than Customs declaration. Customs are also required by law to check the inspection permits of commodities before allowing them to pass. As a result, the two organizations have to work together along the process, and establish a well-developed cross-agency information sharing system. Nevertheless, information sharing between the Exit-entry Inspection and Quarantine Unit and Supervision of Product Quality and Technology Unit of AQSIQ is comparatively underdeveloped. One reason is that although both units are under the leadership of AQSIQ and are responsible for similar functions, they are not viewed as the same business process. The former targets the import-export business and the latter focuses on the domestic market. Almost all participants from both units recognized that it would be helpful to share information with each other. However, when they were asked why they did not make that happen, they all come up with the same reason: "We are not on the same process, so we do not have to." The case study did not provide evidence of a process boundary along the vertical direction.

5.2.5. Development phase boundary. The development phase boundary also occurs along the horizontal direction. A boundary stands out between local agencies in relatively developed regions and local agencies in underdeveloped regions in terms of their technological, economic, personnel and managerial capabilities. In general, east coast regions are more developed than western rural regions. The underdeveloped agencies often face lighter workload, fewer special needs, as well as less diversified and complex context. They are usually equipped with less advanced systems and have a few unskilled staff. On the contrary, the developed agencies usually face more special needs, heavier workload, as well as more diversified and complex context. They usually have built up quite sophisticated systems and recruited skillful staff. Overall, information sharing initiatives among organizations on the same or similar development phase seem to be easier than initiatives among those that are on different development phases.

5.3 Non-linearity and interaction.

With regard to the relationship between each specific boundary and the complexity of information sharing initiatives, the study finds that not all relationships are linear. For hierarchical boundaries and horizontal geographic boundaries, it is hard to determine what situation is more complex and what may be less; and what situation might happen first and what next (see Table 1). It all depends on the nature of the settings around a specific boundary.

In addition, although individually many boundaries seem to be linearly associated with the complexity of an initiative, when these boundaries act collectively, the whole matrix is not a linear relationship (see Table 2). For a specific initiative, several or even all boundaries may exist and take effect simultaneously. Their effects could then superpose, amplify, weaken, or mediate each other.

In addition, we can also see in Table 2 that the nature of horizontal boundaries could vary across vertical boundaries, and the nature of vertical boundaries could also vary across horizontal boundaries. For instance, the nature of hierarchical boundary could differ across departmental boundary: while CIQs and AQSIQ have a vertical administrative relationship, BQSs and AQSIQ have a non-vertical relationship. Similarly, the nature of departmental boundary could vary across hierarchical boundaries: while at the provincial level, CIQs and BQSs are independent agencies; at the central government level they are two functions within AQSIQ. Moreover, the nature of horizontal personal boundary could differ across hierarchical levels. It is found in the case that while staffs of two agencies at the national level do not get along with each other, staff of the same two organizations at the provincial level could instead have very good relationships. The degree of horizontal geographic boundary could also change across hierarchical levels. While at the provincial level, AQSIQ might be located next door to the Customs; at the central level, their offices are quite far from each other. In addition, the nature of horizontal development phase boundary could vary across hierarchical levels. The degree of development phase boundary among organizations at lower levels seem to be more significant than that at higher levels, probably because the lower the level is, the larger the regional disparity could be. Also, the nature of vertical personal boundary could differ across departmental boundary, and vertical development phase boundary could differ across departments.

Furthermore, sometimes vertical boundaries and horizontal boundaries could directly interact, interweave, and integrate with each other simultaneously. For example, departmental boundary could be affected by the hierarchical boundary. When an official in a provincial BQS explained why sharing information with the CIQ in the same province is so difficult, he said: "Because they report directly to AQSIQ, and we report directly to the provincial government, we do not have the same leader and we do not attend same meetings." Moreover, vertical personal boundary could be affected by development phase boundary : people in more developed agencies are more likely to be promoted to a higher level. The study also finds that vertical personal boundary and horizontal personal boundary could affect and interact with each other. Vertical personal boundary could aggravate horizontal development phase boundary, and vertical development phase boundary could sometimes be caused by horizontal development phase boundary (see Table 2).

6. Building a framework

6.1. A dual-directional, multi-dimensional, and non-linear framework

Based on both a literature review and the case study, the paper develops a theoretical framework to define the concept of boundary in the context of information sharing and integration. The framework is dual-directional, multi-dimensional, and non-linear.

It seems that boundaries along the vertical and horizontal directions are equally important and could happen simultaneously. Vertical boundaries are not necessarily less complicated or happen in an earlier stage than horizontal boundaries. Namely, a specific information sharing initiative is very likely to be faced with influences from both directions simultaneously, and vertical and horizontal perspectives could be very different. Sometime the key to a horizontal problem may be imbedded in a vertical issue, and vice versa. Therefore, when we tackle the complexity of a specific information sharing initiative, it will be critical to think both vertically and horizontally.

The framework also expands the dimensions of boundary for information sharing and integration to include organizational, geographic, personal, development phase and process boundaries. Although some of these dimensions have been identified through previous research, they have not been comprehensively analyzed. Among these dimensions, some seem to be more formal and explicit, and some are more latent and seemingly have been ignored in earlier research. We should pay special attention to those hidden boundaries under the surface of the iceberg.

Most importantly, unlike earlier models that attempt to draw a linear or stage picture between the

Table 1. Relationship between each boundary and the complexity of initiatives

Vertical Direction	Relationship	Illustrations
Hierarchical boundary	Non-Linear	Judging the complexity of non-vertical administrative relationship vs. vertical administrative relationship depends on from which perspective a case is viewed
Personal boundary	Linear	The complexity goes up with the degree of the vertical personal boundary
Geographic boundary	Linear	The complexity increases with the degree of the vertical geographic boundary
Development phase boundary	Linear	The complexity increases with the degree of the vertical development phase boundary
Horizontal Direction		**Illustrations**
Departmental boundary	Linear	The complexity goes up with the span of the departmental boundary
Personal boundary	Linear	The complexity goes up with the degree of the horizontal personal boundary
Process boundary	Linear	The complexity increases when participant organizations are not on the same process
Geographic boundary	Non-linear	It all depends. The complexity does not necessarily increase with the degree of the geographic boundary.
Development phase Boundary	Linear	Initiatives among different development phases could be more complex than among same or similar development phases

Table 2. Interactions between boundaries on two directions

		Horizontal Boundaries				
		Departmental	**Personal**	**Geographic**	**Development phase**	**Process**
Vertical Boundaries	**Hierarchical**	-The nature of hierarchical boundary could differ across departmental boundary -The nature of departmental boundary could vary across hierarchical boundaries. - Departmental boundary could be affected by hierarchical boundary	The nature of horizontal personal boundary could differ across hierarchical levels.	The degree of horizontal geographic boundary could change across hierarchical levels.	The nature of horizontal development phase boundary could vary across hierarchical levels.	Not found
	Personal	The nature of vertical personal boundary could differ across departmental boundary	Vertical personal boundary and horizontal personal boundary could affect and interact with each other.	Not found	-Vertical personal boundary could be affected by development phase boundary. -Vertical personal boundary could aggravate horizontal development phase boundary	Not found
	Development phase	Vertical development phase boundary could differ across departments	Not found	Not found	Vertical Development phase boundary sometimes could be caused by horizontal development phase boundary	Not found
	Geographic	Not found	Not found	Not found	Not found	Not found

two directions or among multiple dimensions, this study delivers a non-linear framework which could capture more complexity and depth in the context of information sharing and integration. For a particular initiative, its complexity is case-specific, situational and dynamic; depends on the emergence of specific boundaries and the interactions among them.

6. 2. Boundary vs. barrier

The term of "boundary" and "barrier" appear frequently in previous literature without clear clarification. The paper finds it necessary to differentiate the term of "boundary" and "barriers" in the context of information sharing and integration. Boundary is an area that people need to pay attention to and be cautious with. Boundary is neutral, but it is not insignificant. Barriers, however, are the context or attributes around a boundary. Behind each boundary there might be a number of political, organizational and technological barriers, which determine the nature of the boundary. For instance, specific barriers around the departmental boundary include lack of organizational trust, organizational conflicts of interest, security concern, policy conflicts, organizational culture conflicts, and value issues. Specific barriers identified around personal boundary include lack of personal trust, personal conflict of interest, and bad prior personal relationship.

Barriers could be overcome or eliminated with some efforts, but boundaries tend to exist for a long period of time unless significant changes happen. A metaphor could help to explain the difference between the two concepts. A boundary is like a crossroad, and the difficulty of passing it depends on the conditions of a number of potential barriers around, such as the color of the traffic light, the weather conditions, the number of cars and pedestrians, and the road surface conditions. A crossroad may exist for a long time, but those contexts around it change every minute. A crossroad could be very easy to pass when all those conditions are favorable, but become problematic when conditions are harsh. However, no matter what drivers must be aware of the conditions in the crossroad, and how each will interact with the other to complicate or simplify the effort.

7. Conclusions

With this paper we seek to define the concept of "boundary" in the context of multi-organizational information sharing and integration. We present a dual-directional, multi-dimensional and non-linear framework, based upon both previous literature and

findings in an empirical case study. The two directions are the vertical and horizontal directions and the multiple dimensions include organizational, geographic, personal, development phase, and process. The framework can be used both as a theoretical model for researchers and a comprehensive analytic tool for practitioners. Future research can test the magnitude of the influence of each boundary with quantitative studies or identify more nuances of the boundaries. Also, although the framework built in this study has embraced prior findings from western countries and a case study from an Asian country, it will be interesting to test the framework in other nations to compare the results.

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