

The Challenges of Accelerating Connected Government and Beyond: Thailand Perspectives

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Abstract: Key issues to make Thailand more dynamic, competitive and prepared for ASEAN economic integration are the implementation of Internal Smart with eGovernment, International Smart with intergovernmental processes and overcoming language barriers. As a first step towards internal smart or being a smart society, eGovernment has been implementing since 2000 in order to improve government services, transactions and interactions with citizens and business. Since 2007, the Ministry of Information and Communication Technology has been developing the Thailand eGovernment Interoperability Framework (TH e-GIF) as guidelines for transformation to connected government. However, the transformation has been slow for six main reasons: lack of national data standards and standard governance body, lack of clear understanding about common processes across all involved stakeholders, lack of best practices and knowledge sharing in implementation, lack of data quality and data collection resources, lack of laws and regulations in data sharing and absence of a proactive mindset. The challenges are how to accelerate connected government and push forward to the connected ASEAN. This work focuses on three main activities: analyzing the gaps and prioritizing the need of information exchange, providing systematic approach for data standardization as well as developing a roadmap for moving towards a smart government with smart health, smart education, smart agriculture, smart tourism, smart trade and smart energy by 2015. Using best practices and the road map, the creation of connected government and connection to ASEAN can be pursued in a strategic and rapid manner. Moreover, secure e-transactions with supportive laws, science, technologies and innovation are also key factors for economic growth sustainability and community well-being enhancement.

Keywords: data standardization, TH e-GIF, connected government, connected ASEAN, data landscape, information logistic, ontology based information exchange, connected government roadmap

1. Introduction

ASEAN leaders agreed to establish the ASEAN collaboration by 2015 consisting of three pillars: the ASEAN Economic Community (AEC), the ASEAN Political-Security Community (APC) and the ASEAN Socio-Cultural Community (ASC). Thailand is facing both internal and external pressures. Internally, the performance of government services is increasingly being measured by the benefits they can create for citizens, communities and the business sector. These government customers demand greater efficiency, accountability, public trust and better services. Examples are faster payment of promised compensation to flood-affected households, reducing waiting time and cost of referring patients from one hospital to another as well as providing one-stop service to enable searching and viewing all data pertinent to an individual citizen. In order to decrease this internal pressure, connected government is required.

External pressure comes from the need for Thailand to be more dynamic, competitive and ready to participate in the ASEAN community collaboration. To reduce external pressure, intergovernmental processes for connecting ASEAN with secure e-transactions for AEC, with supporting poverty alleviation and promoting sustained peace and stability in the region for APC as well as with lifting the quality of life and its' people for ASC are recommended. In addition, better language competency for ASEAN and international communication is also necessary. The challenges are how to accelerate the implementation of internal smart with eGovernment and international smart with e-ASEAN.

As a first step towards internal improvement, eGovernment has been implemented since 2000 to improve government services, transactions as well as interactions with citizens and businesses. In Thailand, almost all government agencies are actively grooming their organization to incorporate eGovernment to provide better services. However, processes have been individually designed and developed by data owners or by software developers, which has resulted in a wide variety of non-standard data formats and data collection procedures. Beginning in 2007, the Ministry of Information and Communication Technology (MICT) developed Thailand's eGovernment Interoperability Framework (TH e-GIF) as guidelines for transformation to connected government. Two main phases, TH e-GIF 1.1 and TH e-GIF 2.0, are put forth as recommendations and guidelines for eGovernment interoperability implementation (Ministry of Information and Communication Technology, 2009; Ministry of Information and Communication Technology, 2010). The recommendations relate to data harmonization, data interoperability standards, technical interoperability standards, eGovernment project development, etc. Some pilot projects have been implemented. TH e-GIF 2.0 extension (phase 4) develops a data standardization manual for government interoperability (Ministry of Information and Communication Technology, 2011a) as well as develops a roadmap for national data standardization (Kawtrakul et al., 2011a). Currently, TH e-GIF extension (phase 5) follows the roadmap by developing a data standardization registry system, establishing a data standardization committee and implementing an information exchange system as a best practice. However, the transformation to connected government has been slow for six main reasons: lack of national data standards and standard governance body, lack of clear understanding of common processes across all involved stakeholders, lack of best practices and knowledge sharing in implementation, lack of data quality and data collection resources, lack of laws and regulations in data sharing and absence of a proactive mindset. The challenges are how to move proactively from an inefficient current state to a desired future state and prepare for the ASEAN collaboration in the dimensions of economic and social sustainability. The preparation includes infrastructure development such as logistics and next generation network, trust development such as enhancing information security, supportive regulations and laws as well as high-touch and high-tech development with science, technology and services innovation.

The path from the current situation to the desired situation starts by analyzing the gaps, defining a strategy, roadmap and implementation. As stated in (Dada,2006), some key challenges which should be also addressed are the ability of government organizations to interchange and integrate information using common data standards, creating success cases for sharing and reusing best practices as well as strategies and policies to support transformation to connected government and connected ASEAN. This work focuses on three main activities: analyzing the gaps and prioritizing the need of information exchange, providing systematic approach for working as well as developing a roadmap for moving to a smart government with smart health, smart education, smart agriculture, smart tourism, smart trade and smart energy by 2015. Based on the best practices and road map, the creation of connected government followed by connection to ASEAN can be pursued in a strategic and rapid manner. Moreover, secure e-Transactions with supportive science, technologies and innovation are also key factors for enhancing economic growth, sustainability and community well-being.

In section 2, the background of TH e-GIF is given; analyzing gaps and the need of information exchange are described in section 3. The systematic approach to accelerate connected government is explained in sections 4. A roadmap is described in sections 5. The final section presents observations, lesson-learned and recommendations for future work.

2. Background of TH e-GIF development

In order to achieve the targets of one-stop service: providing seamless data integration as well as quality and cost effective service delivery, the Thailand eGovernment Interoperability Framework (TH e-GIF) was developed under the auspices of the MICT. TH e-GIF 1.1 and TH e-GIF 2.0 are put forth as recommendations and guidelines for eGovernment interoperability implementation.

TH e-GIF version 1.1 (Ministry of Information and Communication Technology, 2009) provides six recommended guidelines for eGovernment interoperability implementation as follows:

- Policies and guidelines for government data integration
- eGovernment interoperability benchmarking

- Business process modeling
- Business information modeling with XML Naming and Design Rules
- Interoperability technical standards that allow data, IT systems, business processes and delivery channels to interoperate such that services can be properly integrated
- TH e-GIF change management and compliance.

Many public agencies have been implementing e-Document for back office functions and some integrated service applications, such as e-Tax and e-Procurement, under TH e-GIF 1.1 guidelines.

TH e-GIF 2.0 provides more details for how to develop interoperability projects with pilot projects and indicates success criteria with evaluation methods. A one-stop driver licensing service and flood-affected-households compensation have been implemented as proof-of-concept. TH e-GIF 2.0 extension (phase 4) develops a data standardization manual for government interoperability with three case studies (Ministry of Information and Communication Technology, 2011a) as well as develops a roadmap for national data standardization (Kawtrakul et al., 2011a). Currently, TH e-GIF 2.0 extension (phase 5) follows the roadmap by developing a data standardization registry system, establishing a standardization committee and implementing an information exchange system as a best practice. However, acknowledgement of government agencies in order to raise their awareness and make them collaborate in building domain specific and common data standards has not been accomplished yet. In addition, national data standards have not been developed. Data standards can provide not only common syntactic but also semantic understanding of data among government agencies. Without national data standards, government agencies are unable to share information in a timely and effectively manner.

According to NIEM (2007), data standards establishment for TH e-GIF are, also, classified into three categories: universal core data, common core data, domain specific core data (see Figure 1).

- Universal data standard is defined for data that is commonly shared and understood among all domains, e.g., person, address.
- Domain-specific data standards are defined for each specific domain.
- Common core data standard is defined for use in two or more domains.

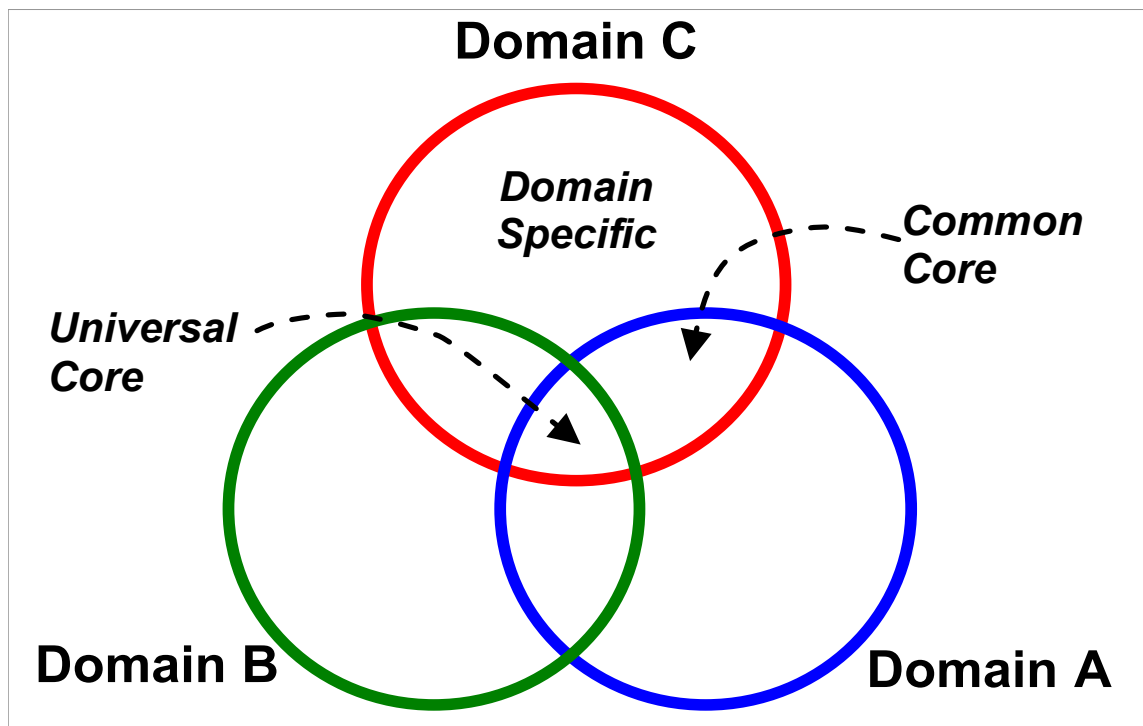


Figure 1: Domain data core concept (NIEM, 2007)

There are three main types of data that should be standardized for information sharing are:

- A data component, describing a concept by giving its name and details (attribute names). For example, a person is a data component describing an individual person by attributes such as the person’s name, date of birth, gender, race and ethnicity.
- A code list, a list of codes and descriptions representing objects in the same set such as currency codes (ISO-4217) and country codes (ISO-3166-1) defined by ISO (in Charalabidis et al. 2008:42).
- An electronic document for interchange among government agencies composes of data extracted from their internal databases. It is essential that the data contained in each document conform to existing data standards. A commonly used document can be registered as a standardized document for reuse or restructuring to create new related documents.

To become a universal data standard, consensus by all domains is needed on the semantics and structure of the data (NIEM, 2007). An example of a universal address component defined by UK e-GIF (2010) is shown in Table 1.

Table 1: UK e-GIF universal address (UK-eGIF, 2010)

BS7666 Address Component	Cardinality
Basic land and Property Unit	0-1
Primary Addressable Object Name	1
Secondary Addressable Object Name	0-1
Unique Property Reference Number	0-1
Street Descriptive Identifier Structure	0-1
Unique Street Reference Number	0-1
Postcode	0-1

Note: details of each component are given on the UK e-GIF website (UK-eGIF, 2010)

Figure 2 shows the relationships between each type of data standard where the innermost, universal core set, is necessarily defined first as core data standard for reuse in defining domain specific or common core sets. For example, a *person* data component could be reused to create new kinds of people components such as *student, farmer and patient* (see Figure 3). Compliance with the universal data standard enables *person* data in all domains to be effectively interoperable. Based on data standards, electronic documents can be designed for exchange among government agencies.

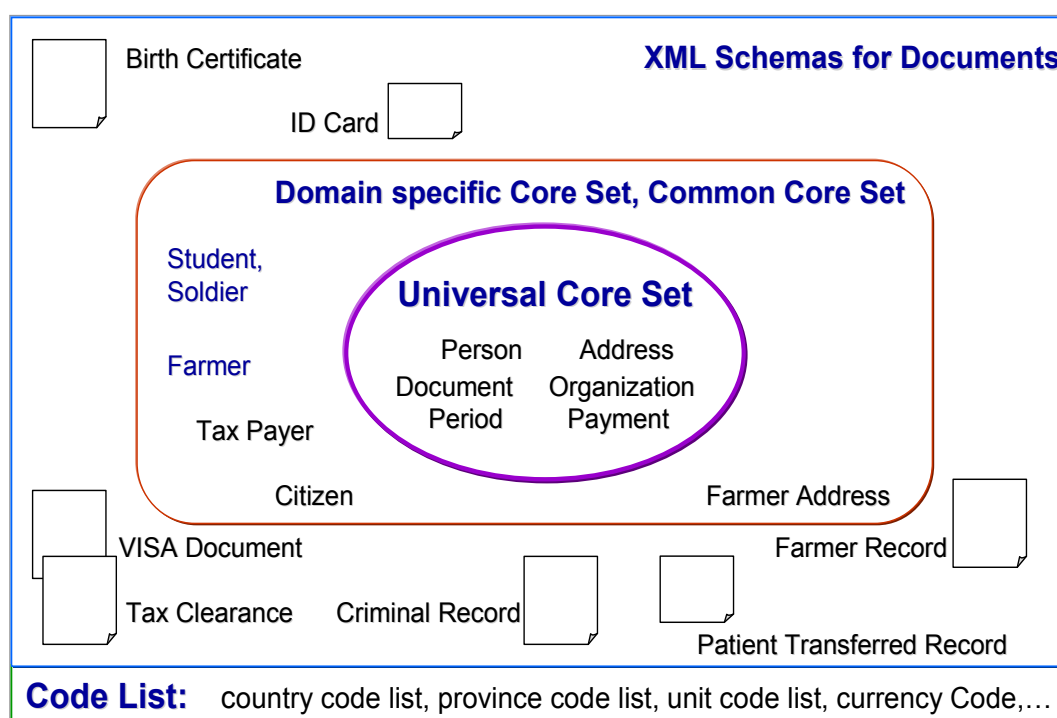


Figure 2: Basic data modeling concepts and their relations (modified from Charalabidis et al, 2008)

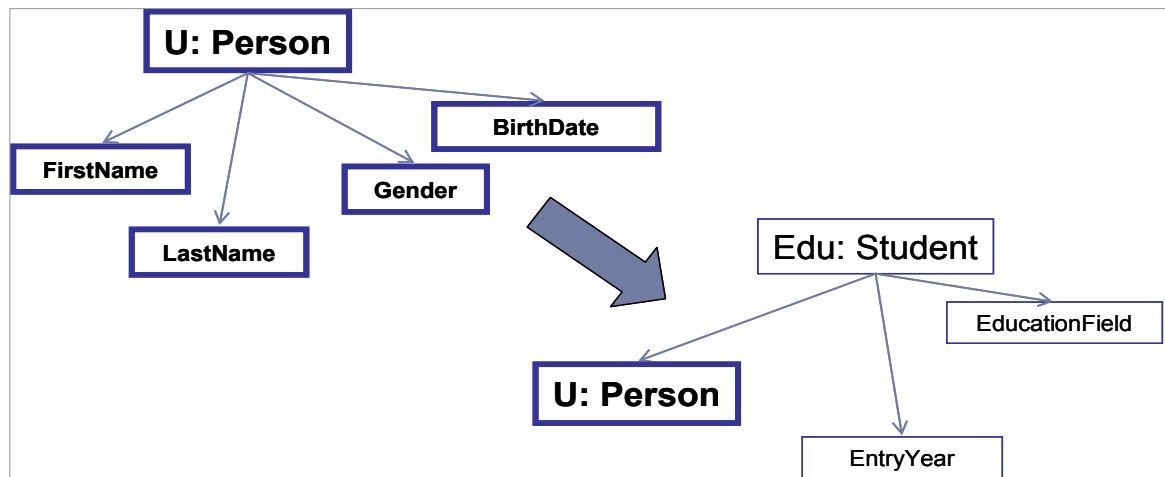


Figure 3: Reuse of universal core data schema (NIEM, 2007)

TH e-GIF 2.0 recommends using the Core Component Technical Specification developed by UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business) for electronic document data modeling, XML Naming and Design Rules (UN/CEFACT) and existing international data standards. However, there are many different international data standards which make it difficult for public organizations to follow this guideline. Moreover, the international standards may not be applicable in every case, for example, the address component of each country has both schematic and semantic differences. In Thailand, there exist data standards, mostly of code list types, used in some government agencies, but they have not been declared national data standards yet. In addition, there is some redundancy in data standards developed by different government agencies with different semantics and schemas.

In conclusion, moving proactively to connected government, national data standards, especially universal core set, practical footprints for starting information exchange projects, supporting tools and best practices are essential.

3. Analyzing gaps and the need of information exchange

In order to arrive at the desire future state, i.e., connected government and beyond as well as achieve measurable results, analyzing the root causes of the current problems is necessary. Also, studying multi-sectoral information exchange requirements and their strategic priorities are needed. From our previous work (Kawtrakul et al., 2011a) on the TH e-GIF project (phase 4) hosted by the MICT of Thailand, we conduct many activities to gather information about the barriers of information exchange among Thai government agencies and information exchange requirements as follows:

- Conducting e-survey of governmental information systems to find out what data exist and where they are stored in government agencies as well as to find out the problems of input data collection and information dissemination. (30% response rate or 250 departments responded)
- e-Survey one day training for the selected government agencies(250 persons) to input the survey data through the web.
- Conducting three-day workshops 3 times for operational officials from several government agencies to prepare the data standardization manual aligned with the three selected scenarios.
- Conducting two-day seminars twice for executive officials(100 persons) from several government agencies to raise awareness in data standardization among top management.
- Organizing the "eGovernment day", a one day conference for raising awareness in data standardization and sharing best practices.

3.1 Barriers of information exchange among Thai Government Agencies

From the analysis of information exchange among government agencies, we come up with the barriers of information exchange both on the data collection as well as the information production and

dissemination. Government agencies had four types of problems in data collection for their database systems as shown in Figure 4. The largest problem was lacking resources for supporting data collections, accounting for 65% of all respondent organization problems. For data standard, there was only 7% of problems reported, which may due to the low rate of information exchange among government agencies during the period of conducting survey.

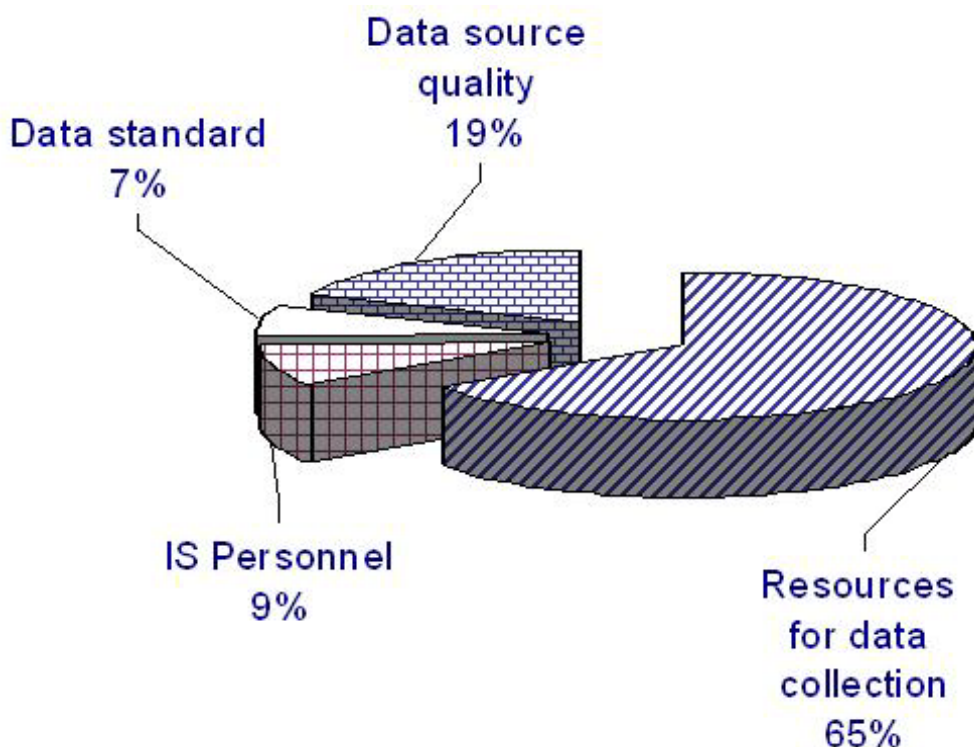


Figure 4: Problems of data collection

Figure 5 illustrates the problems of data production and dissemination in government agencies surveyed by our previous work. It shows that almost 50% of the problems come from lacking resources for producing information. It corresponds to the largest problem of data collection.

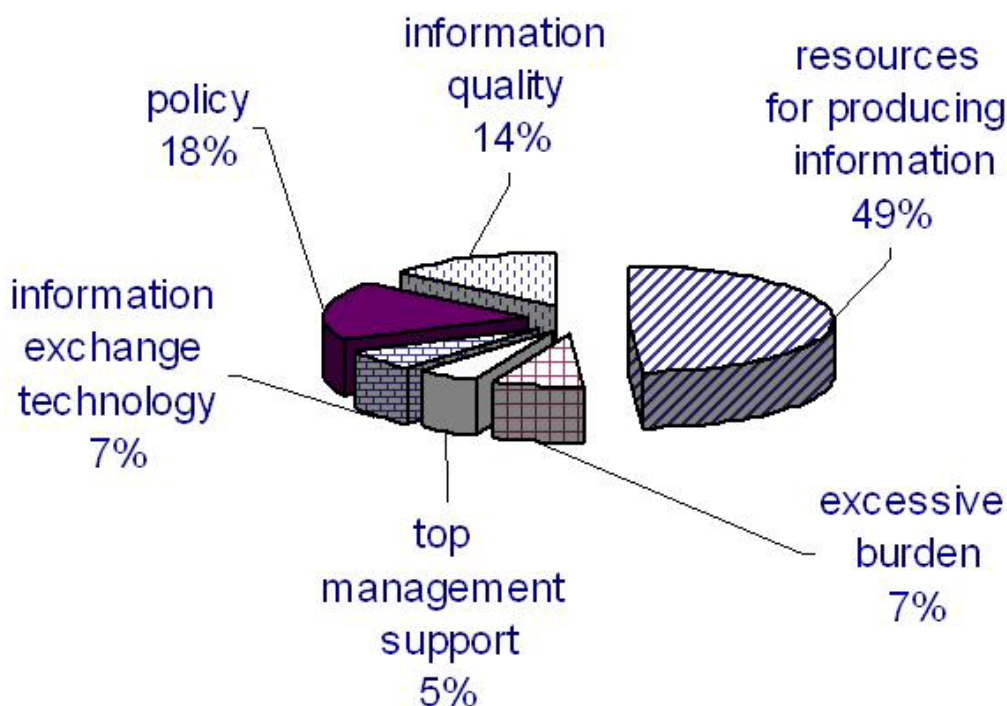


Figure 5: Problems of data production and dissemination

From e-survey, interviewing and discussions during our various activities mentioned above, the barriers of information exchange among government agencies can be summarized as followed:

- Information Management
 - *Lack of national data standards*
 - *Absence of standardization guideline*
 - *Lack of data quality: completeness, accuracy, timeliness*
 - *Lack of data standard governance*
 - *Lack of best practices and knowledge sharing in eGovernment implementation*
- People
 - *Insufficient IT personnel*
 - *Data ownership and data sharing mindset problems*
 - *Lack of awareness about the necessity of data integration*
 - *Lack of clear understanding about data standardization processes*
- Policy and Laws
 - *Frequent change of political agenda affecting eGovernment projects*
 - *No clear rules about hosting for cross-ministry projects*
 - *Lack of laws and regulations in data sharing*
 - *Insufficient budget for activities such as data collecting, data standardization , data cleansing and data sharing projects*
 - *Data privacy issues*
- Technologies
 - *Lack of data mapping and conversion tools*
 - *Lack of research innovation for eGovernment services*
 - *Lack of enterprise service architecture*

Comparing to the barriers of eGovernment integration identified by Lam(2005), there are similarities between barriers in both studies, especially in the areas of governance, data standards, guidelines, agency readiness, funding issues, data ownership and privacy issues.

3.2 Information exchange requirements for G2G

From the analysis of information exchange requirements for government to government (G2G) gathered during both executive and operational level workshops (Kawtrakul et al.,2011a), information exchange models were created. Information exchange models with horizontal integration means integrating information across domains/organizations and vertical integration means integrating within the same domain but in different levels such as referred data of the patients between a primary care unit and a provincial hospital (see Table 2). These models are future extra requirements which have not been implemented yet. Three of them were selected based on prioritization factors for study in detail to be case examples in data standardization guideline establishment. Those are data integration for tracking educational records, data interchange for patient referral and data integration for traceability of agricultural products.

Table 2: Information exchange models derived from workshops

Information Exchange Model	Domain	Integration Type
Data integration for tracking educational records	Education	Horizontal
Research data integration	Education	Horizontal
Data exchange for checking vaccine receipt records of students	Healthcare	Vertical
Data interchange for patient referral	Healthcare	Vertical
Data integration for preventing the spread of diseases	Healthcare	Horizontal
Data integration for finding causalities of traffic accidents	Healthcare/Security	Horizontal
Data exchange for preventing illness from environmental problems	Healthcare/Environment	Horizontal
Data integration for traceability of agricultural products	Agriculture	Horizontal
Data integration for predicting the spread of brown plant hoppers (rice insect pests)	Agriculture	Horizontal
Individual and juristic person data exchange for ship registration	Agriculture	Horizontal
Data exchange for natural disaster assistance for farmers	Agriculture	Horizontal
Data exchange for rubber exporter subsidiary	Agriculture	Horizontal
Data exchange for criminal background checks	Security	Horizontal
Data integration for elderly monthly payment service	Security	Horizontal
Data integration for job finding assistance for disabled people	Security	Horizontal
Data integration for pollution control	Environment	Horizontal
Data integration for checking juristic tax fraud from water usage amount	Justice	Horizontal
Data exchange for facilitating application for factory building in settlement industrial zones	Economic	Horizontal

The projects were prioritized using six criteria: readiness of technology infrastructure, data quality, budget for implementation (compared to cost), personnel readiness, impact on the nation and collaboration among related organizations. However, prioritizing projects based on their impact is difficult, since the impact is not always quantifiable and comparable. Accordingly, prioritization can be done by brainstorming by people who are affected by each project (McGilvray, 2008).

From these information exchange models, we can specify the healthcare information exchange domain which consists of four engaged ministries: public health, agriculture, internal and education as depicted in Figure 6. These four ministries need to exchange or integrate data concerning patients, vaccine receipt records of students, accidents, planting areas, human and animal disease spreading and patient referral. It is crucial to have both universal data standards (e.g., person, address) and domain specific standards (e.g., disease, vaccines, crops) to support data integration and service interoperability among these ministries.

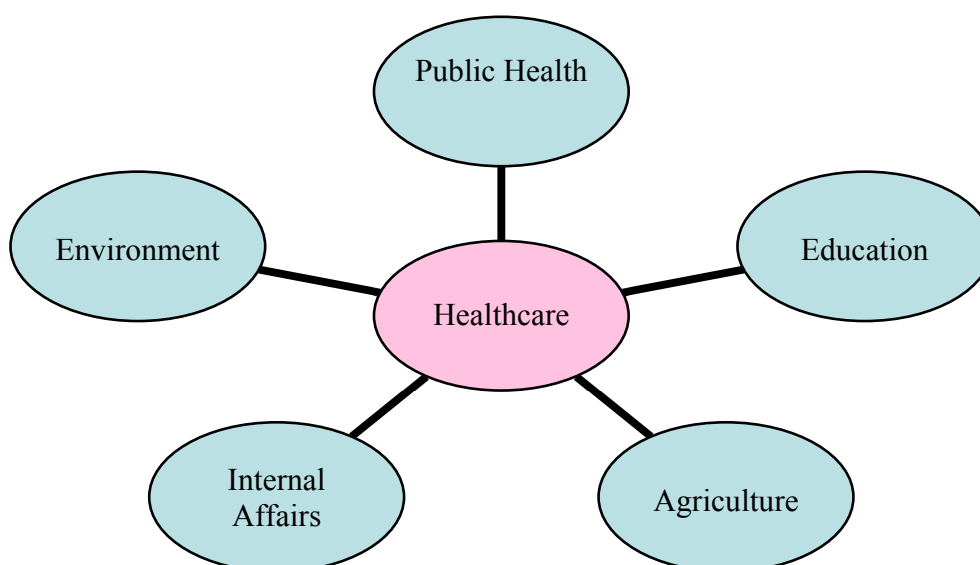


Figure 6: The healthcare information exchange domain

3.3 From internal smart to external smart

As mentioned above, G2G is the first step of internal smart to provide interoperability and service integration in eGovernment and there are many barriers as mentioned in section 3.1. However, after conducting three workshops and implementing at least three pilot case studies, we found that the transformation of eGovernment was slow due to lack of national data standards and standard governance body, lack of clear understanding about common processes across all involved stakeholders, lack of data quality and data collection resources as well as lack of laws and regulations in data sharing and absence of a proactive mindset.

Besides internal pressures, there is also external pressure since Thailand is a member of ASEAN Economic Community (AEC) which formed by 10 Southeast Asia countries: Indonesia, Malaysia, Philippines, Singapore, Vietnam, Brunei, Myanmar, Cambodia, Laos and Thailand. AEC objective is to transform ASEAN into a region with free movement of goods, services, investment, skilled labor and free flow of capital by 2015 (Association of Southeast Asian Nations, 2007). To be a single community, the intergovernmental processes in ASEAN, academic and policy-relevant activities, especially, economic integration are required. To achieve those goals and ensure timely implementation by 2015, eGovernment and e-transactions consisting of e-commerce, e-business, e-document and e-payment are being developed by the government sectors. Preparation is on-going not only to be ready for the ASEAN Economic Community (AEC) but also the ASEAN Political-Security Community (APC) and the ASEAN Socio-Cultural Community (ASC).

The challenges are how to move proactively from an inefficient current state to a desired future state and be ready for ASEAN community collaboration. This move includes infrastructure development such as logistics and next generation network, the trust development such as enhancing information security and establishing information sharing regulations and laws as well as the high-touch and high-tech development with science, technology and service innovation. Some key challenges are to enable government organizations to interchange and integrate information using common data standards, to create best practices for sharing and reusing as well as to set strategies and policies for supporting transformation to connected government and connected ASEAN.

To be fully integrated into global community, MICT and Electronic Transactions Development Agency (public organization) are the leaders and main actors to set out the key strategies and action plans to transform eGovernment to be connected government and transform traditional transactions to be full-electronic transactions. Moreover, in order to sustain economic growth, enhance community well-being and promote ASEAN integration, science, technology and innovation are to be considered as the key factors. Accordingly, in parallel, National Electronic and Computer Technology Center (NECTEC), sets up the technology roadmaps and a series of action plans for electronics, computer, telecommunication, information and services innovation to support the ASEAN blueprint, e.g., smart health, smart agriculture (National Electronic and Computer Technology Center, 2011; Kawtrakul et al., 2011b).

To push forward to implement the concrete and productive actions mentioned above, Thailand has to move up the infrastructure of the eGovernment Interoperability, especially building national data standards complying with international data standards to ensure data interoperability among ASEAN collaborations (AEC, APC and ASC) in the activities of eGovernment, e-commerce, e-business, e-document and e-payment. In addition, Thailand needs to focus on smart society building in order to be internal smart before being external smart. The current selected domains for transforming to be connected government are agriculture, health, education, logistics, security, economic, environment and energy.

4. A systematic approach to accelerate connected government

As stated in section 2 and section 3, data standards are crucial to eGovernment integration and service interoperability. To achieve both vertical integration (between tiers of public administration) and horizontal integration (across boundaries of functions, organizations, or nations) (United Nations, 2008), every domain must define its domain specific core set; and related domains collaborate to define common core data sets. To accelerate this process, it is important to develop automated tools and guidelines consisting of data landscape, information logistic for supporting data sharing and standardization as well as web-based language translation for data and information accessibility in order to support ASEAN collaboration activities and intergovernmental processes.

4.1 Developing tools for supporting data sharing and standardization

To be able to share data, a government agency needs to know where and what data exist in other government agencies. The landscape of government data is also useful for discovery of interrelated data and semantically matched data stored in various different names in government agencies. The flow of data shared among government agencies, data logistics, is useful for data standardization, especially in the process of building common core data and universal core data.

Data landscapes and information logistics can be developed by conducting an e-survey to collect data about governmental information production and dissemination from government agencies with the following details.

- **Government agency (at department or division level of all ministries)**
- *name of respondent, department name, ministry and contact information*
- **Information systems of the government agency, data of each system consist of**
- *Information system*
- name
- type of database system
- *Input data*
- main entities stored in each database
- sources of data
- data collection problems
- *Information production*
- names of information or reports produced by the system
- channel of information disseminations
- information users(organizations or groups of people)
- Internal problems of information production such as too many information requests to handle, lack of IS personnel
- *Referenced data standards*
- *Services provided/ operational functions*
- **Additional data exchange requirement (status: future or on-going project)**

Figure 7 shows the structure of the e-survey database. In addition, the collected information can be used to study state of the art of information production and data sharing among government agencies.

4.1.1 Developing data landscapes

Data Landscapes (Chisholm, 2008) are information about all data and information stored or produced by government agencies. Table 3 shows an example of the *crops and farmers* data landscape. Data landscapes can be used for searching eGovernment data.

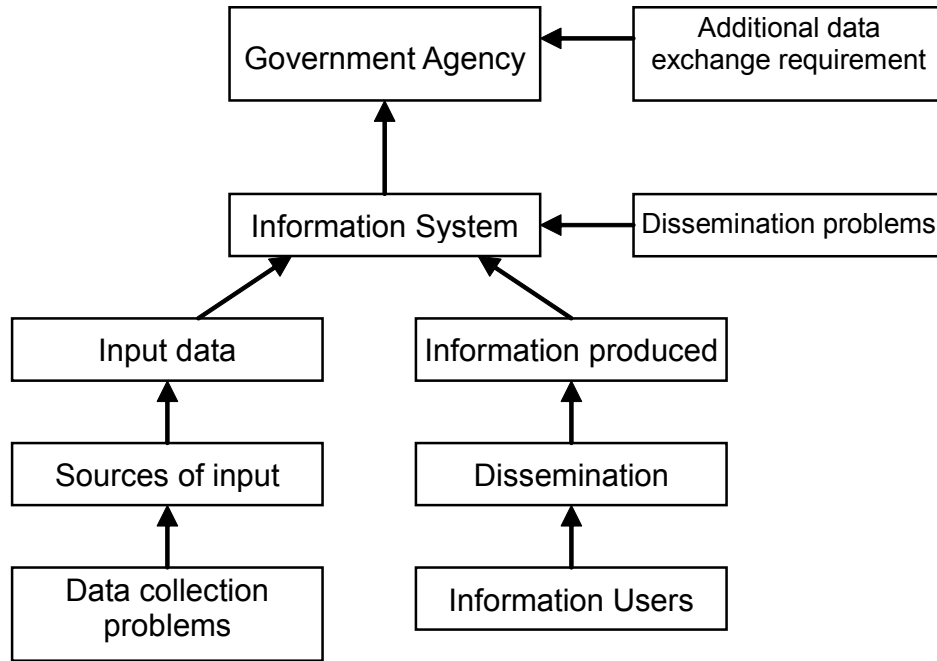


Figure 7: e-Survey data structure

Table 3: An example of data landscapes

Department name		Ministry							Ministry	
		Agriculture & Coopertives (A)							Healthcare(H)	
		A1	A2	A3	A4	A5	A6	A7	H1	H2
Data element name		Cooperative Promotion	Agricultural Extension	Fisheries	Land Development	Agricultural Economics	Rice	Agriculture	Hospitals	Disease Control
Crops	crop production area		C		U	C		C		
	crop production amount		C		U	C				
	crop seed							C		
	rice seed						C	U		
	rice production cost					C				
Farmers	rice grower registry						C			U
	farmer registry		C			U				U
	fisherman registry			C		U				
	GAP farmer registry					U		C		
	economic crop farmer registry		C			U				U
	farmer crop production							C		U
farmer career groups	C									
Patients	patient health records								C	U
	spread of diseases caused by animals								C	U

Note: C indicates that the department creates/stores that data in its database

U indicates that the department requires using that data

By analyzing data collected by the e-survey, data landscape can be produced for any level of an organization, or across organizations. Furthermore, related specific data entities entered by government agencies can be categorized into generic common terms, e.g., weather, forest, student, or soil, before illustrating the data landscape. Then, government agencies that produce or store that information are interrelated as shown in Table 3 above. As a result, information users can find government agencies that own related information.

4.1.2 Developing information logistics

It is essential to know current information exchange across departments or ministries to support data standardization. This work introduces the concept of **information logistics** to model data flows among government agencies. Information logistics is a directed graph IL as follows;

- $IL = (V, E)$
- $V =$ set of nodes representing organizations
- $E =$ set of ordered pairs of nodes $(n1, n2)$, called directed edges, where each directed edge represents a flow of data from organization $n1$ to organization $n2$.
- Each edge is labeled with a data element name that organization $n1$ sends to $n2$. In addition, each edge can be categorized by data dissemination methods: paper based, electronic, or online exchange. Figure 8 shows a sample of information logistics obtained from our survey data.

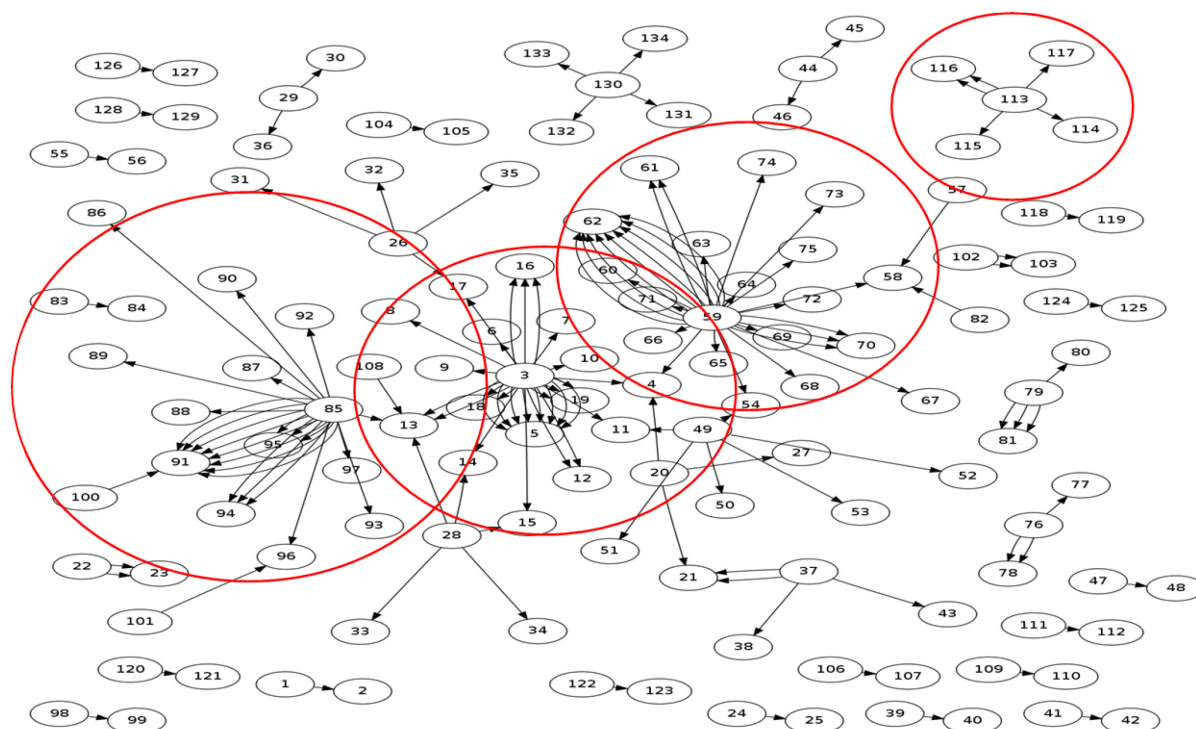


Figure 8: An example of information logistics.

Note: Data labels on edges are omitted due to space limitation, each node represents an organization.

Circles delineate an information exchange model outlined from information logistics

Combining data sources and data dissemination from the e-survey, data landscapes of all ministries can be integrated to establish the governmental information logistics, illustrating flows of data among government agencies. Using graphical tools to display the logistic, the density of traffic can easily be detected and the status of data exchanging methods explored. Moreover, by using the ontology and graphical reduction techniques, we can explore more specific information logistics.

The information logistic can be reduced to specific information logistic by indicating the data concept of interest. The ontology can support this reduction process by eliminating edges that do not relate to a specified data concept. Then, nodes without any out-going edges are eliminated resulting in smaller specific information logistic. In addition, edges from x to y can be combined if they are labeled with a data element in the same specified concept.

4.1.3 Ontology based information exchange domain identification

An ontology is defined as “An explicit specification of a conceptualization.” (Gruders, 1993) It is a set of concepts and relations describing domain knowledge. Ontologies can be used in various

applications such as data integration, knowledge management, natural language processing (Blomqvist and Öhgren, 2007; Dahap et al, 2008; Janssen et al, 2009.) Since information exchange or integration among government agencies requires consistency in data interpretations; ontologies could also support automated semantic matching of different data elements as well as categorizing data elements into specific topics or domains. By using a specific ontology such as governmental organization ontology, object and task-oriented ontologies in agriculture, health or justice domains, identifying information exchange domains for data standardization can be done automatically. An example of instances of organizational and domain specific ontologies is shown in Figure 9.

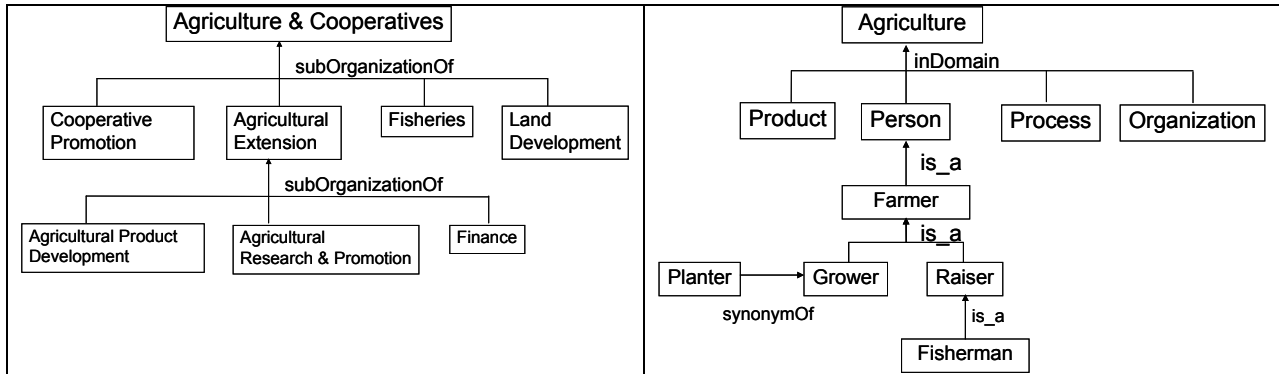


Figure 9: An example of instances of organizational and domain specific ontologies

Organizational and domain specific ontologies can be used to support identifying information exchange domains (see example in Figures 10 and 11) which are important keys to initiate national data standardization. Each domain indicates *what data* is needed for interchange and *who* the stakeholders are.

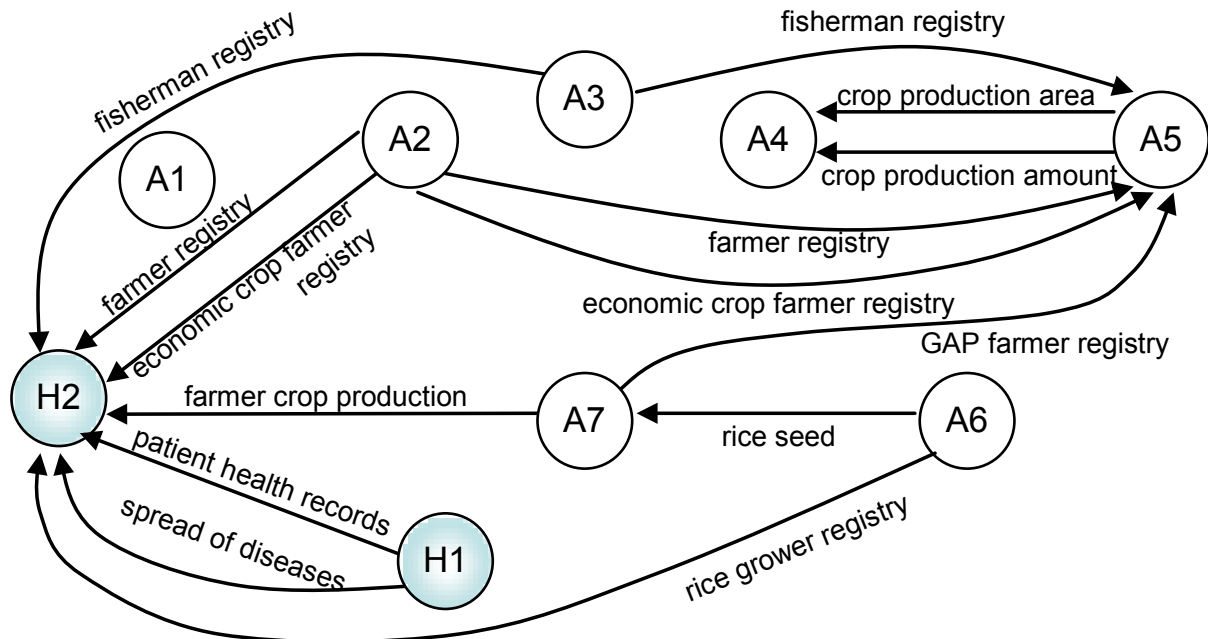


Figure 10: An example of Information logistics before reduction

Note: see Table 3 for the full organization names of each node

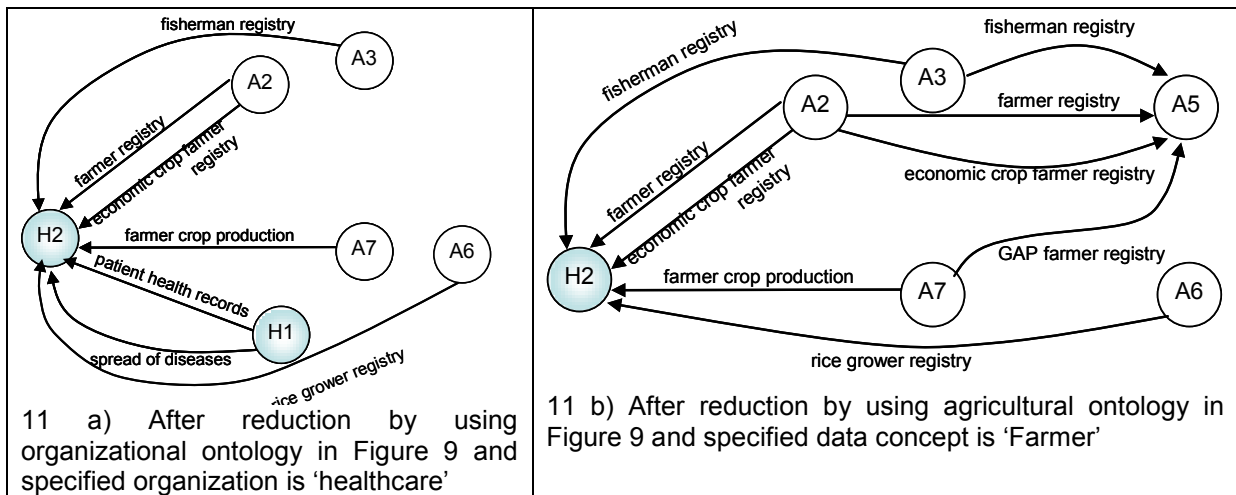


Figure 11: Ontology based domain analysis on information logistics

Figure 12 shows the overall process of generating the information exchange domains. It can facilitate data standardization in these three processes: business scenario creation, requirement gathering analysis and forming communities of interests among government agencies for data standardization.

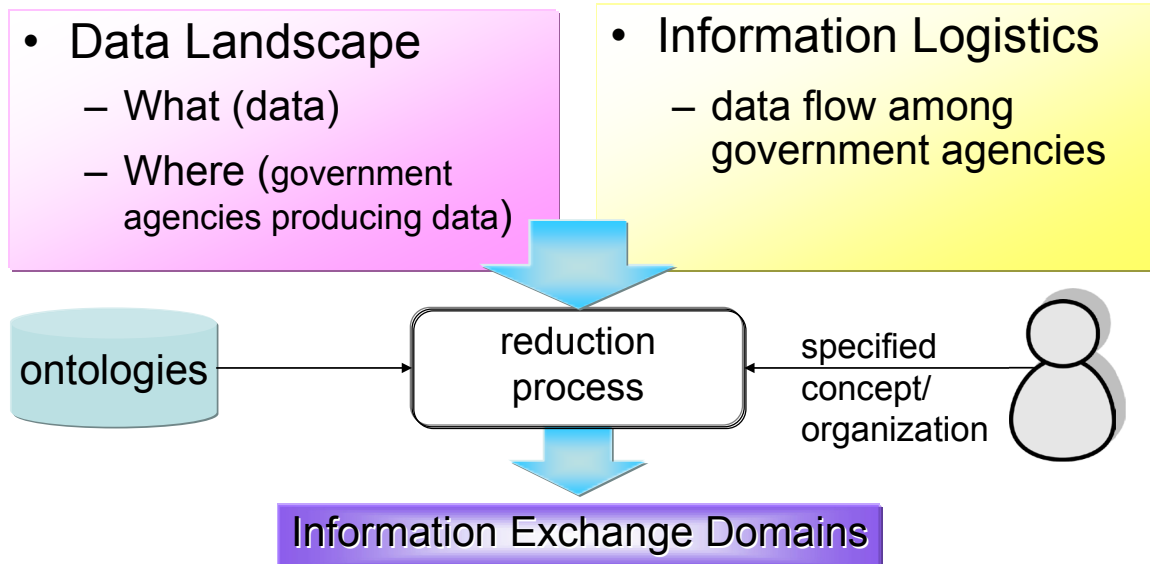


Figure 12: Ontology based information exchange domain identification

4.1.4 Finding common data interchanged among organizations

Besides using ontologies to identify information exchange domains, we can also apply ontologies to find common data that are exchanged between two or more organizations. This can be done by analyzing information logistics and data landscapes to determine data element that each organization uses or creates. Data that are common between organization A and B are data that are either used or created by both A and B. The method of finding common data interchanged among organizations is explained as follows.

Let D_x = a set of data that organization X uses or creates, where data element names are from data landscapes or information logistics.

Define $D_A \cap D_B$ as a set of common data interchanged between organization A and B

To find $D_A \cap D_B$, the following two steps need to be performed.

Find $D_A \times D_B$ where

$$D_A \times D_B = \{(a_i, b_j) \mid a_i \in D_A \text{ and } b_j \in D_B\}$$

Consider all members of $D_A \times D_B$ and

add a_i into $D_A \cap D_B$ if $a_i = b_j$,

add generalized term of a_i and b_j into $D_A \cap D_B$ if $a_i \neq b_j$ and a_i relates with b_j such that they are synonyms, generalization or specification of one another, or they have the same root concept.

For example, if

a_i = rice grower registry and

b_j = fisherman registry

then the generalized term of a_i and b_j is farmer registry.

Hence, we can conclude that organization A and B have a common data named 'farmer registry' since when looking up in the agricultural ontology, we'll find that rice grower and fisherman are both farmers. Both of them can inherit a common core data from 'farmer' data standard as shown in Figure 13.

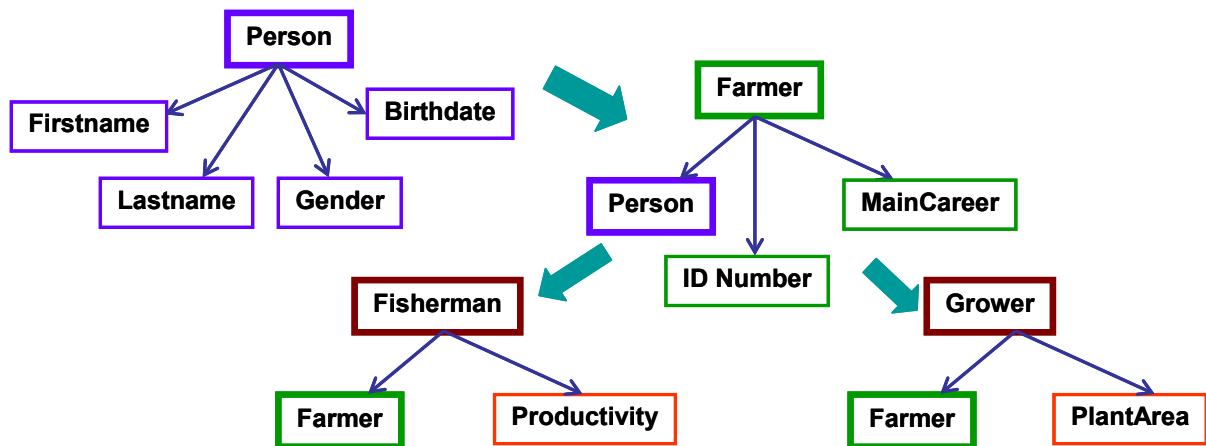


Figure 13: Example of Inheriting common core data from 'Person' and 'Farmer' data standards

NLP techniques along with ontologies are needed to determine the generalized term of a_i and b_j as described above. By using this method, we can find common data interchanges among any number of organizations. As a result, we can also find universal core data sets.

4.2 Data standardization framework

To establish national data standardization, it is important to consider the re-engineering of processes, tools and technologies, skills and the mindsets of public officials within a holistic framework. In order to accelerate connected government transformation, a framework for data standardization has been recommended. This framework consists of three main parts: data standards, processes and data standard governance.

Universal core set

Before any organization attempts to develop a domain specific data standard or common data standards among domains, a universal data standard set should be developed. The universal data standard set is defined for data that are commonly shared and understood among all domains such as person, address, document, vehicle, organization, activity, or project.

Data standardization processes

To help government agencies understand how to initiate data standardization in their organization, it is essential to have a data standardization guideline as shown in Figure 14. This guideline starts with

an introduction to data standard concepts following by how to prepare teamwork for data standardization project that may involve many organizations. Then, a four step cycle is suggested.

The cycle starts by creating business scenarios of information exchange such as earthquake scenario or flood scenario. Using methods described in section 4.1, many scenarios of information exchange can be identified. Second, analysis of information exchange required in each scenario is performed. Third, data standardization is done by analyzing both syntax and semantics of information exchanged among agencies and applying the national standards (if existing) or creating a new data standard which should conform to related international standards. Forth, the newly created data standard needs to be validated and published by an authorized national body. Finally, cost-benefit analysis of data exchange projects is presented along with project prioritization methods which will be useful for organizations that have many projects to implement.

For better results, this data standardization guideline should include best practices from both vertical and horizontal information exchange projects.

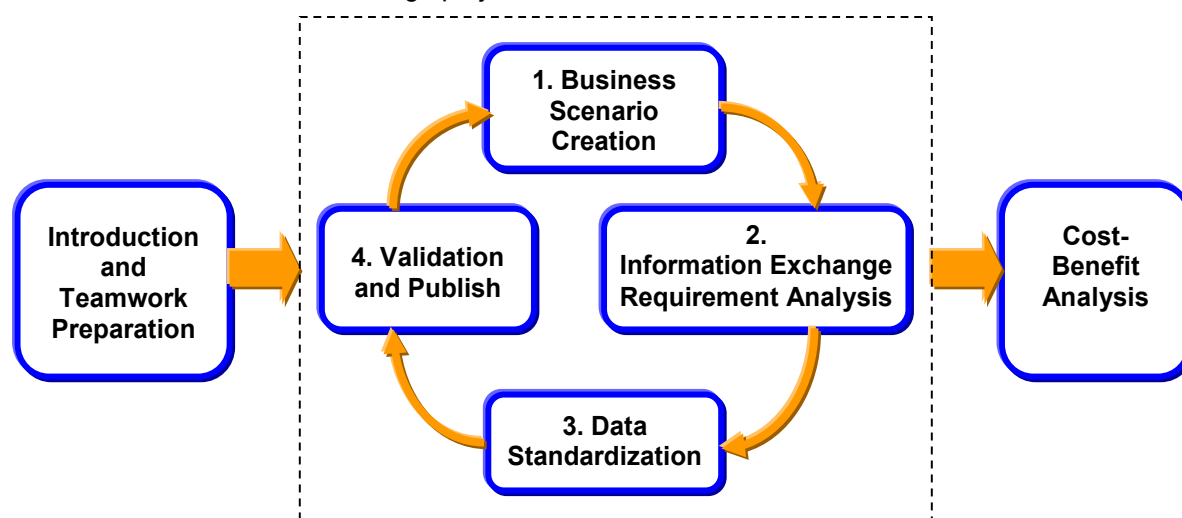


Figure 14: The data standardization processes (modified from NIEM, 2007)

Hence, government needs to support the development of a data standard registry system and a guideline for data standardization processes. The data standard registry system should provide these functions: searching, validating and publishing data standards. In addition, mapping tools to convert data into standards should be also developed for various data mapping. For example, Sahavechaphan et al.(2011) have developed a data mapping tools for supporting an efficient environmental management system.

Data standard governance

Data standard governance is important to ensure the success of data standardization and data standard application. There must be a national data standard body that is responsible for developing, supporting data standardization as well as promoting, controlling and certifying national data standards.

4.3 Overcoming language barriers for connected ASEAN

In parallel to the standardization framework, many activities are needed to prepare for integration into the AEC, APC and AEC. Both human-human interaction and computer-computer interaction will be needed, especially for smart trade and smart tourism. To address human language issues, we propose web based language translation to support data or information accessibility.

5. Road map for moving a smart government with Smart X

The survey, workshops and seminars, along with a study of national strategic plans, including the IT Master Plan 2020 (Ministry of Information and Communication Technology, 2011b), Secure e-Transactions by Electronic Transactions Development Agency, Smart-X flagship projects by National Electronic and Computer Technology Center (2011), enabled us to come up with a roadmap that

consists of four main activities for supporting connected government and connected ASEAN. The four main activities are data management, research and development, human resource preparation as well as policy and plan establishment. Based on the best practices and road map, the creation of connected government and ASEAN integration can be pursued in a strategic, rapid manner. Moreover, secure e-transactions with supportive science, technology and innovation is also a key for economic growth, sustainability and community well-being enhancement.

Two executive seminars were conducted in 2010 where 100 executives were invited from various government agencies. The seminar participants brainstormed for ideas on the success factors of information exchange among government agencies, resulting in identification of four success factors: human resources, budget, policy and measurement which details are presented in Table 4.

Table 4: Success factors in connected Government implementation

Success Factors	Requirements
Human Resources	Continuous training and education for operational, management and executive personnel. The topics are data exchanging model, data standardization process and data quality management.
Budget	Sufficient budget for connected government implementation, e.g., data standardization, information exchange projects, data quality improvement programs and Plan-Do-Check-Act for road map implementation
Policy and Plan	Establishing National policy and regulations for public information sharing Building connected government road map Promoting connected government as strategic driving
Measurement	Need good measurement for both quantitative and qualitative in government interoperability and services to citizen, community and business sectors

Raising awareness, building capacity and obtaining collaboration from all government agencies are essential for the success of connected government. To accomplish those goals, skills, culture, politics and mindsets of public officials with a holistic framework should be considered (Archmann and Kudlacek, 2008; Gottschalk and Solli-Saether, 2009). This section proposes a roadmap that highlights four categories of tasks: data standardization and data quality management, government personnel preparation in order to tackle data interchange challenges as early as possible, policy and laws for information sharing as well as research and development for connected government and connected ASEAN implementation. Figure 15 shows the 10-year roadmap for 2011-2020 with short term (1-2 years), mid-term (3-5 years) and long term (5-10 years) goals.

6. Discussion and future work

There are three main lessons learned from our work in creation of information exchange model, development of a data landscape and information logistics and knowledge transfer.

- Creation of information exchange models: from workshops and creating information exchange models, we learned that:
 - *Representatives of each government agency joining the seminar should come from both business and IT departments since most IT people do not know the usage and usefulness of their organizational data.*
 - *The more organizations involved in the workshops, the more useful business scenarios can be created.*
- Data landscapes and information logistics:
 - *The response rate from our e-survey was 30% (250 agencies); most are representatives from invited organizations at the department level that we trained how to use the e-survey system. Hence, to obtain all information from all ministries, we need to train representatives from lower level organizations that are divisions which are sub organizations of departments since some divisions manage their own information systems.*
- Knowledge transfer:

- Most representatives do not know the concepts of data standards and standardization. In addition, many of them do not realize its importance. Therefore, all government agencies should educate and train their personnel in all levels about these concepts.
- Knowledge of best practices should be managed and shared.
- Technical training for government IT personnel is needed.
- Initiative projects are necessary for action learning and creating best practices in implementation (Kawtrakul et al.,2011b; Sahavechaphan et al.,2011)

	Short Term	Medium-Term	Long Term
Data Management	National data standard committee appointment	Revision	Revision
	Universal data core set development	Revision and usage promotion	Revision and usage promotion
	Establishment of communities of interest for all domains	Extension to all domains	Extension to all domains
	Development of domain Specific and common core sets	Revision and extension to all domains	Revision and extension to all domains
	Developing data standard benchmark and evaluation system	Monitoring and auditing	Monitoring and auditing
	Data quality improvement program implementation	Implementation and evaluation	Implementation and evaluation
People	Increasing IT personnel workforces and capacity improvement	Continuing	Continuing
	Raising awareness and building capacity in data standardization and Information exchanging for all government agencies	Knowledge management and sharing	Knowledge management and sharing
Policy & Plan	Studying national policy and regulations for public information sharing	Establishing	Revision
	Establishment of policy for data standard deployment	Implementing	Revision
R&D	National data standard registry development	Maintenance	Maintenance
	Implementing information exchange projects as best practices	Knowledge sharing	Knowledge sharing
	Implementing information exchange projects aligning with national agenda	Continuing	Continuing
	Research innovation for e-Government services	Continuing	Continuing
	Studying and planning for next generation network	Next generation network implementation	Next generation network implementation
	Public safety system implementation	Continuing	Continuing
	Developing tools for supporting data exchange	Continuing	Continuing
	Language translation for supporting e-services, e-transaction, e-laws and smart services	Continuing	Continuing
	1-2 years	3-5 years	5-10 years

Connected Government and Connected Asean

Figure 15: The 10-year roadmap for connected government

From the analysis of information exchange situation among government agencies, we found that there were problems in data management, personnel capability, policy, laws and supporting tools. Hence, to accelerating connected government, we propose systematic approach for moving fast in data standardization and propose a road map for the government to implement necessary foundations and strategic actions for tackling problems while moving towards the goals.

In order that mindsets and work systems reflect best practices, the following issues should be considered:

- Initiate and promote events for sharing best practices in the public sector, such as an eGovernment day for sharing service innovation, service innovation exhibition, etc.
- Capture, share and reuse knowledge and best practices in data standardization
- Develop and design innovative mechanisms for driving the data standardization implementation
- Promote the benefits and importance of data standardization to all government personnel, including top management
- Establish a standardization evaluation system with
- *Key performance indices which are academic based, outcome-oriented and mission-based*
- *Non-financial incentives for motivating proactive participation in data standardization*
- *Rewards for success cases in developing connected government applications*

For future work, ontology development, including multilingual ontology for eGovernment and e-ASEAN should be constructed to function as a key word index to support online search and as a “category list” to support navigational browsing. This ontology could support automated semantic matching. Moreover, language competency building and web-based language translation are challenges for integration with the ASEAN community. For example, when users want to find data about farmers by using the ontology, the search system could find data elements in data landscape that semantically relate to the word ‘Farmer’. In the Thai language there are many words belonging to the subcategory of ‘Farmer’, e.g., ‘*chao na*’ meaning rice grower and ‘*chao rai*’ meaning grains grower.

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