Information Integration to Create an Infrastructure: Facilitating Public Service Provisioning in Taiwan

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Abstract: Any e-Government exists to create and capture convenient public services, and much of these services are created through the integration of resource databases and information flows. The key question in this study is, "how does e-Government appropriately integrate information across organisations to facilitate an infrastructure for public services in Taiwan " In order to answer this question, this research uses the participant observation method from 2004 to 2006 to explore the effects of the integration of databases across organisations on public service delivery, with Taipei County selected as a research subject. The results showed that information integration has influenced online public services because of its convenience and efficiency. Meanwhile, automatised services are able to decrease civil servants' administrative loading. In the case study the following three steps were taken to integrate information and provide added values of public services: first, the use of directory services to centralise user account management and to authorise database use; secondly**,** to thoroughly audit contemporary databases to check and consolidate operating programs, and to establish a core database and standardised operating database and the related rules; finally to rebuild operating systems and query frames to save information among databases in order to efficiently access information across databases and conveniently print out necessary forms.
Keywords: e-Government, Information Integration, Public Services, Databases.

1. Introduction

The information in the digital age has been circulated by an integrated gateway to access government or business information and public services. E-government public services refer to governmental information delivered to general citizens and businesses via the e-government web portal. That is to say, the purpose of e-government is to efficiently integrate the contents of public services and promptly respond to public demands from businesses or citizens with the help of information technology. Therefore, a digitalised trend of information integration among organisations has emerged in e-government. This new trend, as well as the final stage of e-government development, emphasises comprehensive access to departmental information and services through the governmental portal; in addition, a cohesive interface covers attached agencies, concerned agencies and all other services; that is, the **"**fully integrated Web presence of governments" (Digital Philippines, 2001). The main idea of this final stage in public organisations is the "cross-functional process integration" and "collaboration," which are seen as basic key components to increase customer responsiveness and reduce information cycle times (Brown and Ross, 2003). As a result, e-government designed to deliver public services must consider both customer orientation and the public's demand for administrative information flow. In other words, the ultimate goal is to use all acquired information as a resource database on user needs related to online public services, and on user-oriented methods for meeting these needs (IST Results, 2006). The key question in this study is, "how does e-Government appropriately integrate information across organisations to facilitate an infrastructure for public services in Taiwan□" In order to answer this question, this research applies the 'participant observation method' to explore the integration process of resource databases across organisations and the effects of interorganisational integration of resource databases on public service delivery, using the Taipei County government as a research subject.

Since the end of the 1990s Taiwan's government has invested numerous human and budgetary resources in achieving digitalisation and computerisation. Initially, each public sector digitalised according to its own administrative demands, and used different information systems to update databases; consequently, inconsistent digitalised development in public organisations has repeatedly necessitated setting up resource databases and governmental site maintenance in order to update public service delivery. The results influenced resource integration, information cycle times and administrative efficiency in the public sectors. Therefore, the government reconsidered providing a plan to integrate the resource database, web sites and user preferences to create efficient and convenient core database in accordance with public service delivery. When governments have a portal page, the page should have useful links to other agencies to integrate governmental information; ensuring each department is not just a single and separate entity on a governmental website (West, 2005). According to an e-government evaluation reported by Brown University

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(West, 2005), which evaluated 1797 web-portals of 198 e-governments, including disability access, contact information, and the number of online services from 2001 to 2005, Taiwan earned the first place among 198 nations in 2002, 2004 and 2005. Taiwan was able to earn this rank mainly due to convenient on-line public services, appropriate user preferences and easily navigable local governmental portals. In order to maintain its reputation, the central government must provide the necessary support to local governments while they are undergoing digitalisation. Therefore, through appropriate cross-organisational information integration, this research aims to facilitate an infrastructure for public service provisioning in the selected research case study area, Taipei County, Taiwan.

This research is a quantitative study. The paper is divided into six sections: (1) To introduce the research origin, goal and background; (2) to study previous literature related to information integration and public services in order to establish research foundations; (3) to explain research area, method and dimensions to understand research objectives and processes; (4) to explain the pre-preparation and challenges of inter-organisational information, that is, to understand current problems the government is experiencing with information integration in Taipei County, such as setting up the resource database, distributing manpower and designing operating systems; (5) to illustrate the solution of information integration; this section aims to organise related factors and to provide a proper scheme of information integration among resource databases and operating systems; (6) to draw conclusions and provide related suggestions for achieving more efficient information integration in e-government.

2. The relationship between database integration and online public services

The development of e-government is an unavoidable trend in the 21st century. E-government is defined as a way for governments to use information technology, particularly web-based Internet applications, to provide convenient access to government information and public services, to improve the quality of governmental services, and to transform relations with citizens, businesses, and public officials (Fang, 2002; Seifert and Bonham, 2004). All e-Government services are delivered in a seamless way. Therefore, the term “online public services” usually refers to governments making significant commitments in staffing, finances, and technology in order to develop and improve the delivery of e-government services to their citizens; that is, public services are directly provided by e-government to citizens via government websites (Sleeman**,** 2004; Wikipedia, 2005). Thus, Internet delivery enables citizens to seek information whenever and wherever they need it (West**,** 2004). IT applications in the public sector are aimed at improving governmental efficiency, effectiveness and accountability in public services delivery. According to the stages of growth in e-government, Janssen and van Veenstra (2005) provided five stages: (1) no integration: integration does not exist in organisations, and information is copied manually; (2) one-to-one messaging: an electronic connection or coupling is set up for each service to be delivered separately; (3) warehouse: to establish database containing information that is copied from various systems; (4) broker: through a central point for information exchange that passes on information between the different information systems in real-time; and (5) orchestrated broker architecture: to reach business logic included in the information broker to create workflows and even complete business processes. Layne and Lee (2001) provided four developed stages: (1) cataloguing: to focus on establishing an online presence for the government; (2) transaction: to consist of putting live database links to online interfaces; (3) vertical integration: which refers to local, state and federal governments connected for different functions or services of government; (4) horizontal integration: which is defined as integration across different functions and services. In vertical integration, the focus is on transformation of government services, rather than automating and digitising existing processes; therefore, the target is to seamlessly integrate the state’s system with federal and local systems for cross referencing and checking, and to consider improvements in efficiency, privacy and confidentiality issues (Layne and Lee, 2001; Beretta, 2004). At the horizontal integration, databases across different functional areas will communicate with each other and ideally share information, so that information obtained by one agency will propagate through out all government functions; moreover, the aim is the vision of efficiency and effectiveness in using information technology (Layne and Lee, 2001). In short, the stage-four e-government offers the best hope for improved efficiencies through administrative reform because of both its vertical and horizontal integration. Such integration will facilitate “one-stop shopping” for the citizen (Layne and Lee, 2001).

For the sake of providing efficient online public services, governments have to maintain unhindered information flow in the public sectors so that citizens may directly access a resource database. Databases are important because information about customers, knowledge and governmental information are today's vital assets, and a database facilitates the storage, access, and usage of this information. A database is a necessary tool for public services (Rosenfield, 1995). The progress on e-government data integration is a

matter of technological and organisational complexity; that is to say, the technology quest for data integration that enables a government to harvest economies-of-scale benefits, improve document repository facilities, and reduce transaction costs are indeed reasonable motives for the government to pursue when investing in IT (Andersen and Henriksen, 2006). There are several effects of data integration on governments: (1) it enables appropriate collection, processing and transmission of related information; (2) it enables accurate assessment of the status of national land and evaluation of various measures proposed through simulations; (3) it allows disclosure of related information and its appropriate use; (4) it enables all work to be done more efficiently; (5) it ensures access to useful information and services; (6) and it coordinates local, regional, and national e-government initiatives (Jaeger and Thompson, 2003; Harutoshi**,** 2006). Therefore, organisations IS management strategy is an important component of improving services. The key indicators reflecting an organisation's IS management strategy are (1) proprietary core: there is a stronger need to integrate disparate IS applications; (2) infrastructural core: IS is centralised with economies of scale, (3) hybrid core: the integrated of IS by Web Services provides consistent information availability (Xua, et al, 2005:330-331). In fact, the integration aims not only for efficiency and effectiveness for public service and administration, but also for citizens' ability to choose the information they want or need. In executing inter-organisational integration for public services, the government has to consider creating accessibility without barriers to avoid digital divide, and ethical implications of e-government, such as a manageable realm of e-government, impacts on individuals' rights and privacy and information security (Asgarhani,2005; Stahl,2005). In Taiwan service digitalisation is regulated by the Standard Purpose in Data Protection Law, Web Accessibility in Taiwan, Digital Divide and related laws (Taiwan's' Laws and Regulations database of the Ministry of Justice, 2006; Web Accessibility in Taiwan, 2006; Digital divide in Taiwan, 2006). Therefore, digital divide and ethical problems are issues that are considered when integrating public services. In short, database integration enables governments to directly interact with citizens and create more efficient access to core processes and information integration; moreover, it increases information utilisation and breaks geographic limitations.

3. Research method

3.1 Research area

Local governments in Taiwan are the basic administrative agencies for providing public services to residents, such as residence registration, land administration and anti-epidemic stations. Taipei County was selected as a research subject in the study based on two essential reasons: (1) there were appropriately 3,700,000 residents, 27,000 factories, and 107,000 companies registered in Taipei County (Taipei County Accounting and Statistics Office, 2006). The amount of people, industries and business companies in Taipei County was the largest number of all local governments in Taiwan. (2) Taipei County was the first region to digitalise organisations compared with other local counties. Nowadays, the web portal of Taipei County has already provided 23 integrated types, such as civil affairs, finance and transportation to reach a total of 590 items of public service for citizens, such as birth, death and marriage registrations, employment forms, online tuition payment and so on. But, only 6,974 civil servants in Taipei County deal with enormous administrative loadings every day. Recently, the Taipei County government redesigned the operating system of public services to be based on lifestyle, such as food, clothing, residence, birth, illness, death and transportation and so on. Public services have been gradually transformed to become online service delivery instead of the traditional face-to-face method provided by civil servants. Therefore, digitalisation and computerisation in Taipei County are helpful tools used to promote efficient administration and convenient public services and to overcome a lack of manpower.

3.2 Research method

This research is characterised as qualitative research using the 'participant observation method,' which relies on becoming familiar with a given group, such as an occupation, through intensive involvement with people in their environment. Participant observation is usually undertaken over an extended period of time so that the researcher is able to obtain more detailed and accurate information about the people or the group under analysis (Jorgensen, 1989). From 2004 to 2006 the Taipei County government carried out the integration of digitalised administration systems. Over three years the researcher HSIEH participated in redesigning public services, and personally observed the Information Management Centre of Taipei County Government (IMCTCG) in charge of implementing the process of systems integration. Both researchers discussed the observed situation and noted the proceedings and findings related to information integration across organisations. Through personal involvement, meeting records and academic discussions, the researchers explored the obstacles of information integration and rebuilding resource databases for public services.

3.3 Research dimensions

Integration has to be leveraged along three dimensions: information integration, cognitive integration and managerial integration (Beretta, 2004). According to the literature review, personal experience and participant observation in IMCTCG, the research dimension selected focuses on information integration in two perspectives: 'resource databases integration' and 'information systems redesign'. Firstly, the dimension of resource database integration refers to arranging the existing cross-agency resource database for the purpose of establishing information data with consistent, renewable data in real time and using a standard operating procedure (SOP). The dimension of information systems redesign focuses on establishing a core database concerned with system arrangement and management such as interface and inter-agency system functions.

4. Pre-preparation and challenges of inter-organisational information integration in Taipei county government

4.1 The proceedings of inter-organisational information integration

Taipei County government primarily focuses on administrative digitalisation in order to conveniently execute administration for civil servants and access necessary data, as well as check works for system design. Taipei county government primarily carried out digitalised administration regarding the division of job categories. That is to say, administrations were digitalised according to different job descriptions at separate times. Each agency in Taipei County Government individually established its own systems in a different period and used different software to set up the resource database; at the same time, each agency within the different systems managed its own user accounts and authorisation to operate information systems. Due to each agency doing its own management, the original design of each system lacked an inter-organisational integration scheme. Moreover, while dealing with common resources and information, each agency established duplicate databases to store information and resources that wasted time in searching for information. Users became frustrated when searching for information they needed or when trying to obtain public service from different web-based entries. Furthermore, duplicating databases wasted database capacity and created inefficient data renewal, as well as threatened information security. In order to resolve the above-mentioned problems, the Taipei County government focused on user authorisation and inter-organisational administration to integrate resources databases as follows:

4.1.1 Integration of personnel information

Taipei County government integrated user accounts and authorised using systems with organisational human resource databases. After entering the organisation, a newcomer received an authorised system account in accordance with his or her administrative duties and position. Taipei County Government applied a directory service (DS) to centralise management for such data as user accounts and authorisation (see Figure 1). The government applied three modes—(1) information input by hand, (2) information input from different organisations and (3) information synchronisation—to renew the governmental human resources databases; furthermore, it transmitted the renewal data into a DS database which allowed users to use a unique account and single sign-on (SSO) to enter the system.

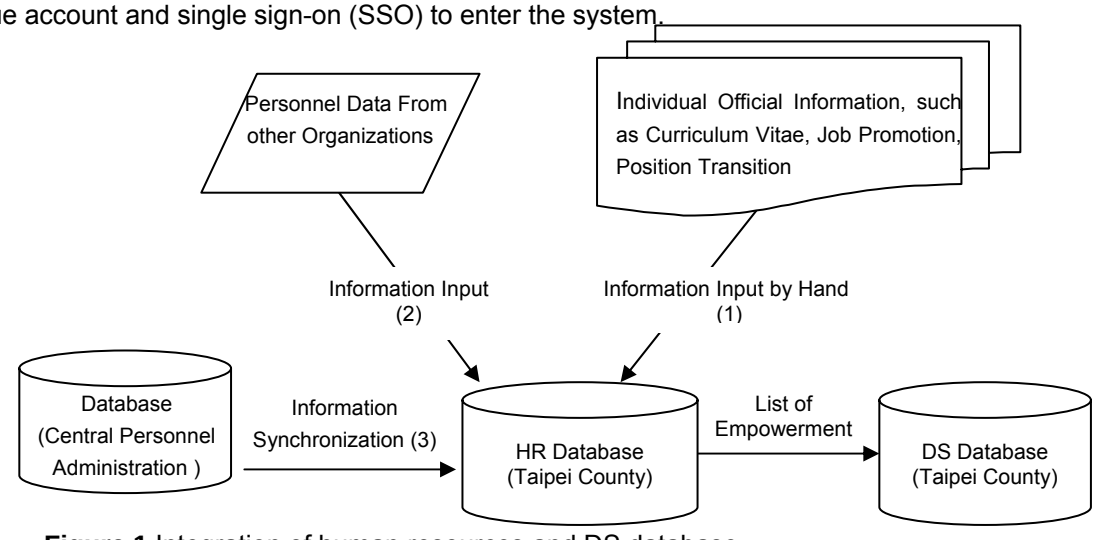

Figure 1 Integration of human resources and DS database

Note: - Administrative data. - Data. Database. - Data flow.

4.1.2 Inter-organisational integration of administrative information and data

Since 2004 Taipei City government began thoroughly checking existing systems and databases, and advanced data integration according to the classification of job categories. The county government used two methods of handling data: (1) less frequently used data was kept in the present mode and accessed in order to preserve the autonomy and integrity of existing resources. The strategy was to establish a virtual integration of basic data, such as data source, data mode and search manner. (2) For frequently used basic data, the government used data rearrangement and re-emergence to establish a common core database as a substantial strategy of data integration (see Figure 2). Information or data used in the core database was codified by a standardisation of process (SOP); that is, administrative systems in each agency were required via application programming interface (API) to enter the core database and to legally authorise users to change and access data. The purpose of this strategy was to maintain the consistency and efficiency of the core database and to renew it in real time. According to Figure 2, database integration affected the establishment of the core database and the standardisation of information access, which were helpful to maintain information consistency and circulation in resource database and to unify different information access and the management of information systems (Haas, Lin and Roth, 2002).

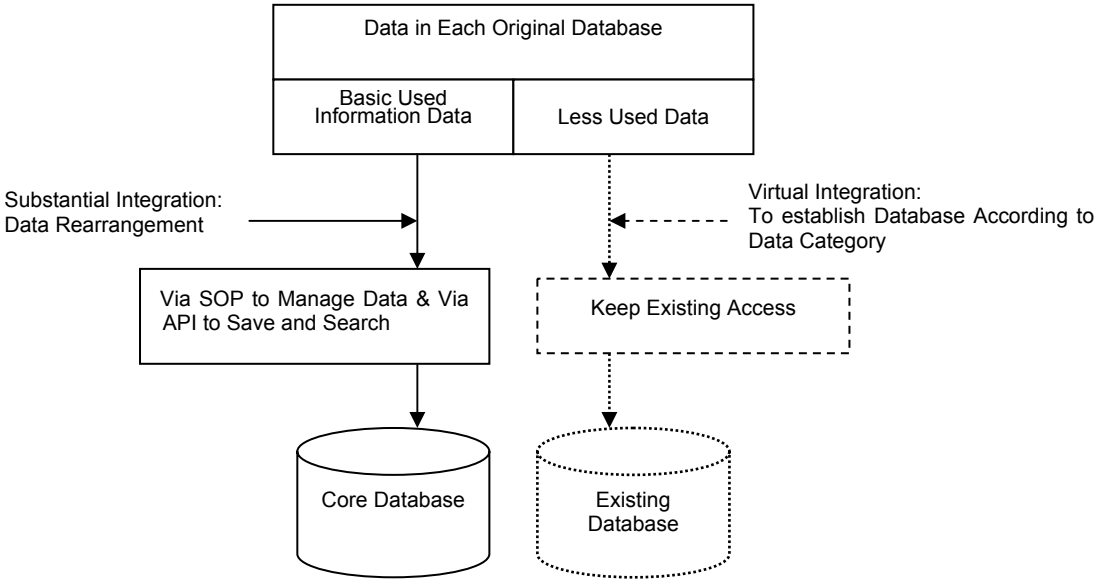

Figure 2 Integration of Administrative Data Across Organizations

Note: ···means unchanged access.
means managed access.

4.2 Challenges while developing interorganisational information integration

Owing to the division of digitalisation and computerisation into different stages in different agencies, the government recently confronted several problems:

- Duplicating databases and discrepantly existing data contents caused governmental information to be inconsistently posted on the website, casting doubt on the accuracy of online governmental information. According to the research done by Janssen and van Veenstra (2005), while maintaining databases, copying by hand and database information copied from various systems caused several problems, such as time wasting, difficulties with maintenance, incorrect information and inability to renew data. For example, social welfare agencies distributed welfare subsidies to qualified citizens by relying on residential data saved in the databases. Due to the renewal of data on registered residences at different times in different agencies, the authorised agency occasionally gave insufficient subsidies or excessive grants to citizens. On the other hand, data spread throughout different databases forced citizens to apply for official documents in different agencies; this process was very complicated and cost a lot of time and money. Therefore, integrating governmental data and information via digitalisation in a core database was a very important task.
- Possible weaknesses of database operation and maintenance. Most governmental agencies delegated the innovation or development of individual management of information systems (MIS) to computer companies, which resulted in most of the database schema being controlled by these companies.

Therefore, when the agency needed to change or remove data, it had to negotiate with the company. As a result, the government could be decreasing its autonomy and control over the information, and wasting time and financial resources; meanwhile, it is difficult for MIS managers to control and renew sources and data in the database schema on time.

- The agency focus on electronic service delivery did not always sufficiently consider the needs of users, whose concerns include ease of use, ability to find and access content, navigation, and a general ability to use the site for specific purposes (Bertot and Jaeger, 2006).

Furthermore, inconsistent database schema and sources without integration caused difficulty in accessing inter-organisational data; consequently, the government faced dilemmas in integrated public services delivery, specifically in the possibility of using databases to support decision-making, and in clear distinction of the relationship between systems and access. These potential situations could allow MIS managers excessive authorisation within the database or could create simple errors in dealing with relative database problems; an IT security problem may occur while accessing the databases that could compromise the data.

~~5.~~ Suggestions for inter-organisational information integration

The primary task of integrating inter-organisational information to increase the value of public services delivery is to avoid database duplication, inconsistent database access and exclusive relationships with computer companies. The Taipei County Government provided several solutions to deal with the above-mentioned problems.

5.1 To build a core database

According to researchers' participant observation, inter-agency information integration depended on database characteristics and the frequency of data usage; that is to say, less frequently used data was kept in present mode and access; whereas frequently used data was integrated as a core database via a data dictionary to define database structure, table, field, content and form, as Table 1 shows; furthermore, allowing metadata to describe the data dictionary and keeping data attributes in correlation with data in databases was helpful in administering data, as Table 2 shows. Finally, SOP was applied to codify the name and management of the databases in favour of accessing the follow-up database. Therefore, to unify metadata forms and the operation process it was helpful to arrange and display the standardised formats of information attributes and data table attributes in resource database.

Table 1 DD Metadata form

Substantial Names	Concept Names	Length of Data Mode	Allowed Null?	Default value	PK☐FK ☐Unique	Data Resources	Accepted Null	Descriptions

Note: The Table aims to arrange and standardise forms to illustrate DD described the definitions of data attributes.

Table 2 Data correlated with metadata form

Numbers of Data Forms	Substantial Names of Form	Conceptual Names of Forms	Descriptions of Data Forms	Categories of Data	Agencies or A Person in Charge
Numbers of Databases	Capability of Forms	Owners of forms	Data Index	Information Synonym	Empowerment

Note: The Table aims to arrange and standardise forms to express the attributes of Data Table in databases, which describe the definitions of data attributes.

There are three essential steps to building a core database. First (1), the government must thoroughly check all databases and information systems and look for frequently used basic and core data, as well as determine the agencies in charge of managing these frequently used data. For example, human resources data is managed by a personnel agency. The second step (2) is reverse engineering; existing system programs are analysed by software in order to restore the design structure of the original data. In addition (2.1), the company that set the original application systems must produce a physical database model (PDM) in accordance with reverse engineering to enhance the original design concepts and supplement the demand for change. The final step (3) is to arrange a detailed list, data sources, and correlated systems of databases, and to categorise data; then, compile and write a required data dictionary according to the categories (see Figure 3). In Taipei County, the database had been arranged in thirteen categories, such as

human resources, financial accounting, official archives, public knowledge, property, residence management, social welfare, legal regulation, business affairs, engineer management, GIS, navigator, and information security. According to the importance of these thirteen categories of databases, the Taipei County government compiled DD and information correlated Metadata to access the core database.

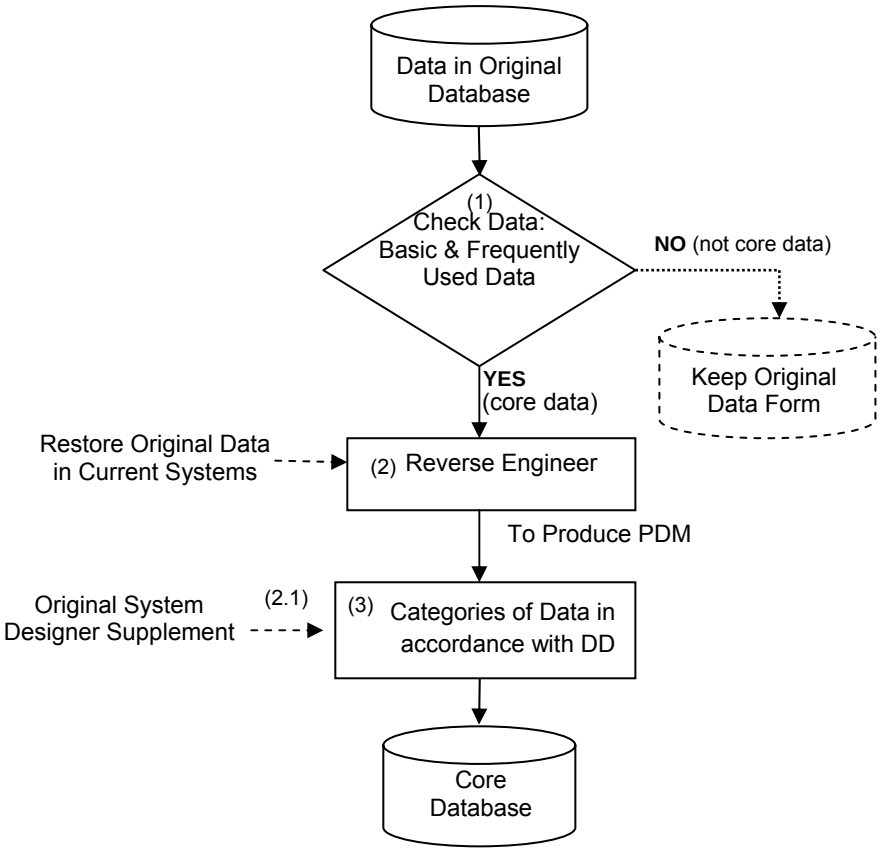

Figure 3 The integration process of core database

Note: Process. To decide.

After setting up a core database, future operating systems would not have individual databases, and data was accessed only from the core database. Therefore, the process of accessing the databases followed two principals: (1) the information query was based on standard structured query language (SQL); (2) the data change was required to pass the operating system to use the Application Programming Interface (API) provided by Data Repository. According to Figure 3, the integration process enabled resource database managers to check currently existing databases. Therefore, through a reverse engineering process, software equipment was applied to rebuild the original information design, which was helpful to overcome the insufficient archives of the current systems. After establishing a core database, new applied systems did not possess respectively independent database systems; thus, access to information was realised in the core database.

5.2 To redesign information systems

Integration between operating areas could be improved with organisation design linkages (Twigg, Voss and Winch, 1992). Therefore, the primary step in redesigning information systems was to simplify and merge the process of public services delivery in order to provide citizens with online integration services (called 'one-stop shopping'). In addition to building a core database, the government should update database contents in real time to survey relative public service systems for citizens. For example, if there was a correlation between two service proceedings, then, these two systems should be automatically connected via an information system to allow citizens to conveniently access these services. The second step was to arrange public services based on service subjects. When integrating the information system database, the Taipei County government sought to renew, categorise and rearrange online service contents presented by means of centralised services, such as online employment service, GIS, or transportation. The final step was to categorise online public services so that citizens could easily understand and use them; for example, using

terms such as food, clothing, transportation, birth, illness and death to describe online service categories. According to the statistical results reported from the Taipei County government in 2006, citizens would be more likely to use service categories rather than departmental categories. In comparing the number of daily users, the number of users using service categories was three times that of users using departmental categories (2,983:1,086 daily users). Currently, the daily number of users using online public services is up to 12,360 people. For example, for use of the online citizen's complaint services until June 30, 2006, the ratio of use of online services compared to paper services is 1:5 (daily online complaints: paper complaints = 28,156: 5,119 people). Therefore, an added value of online public services delivery was to allow citizens using the governmental website to search information wherever and whenever they need it.

5.3 The essential steps to enhance information integration cross organisations

To scrutinise Taipei County Government in developing the process of cross-organisational information integration for public services, this research provides three main successful steps to establish the directory service (DS), the database (DB), and the message platform (Queue). First, the government has to set up user accounts and manage system authorisation. To do that, it is important to arrange DS to control personnel data and to adopt role-based access control (RBAC) to authorise users to renew data based on their administrative accountability. In addition, users are only allowed to use SSO (single sign on) to enter an account, which helps to efficiently manage information sources and to safely access the database. According to government information categorised by the U.S. Federal Interagency Committee on Government Information (U.S. Federal Interagency Committee on Government Information, 2004), access constraints under the standards may apply to certain classified security information, proprietary information, personal information, litigation-related information, and other particular cases; for example, there is certain information for which access is restricted to authorised public citizens, such as (1) information restricted to private citizens eligible to receive that data, (2) information limited to government contractors, (3) information limited to state and local governments. In the second step, the main method is to check thoroughly the current existing DB, and to find original sources, and then to arrange and merge the databases in order to build a core database and maintain data access consistently and in real time. The government is able to adopt SOP to access the database, and ensure updated information and renewed data in order to avoid inconsistent information. The final step is to arrange and merge message platforms (Queue) in order to connect with system authorisation, common functions, data access and to regulate information exchange modes, including Query frame, DS, process and paper printout (see Figure 4).

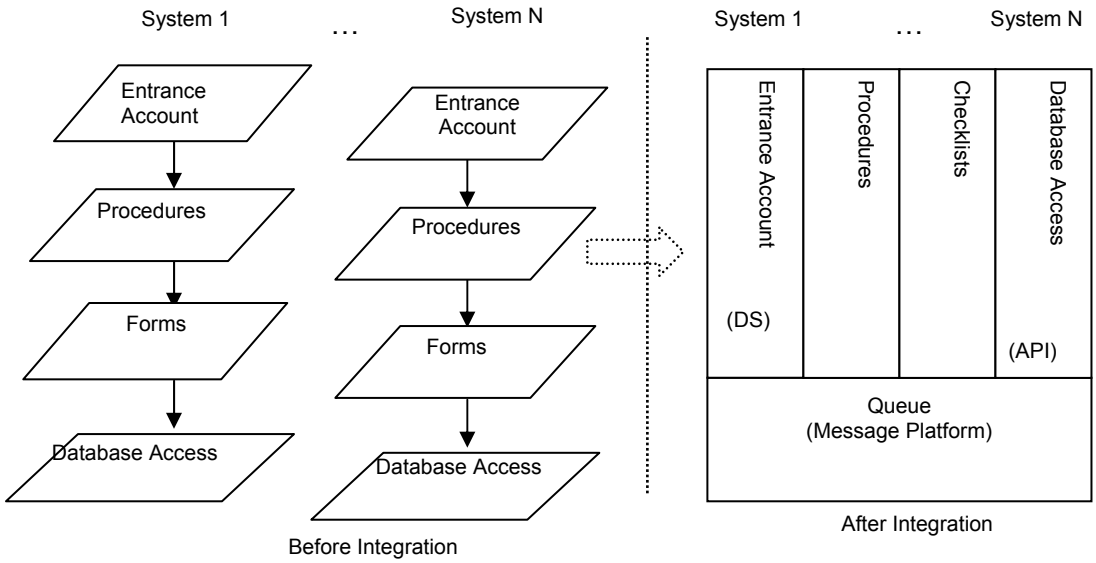

Figure 4 The comparison of integration of queue (message platform)

According to the above-mentioned illustration, these steps, including system merges and Queue plans, allow each system to apply API required functional groups. They also allow the government to avoid duplicating the database and portal, or inconsistently renewing database contents.

5.4 Discussion

Application programs (AP) are able to connect with each other through users' access portal. That is, after registration, AP emerges at the same user's portal for the user's choice. As Figure 5 shows, AP based on information in DS gives users' authorisation to access information. To operate AP based on the operation plan of individual work and through the interface of Queue it is required to use functional groups in the middle level, for example, system operation process, API for report produce, workflow, and information exchange. Meanwhile, each AP requiring API is provided by the interfaces through Queue in the middle level to change information in DB (i.e. a repository). Therefore, to merge DS, Queue and core database is helpful to store information; that is, each AP does not build an individual user account and system authorisation, nor duplicate the checklist and flow function. Furthermore, the standardisation of management in DS, Queue and DB access can reduce improper information renewal, which may cause security problems to occur.

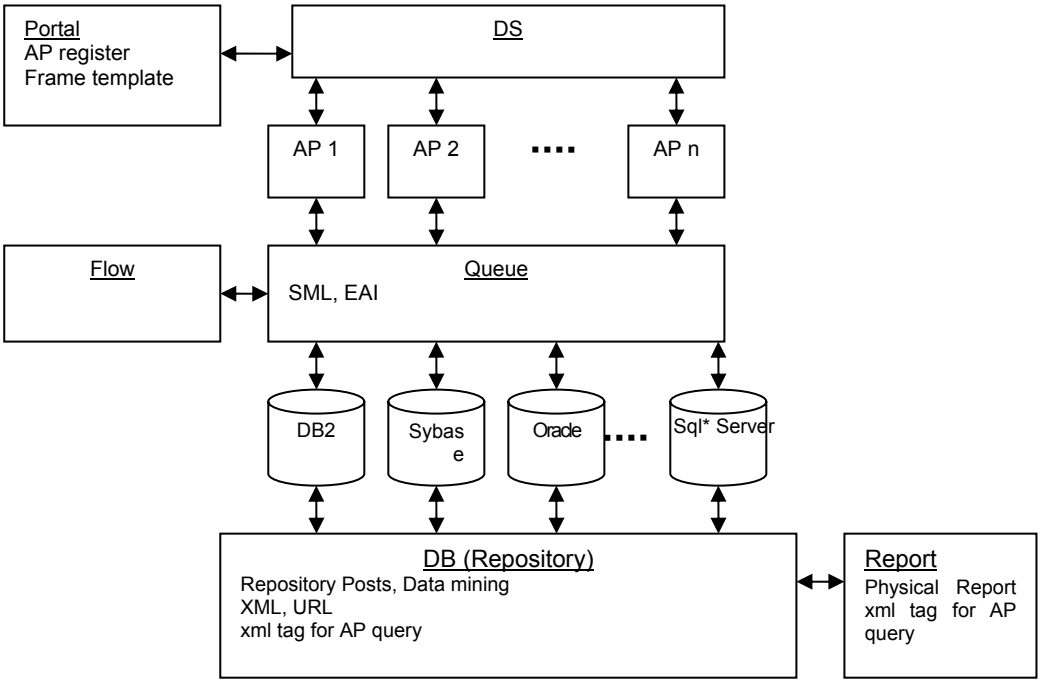

Figure 5 Analysis of information integration process

In order to provide one-stop shopping for public services across inter-organisational integration, Taipei County Government had to authorise users to access relative information via DS, queue, flow connections and databases standardisation. In the execution process, the government faced the twofold difficulties of original system maintenance and new system test. In fact, the communication among employees is more important than the reform of new online systems, therefore, employees' cooperation is worth noticing. In addition, after completing the core database, directors and information managers can then authorise users to access the systems and databases in order to avoid the inappropriate accessing of information and causing security problems. Janssen and van Veenstra (2005) pointed out that the service-oriented architecture (orchestrated broker architecture) stage needed business process engineering and structural transformation. Taipei County Government applied gradual reforms while facing current service access, service mode change, and new service increase. The government selected the most important information to build a core database, basic functions, such as DS, queue (including flow) and SOP, and management principles; and further chose systems confronted with heavy service changes to integrate system function and database modules. Therefore, the module integrations were more efficient than one-stop shopping. Even though they confronted challenges in the integration proceedings, Taipei County Government still considered moderate reform processes, such as employee training and service authorisation. According to the system integration proceedings, information integration produces the following advantages:

- The government saves on the cost of systems development and management because of SOP adoption and the establishment of a common program library.
- The government is able to promote system quality.

- The government sets up a system inspection program to maintain system security, which helps to quickly find system errors. Then, the government is able to fix problems on time to enhance program efficiency.
- The government establishes a management information system to control system innovation and safely maintain achievements to ensure system products are in accordance with the administrative environment.
- The added values of public services are produced after inter-organisational information integration. For example, citizens apply to a given online service; at the same time, they are able to search related information because the systems are automated to connect to related public service procedures.
- After integrating the administration processes, handling the administration procedure becomes more transparent to allow citizens to search public services in real time.
- Online public services are not restricted to an 8-hour workday or a specific agency service counter. After digitalisation and online integration, citizens can adopt the habit of "one-stop shopping" to receive public services anywhere and at any time.

Information integration among databases could be improved with organisation design linkages. As levels of technical or informational integration increase, there is potentially a greater need for organisational change (integration). The development of technical integration requires greater functional cooperation and a strengthening of linkages between all system functions--in particular between information systems and databases. According to researchers' participant observations, increasing technical change is accompanied by incremental changes in database management, human resources and public services. As Table 3 shows, before information integration is digitalised, the government can easily waste technical expenses and manpower and lower administrative efficiency and service quality. After digitalisation, technical integration essentially replaces existing techniques and procedures. The government is able to unite data, to maintain data consistency and transparency, to promote service quality, and to appropriately distribute human resources.

Table 3 Differences in information integration: Before and after

Items	Digitalisation Before Information Integration	Digitalisation After Information Integration
Database	Duplicate access to data in database. Unable to Update Database. Database Schema controlled by the company that developed the original systems. Not easy to advance system integration across organisations. Database contents can be directly changed, which causes them to be easily misarranged.	Data consistency is easily maintained. SOP is helpful to update database schema. Data base schema is open. It is easy to advance information integration across organisations. System contents are changed via API, and database access is changed via SOP.
Public Services	Only able to provide a unique online service. Only able to provide a single inquiry entrance for working proceedings. When applying for several services, user is required to enter different web-based interfaces to receive services.	Able to provide online integrated service across agencies. Able to provide online inquiry entrance for working proceedings across agencies. To provide one-stop shopping after services integration. Easy to provide standardised services.
Distribution of Human Resources	Unequal workload distribution. A civil servant is responsible for many kinds of work; therefore, he or she is unable to be an expert in his or her position. Facing the diverse demands of the public, civil servants must accept a lot pressure from citizens.	Suitable to distribute manpower and increase efficiency. The workload distribution is based on profession or expertise. The government is able to control and inspect systems and databases to avoid influence from computer companies. The government encourages citizens to use online services in order to release pressure on civil servants and to maintain workplace efficiency.
Operating Systems	N Process (Individual Operating Systems)	Integration Process (Consistent SOP, DD)

Maintenance Cost	High Cost, Low Usability	Low Cost, High Usability

In discussing the added value to public services after digitalisation to integrate information across organisations, online users are able to efficiently receive 24-hour services, to seamlessly search information via the internet, and to quickly check case application proceedings via a single online entrance, none of which can be implemented through traditional public service delivery. Yet, after developing the administration categories to digitalise public services, the government is unable to provide complete online services because database integrations are not yet implemented. Therefore, IT expenses and manpower are insufficient to accomplish their goals.

Table 4 Service quality based on different public service modes

Service Quality	Tradition	After Digitalisation based on the Categories of Administration	After Digitalisation to Integrate Information Across Organisations
Unrestricted Service Time (24H)	×	±	√
Seamless Service Location	×	±	√
Service Efficiency	×	±	√
Convenience of Searching Services	×	±	√
Accept Service via the Internet	×	±	√
A single inquiry entrance for working proceedings	×	±	√
Online Integration Services Across Agencies	×	×	√
A single inquiry entrance for accessing proceedings across agencies	×	×	√
Standardised Services via the Internet	×	×	±
One-stop shopping after services integration	×	×	±

Note: √ means completed public services; ± means limited public services; × means unrelated public services.

6. Conclusions

This research explores information integration in e-government to create an infrastructure facilitating public services for citizens, and provides the most important factors that account for the inability to integrate online information, such as repetitive information building, inconsistent information content and information security. In order to solve these problems in information integration, the study suggests that: (1) the government must build core databases to efficiently solve information repetition and inconsistence via DD and SOP; (2) according to users' demands, the process of public services is simplified and integrated to present easily understandable services, which achieves the goal of online system integration cross organisations; (3) owing to the observation of Taipei County Government, DS, DB and Queue are essential ways to integrate applied systems and complex database. Therefore, while developing cross-organisational integration and establishing DS, DB and Queue; the government must synchronously consider authorisation and data access without barriers. The integration method applied by Taipei County Government required gradual reform to integrate complex online systems and database, and technical professions; moreover, it was able to avoid employees' and users' confrontations and negative feedbacks. Even though the government was unable to improve all related problems, such as hackers, it provided fair and equal public services. According to the participation and observation of Taipei County Government, the researchers found: (1) upon the demands from citizens, the government provided public services in accordance with the customer-centre orientation. Through digitalisation the government was able to connect different database cross agencies to improve and integrate public services which enabled the users access in real time. (2) According to efficient integration of database entities, the government developed convenient and interactive online services. For example, medical preventive inoculation, account transfer, online tax payment and integrated service interface, such as PC, cellular phone and PDA. Therefore, it was important to provide an integrated system and consistent database contents in order to offer good quality services. (3) The bigger the database and information systems in government, the greater the difficulty of information integration. Therefore, the government should adopt information systems in the core database after physical integration, particularly

new innovated systems or rewritten information systems. Before implementing a new system, the government should build a test system environment to allow users to try out new systems. Only if the trial systems succeed should these systems be allowed to serve users.

Therefore, the researchers suggest that: (1) while current information systems proceed to transfer data from the integrated database, double tracks are required to transfer information. That is, information synchronisation should update the current database and reconstruct the database at the same time. Then, the transferred information systems and databases are connected and become operational, and finally the information system can be formally transferred to the new database operation. (2) User-friendly system designs are an important part of good technology. The government should provide a user-friendly interface for users to conveniently enter a governmental website. To realise information integration across agencies is helpful for the government to provide consistent and reliable public services and online one-stop shopping. Online public services are not constrained by time and place; therefore, it is helpful to encourage citizens to access public services in accordance with their demands. Based on these advantages, the government is able not only to reduce manpower for public services and reorganise human resources, but also to improve administrative efficiency and service quality via information integration cross agencies.

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