



# E-government adoption: architecture and barriers

E-government  
adoption

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589

## Abstract

**Purpose** – To provide an integrated architecture framework for e-government that represents the alignment of IT infrastructure with business process management in public sector organisations and classify the barriers that might complicate the implementation of the proposed architecture framework. The study will help IT practitioners in the public sector learn how to use and manage information technologies to revitalise business processes, improve decision-making, and gain a competitive advantage from the adoption of e-government. The proposed architecture framework for e-government adoption will reduce confusion surrounding e-government infrastructure in the public sector through understanding the implementation processes, identifying requirements of information and communications technology tools, highlighting the importance of the organisational management resources and the impact of barriers.

**Design/methodology/approach** – A range of earlier studies have been critically examined and analysed to provide an integrated architecture framework for e-government adoption that can address and identify the standards, infrastructure components, applications, and technologies for e-government. The authors have divided the architecture framework into four layers; access layer, e-government layer, e-business layer, and infrastructure layer; each layer addresses a particular aspect of e-government architecture. This paper then presents a critical analysis of barriers experienced in public sector organisations, which prevent the successful adoption of e-government; such barriers being presented in a taxonomy.

**Findings** – Defined organisational and technological requirements that will be necessary for the adoption of e-government in public sector organisations through construct an integrated architecture framework for e-government. The difficulties and barriers that have been experienced in public sector organisations which complicate the implementation process of e-government have been analysed and then identified and presented in a taxonomy.

**Originality/value** – The paper provides architecture framework for e-government adoption that can help to guide IT managers recognise the technological and organisational requirements for e-government adoption in public sector organisations. The framework can also help the decision makers to set a vision statement and strategic action plan for future direction in the information technology age through identifying key elements and stages for action. The authors also identify and classify the perceived barriers that might complicate the implementation process of e-government projects. The awareness of these barriers is important for any e-government project since they will alert the e-government project team with any problems or challenges might be existed during the implementation process so they will be ready to overcome them.

**Keywords** Government data processing, Public sector organizations, Computer applications

**Paper type** Research paper



## Introduction

The adoption of information and communications technology (ICT) and related practices in the commercial sectors, such as e-commerce, and the diffusion of the internet among the general population have resulted in a rising level of comfort and

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familiarity with the technologies in many contexts (e.g. communicating with people, electronic marketing, and academic activities). This has increased the expectations of citizens that public sector organisations will provide services similar to those in the commercial sector with the same effectiveness and efficiency. A recent survey by James (2000) reported that 60 per cent of respondents believed that government organisations would be more effective if citizens could use the internet to register their cars, pay parking tickets, fill out forms and apply for permits. About 50 per cent thought it would be a good idea to allow citizens to vote online and have government auctions on the internet.

An e-government strategy is a fundamental element in modernising the public sector, through identifying and developing organisational structure, the ways of interactions with citizens and business, and reducing cost and layers of organisational business processes. It provides a wide variety of information to citizens and businesses through internet. However, the role of e-government is not only to provide information and services to citizens, which could be provided by commercial firms. E-government can develop the strategic connections between public sector organisations and their departments, and make a communication between government levels (e.g. central, city, and local). This connection and communication improve the cooperation between them through facilitating the provision and implementation of the government strategies, transactions, and policies, and also better use and running of government processes, information, and resources (Cabinet Office, 2000; Heeks, 2001). Governments can also transfer funds electronically to other governmental agencies or provide information to public employees through an intranet or internet. Cabinet Office (2000) and Tyndale (2002) both agree that e-government has improved communication between different parts of governments so that people do not need to ask repeatedly for the same information from different services providers.

Through an integrated web-portal, it will be possible for citizens and businesses to complete a transaction with government agencies without having to visit several separate ministries/departments in separate physical locations. In addition, e-government strategy is enabling public sector organisations to interact directly and work better with businesses, irrespective of their locations within the physical world. This includes digitising procurement services from and to businesses in order to improve their service quality, convenience, and cost effectiveness (Heeks, 2001; McClure, 2000).

Accordingly, government leaders and officials are increasingly aware of the potential of e-government to improve the performance of government organisations and provide potential benefits to their citizens and business partners. However, adoption of e-government is not straightforward and cannot be done in a limited period of time, rather it requires an integrative architecture framework approach to place government information and services online. This is one of the reasons why many government organisations are still in the infancy stage of e-government adoption. Another important reason for this delay is that e-governments require significant changes in organisational infrastructure, which, in turn, can engender resistance. It is a result of these reasons why the authors develop an integrative architecture framework for e-government adoption. The goal of this study is to help IT practitioners in the public sector learn how to use and manage information technologies to revitalise business processes, improve decision-making, and gain a competitive advantage from

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the adoption of e-government. The proposed architecture framework for e-government adoption will reduce confusion surrounding e-government infrastructure in the public sector through understanding the implementation processes, identifying requirements of ICT tools, highlighting the importance of the organisational management resources and the impact of barriers. The framework can also help the decision makers to set a vision statement and strategic action plan for future direction in the information technology age through identifying key elements and stages for action.

In this paper, the authors analyse issues associated with e-government adoption, such as infrastructure and barriers. This paper is structured as follows: analysing the applications and information management infrastructure through discussing the framework of e-government architecture. The significance of the framework layers and technologies of e-government architecture is then discussed. Differing adoption barriers are then identified and analysed, with them being classified and explained with examples to provide a wider view of causes and characteristics.

### **E-government architecture framework**

A public sector organisation planning to adopt an e-government initiative and formulate its IT strategies must evaluate its business models and select appropriate technology solutions that deliver on central government policy. Although there are significant differences in the composition of organisations, there are a number of technologies and systems infrastructure that many organisations need to adopt in common to provide facilities for the integration of their systems in a way that enables them to build a platform for sharing their knowledge resources. For example, an e-government portal requires a common and integrated architecture framework that allows different organisations, provinces, and municipalities to share and exchange data, independent of formats, devices and underlying architecture (Sharma and Gupta, 2002). Therefore, organisation must have a clear understating of architecture frameworks from both the technical and information management level.

The e-government architecture defines the standards, infrastructure components, applications, technologies, business model and guidelines for electronic commerce among and between organisations that facilitates the interaction of the government and promotes group productivity. Since e-government is a relatively new research area, its architecture and adoption strategy have not been widely discussed in the literature. Therefore, the authors review and study these concepts from other relevant areas such as e-business, e-services, and e-commerce. Notwithstanding, a number of studies have discussed the architecture or components of e-government, such as Cabinet Office (2000), Heeks (2001), Sharma and Gupta (2002), Office of Information Technology (2001) and Daniels (2002). However, these studies did not address the aspect of business management model and how it is aligned with the IT infrastructure. Since e-government goes beyond the IT infrastructure, the contribution of this study is to provide an integrated architecture framework for e-government that represent the alignment of IT infrastructure with business process management in public sector organisations. The authors discuss the required business process for the successful implementation and management of e-government activities. The authors also develop the framework architecture to incorporate it with integration applications and interaction tools. The reason for this is that they already play a significant role in enhance business process within organisations and their applications such as

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e-business, e-commerce, enterprise application integration (EAI), web services, etc. so, their inclusion was considered necessary. The significance of integration technologies have been discussed and classified under the e-business layer section since these technologies and approaches are often and need to be used in e-government projects. The reason is that they are designed to support e-business and e-commerce applications. The framework is structured into four layers connected through two-direction arrows which present the hierarchical level of e-government implementation and portray the logical connection of each relevant layer that allow two-way transmission of data and services. The top level of the framework represents the access layer that illustrates who might use the government services and what are the channels of access. Throughout these channels, the e-government portal should integrate all government information and services from disparate departments and organisations, which represent the e-government layer. In connection to the e-government layer, the e-business layer is emerged to manipulate and integrate government data sources across government bodies and make information and services available to the e-government portal in real-time. In the bottom level of the framework, the ICT infrastructure of e-government should be built to reach out all parts of government and hence, support the e-government operation and provide effective and reliable e-government services. This section now discusses the architecture that forms the framework of e-government architecture project.

Figure 1 shows the architecture framework of e-government which is divided into four layers: access layer, e-government layer, e-business layer, and infrastructure layer.

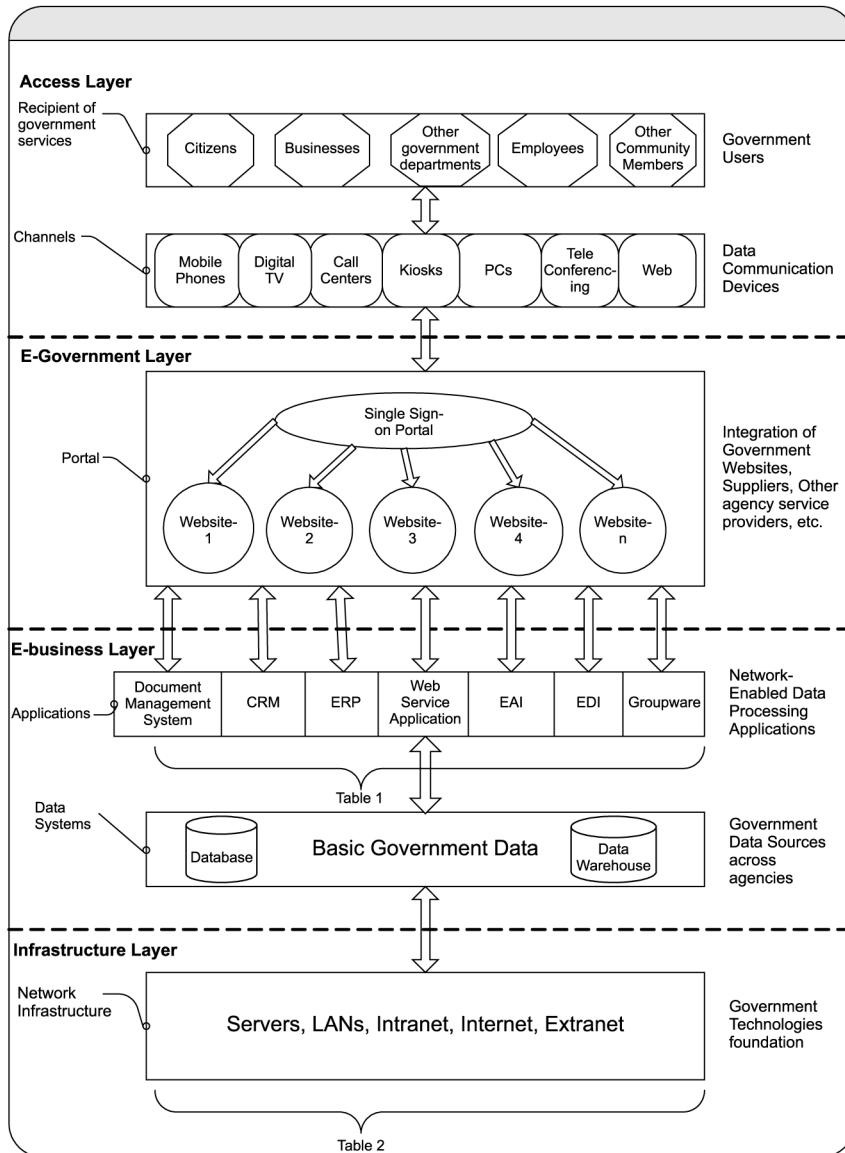
#### *Access layer*

Involves the channels that government users can access the various government services. Government users can be citizens, business, employees, other governments, and other community members. Access channels are critical components of e-government. As shown in Figure 1, they consist of online and offline channels or routes of distribution through which products, services and information are used, accessed and communicated by multiple technologies. For example, web sites accessible from PCs, kiosks, mobile phone (WAP), digital TV, and call and contact centres. This layer considers of the simplest level of e-government architecture, since it is controlled and managed by government users. However, it is essential that public sector organisations provide a common way of finding all government information and services, maintain channel coordination, create a common look and feel across different channels, and comply with the guidelines of technical standards (Cabinet Office, 2000).

#### *E-government layer*

This layer is about integrating digital data of various organisations into a web-portal of government services, in the form of a one-stop e-government portal. This may result in improved access to government resources, reduces service-processing costs, and enables organisations to provide a higher quality of service (Ho, 2002; Gant and Gant, 2001; Sharma and Gupta, 2002).

Government web-portals are emerging as a key priority for public sector organisations, as they develop their e-government initiative and create electronic interaction between government and citizens (G-to-C), government and business (G-to-B), government and its employees (G-to-E), and government and government



**Figure 1.**  
Framework of e-government architecture

(G-to-G). According to Chan and Chung (2002), this layer allows the user to use the web browser to get all corporate information needed through a single window. The portal has a web-based front-end application that allows dispersed sources of information to be linked together. Governments can access and manage all data and information while providing users with the opportunity to customise what they need from information sources (Chan and Chung, 2002). For example, when a citizen moves from his/her

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residence, there is no need to update this information to all organisations that require a current address. The use of an integrated portal will reduce overhead and improve information flow. Without such a resource, citizens will need to identify relevant organisations to contact, complete and submit change of address forms for each, which is clearly time consuming and non-value adding. So the use of an integrated web-portal is increasingly becoming an important component of e-government infrastructure, since it allows citizens to reduce this cumbersome process to a single step.

Since governments are very complex organisations with hundreds of agencies, departments, directorates, commissions, and regulatory bodies, a single government portal is still in its infancy stage. One of the reasons is that it is difficult to determine which features and applications are most appropriate for creating a high-functioning e-government portal. Another reason is technical; providing integrated services can only be realised if all public authorities are interconnected and their systems are interoperable. It needs comprehensive technology, systems integration and project management skills as will be explained in e-business layer. IBM (2001) reports three levels of complexity: information publishing and linking of existing web sites, single organisation transactions, and transactions requiring integration of multiple organisations. From a portal management perspective, it is necessary to maintain user interface construction abilities to increase user control, such as search capabilities, interactive media, and graphics design; and other key features such as e-mail, calendars, instant messaging, and chat areas. As well as including tools to register, dynamically recognise and classify users; and giving the organisation the ability to customise content, information access, and structure to meet the specific needs of employees. Security is another key element of this layer, through deploying government authentication and privacy standards to secure online transactions and protect the portal contents.

#### *E-business layer*

This layer is focused on using ICT applications and tools to harness a networks of trust, knowledge sharing and information processing that takes place both within and between organisations (Moodley, 2003). Practically, it integrates front-end e-government layer applications, such as online catalogues and transaction interfaces in the government portal with back-end activities such as existing databases and data warehouses.

The implementation of this layer will make a strong foundation to build single e-government portal as stated in e-government layer and also support the relationship and interaction between G-to-G and G-to-E. It provides a seamless, automatic and real-time communication between their systems at both a data and process level. In terms of G-to-E, it enables employees to interact efficiently with other departments and agencies concerning human resource information, retirement plan, latest news releases, and drawing on the available resources in an optimal way. This results in supporting decision-making in the formation of new value chains, and reinforces the existing business partner's relationship in form of electronic procurement.

The integration of various IT applications and components inside and outside the organisational boundary remains costly and time consuming, due to the heterogeneity of the computing environments involved in public sector organisations (Chen, 2003; Themistocleous and Irani, 2002). As well, the legacy systems and applications across



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government organisations need to be upgraded to a web-enabled level to extend their functionalities beyond organisational boundaries and to achieve full communication between all the information systems and their processes.

Traditionally, government departments and organisations have maintained separate databases that are not connected to other government departments at the same level or even different level such as the local or central government level. This creates barriers between organisations systems and processes, in term of data transmission and communication, and therefore, makes implementation of e-government single portal not easy. Therefore, the integration of government database systems, processes and applications play a critical role in this layer since e-government relies to a significant degree on existing basic government data, existing systems and existing processes. This layer implies computer systems and applications of different public departments and organisations are being connected to or at least communicating with each other. As a result, the transaction from one system can be interchanged with another system. For instance, if a citizen performs a certain transaction at a local department or agency, the information and results of the transaction will be propagated to the city or central counterpart. Consequently, this connection will result in easier, more flexible and reliable access to government data, as well as improves the business processes and operations of organisation and management of government IT resources. This should result in significant financial savings, by eliminating redundant data collection, increase the speed of transactions, improve the consistency of outcomes, and increase opportunities for cost-sharing partnership.

The continual development in ICTs in the last two decades has presented private sector organisations with many choices of applications and technologies to support infrastructure integration of e-business applications and systems which can benefit the public sector to implement effective e-government portal and support their business process, Table I describes some examples of these applications. Common approaches for e-business layer involve integrating legacy systems, or computer systems that are not connected and do not share data. For example, enterprise resource planning (ERP), EAI, and web services as shown in Table I. ERP systems are integrated and draw directly from live databases linked to the systems. However, ERP systems do not allow organisations to make significant changes in their systems – changes of parameters. The reason for this is that the customisation of ERP systems is a difficult, costly, and risky (Themistocleous and Irani, 2002). However, EAI systems have emerged to overcome some of the limitations of ERP, through providing an integrated organisational infrastructure. It has the ability to control and distribute information throughout the organisation and to effectively manage the control and distribution (Erasala *et al.*, 2003). Web services are the latest approach to developing e-business integration that can be adopted in government organisations, since it is less complex with costs also being reduced. Web services are standards-based and suited to build common infrastructure to reduce the barriers of business integrations, hence, enable e-government systems to collaborate with each other regardless of underlying infrastructure (Huang and Chung, 2003; Ratnasingam and Pavlou, 2002).

Additionally, this layer emerges widespread of applications and systems that help maintain governments' existing data and business processes, as demonstrated in Table I. These applications can use access layer to deliver information and services to

**Table I.**  
E-business layer  
applications and systems

Application/system	Description	Characteristics	References
DBMS	Organisation of components that define and regulate collection, storage, management, and use of data within database environment	Stores and manages large amount of data Maintains internal records Presents data and records to citizens through WWW Supports concurrent access to data Controls access to data	Garcia-Molina <i>et al.</i> (2002) Rob and Coronel (2002)
Customer relationship management (CRM)	Alignment of governmental business processes with citizen needs to manage and ensure they are served in a logical manner and decrease costs of providing services regardless of business lines	Creates confidence between citizens and government Creates citizen profiles Enables higher levels service Timesaving for citizens Increases transparency and openness of government transactions	Jaanssen and Wagenaar (2002) Ho (2002)
Enterprise recourse planning (ERP)	Represents business management system that integrates information flow across all functions of organisation to automate corporate business processes	Solves incompatible between government systems Supports high-level decision-making Supports financial and human resource management Establishes interactive relationships between public sector organisations and with other partners and suppliers	Office of Information Technology (2001) Wimmer <i>et al.</i> (2001) Holland and Light (2001) Yen <i>et al.</i> (2002) Bandyo-padhyay (2002) Chen (2003)
Web service application	Performs encapsulated business functions ranging from simple request-reply to full business process interaction. Government organisations can integrate a powerful, sophisticated search engine into their internet, extranet, and intranet environments without the need for large capital investment or substantial systems integration	Develops business integration solutions Offers standardized service interfaces and common communication protocols Provides comprehensive and dynamic integration capability with back-end systems	Huang and Chung (2003) Yang and Papazoglou (2003) Goble (2003)

(continued)



Application/system	Description	Characteristics	References
EAI	Integrates both intra and inter-organisational systems by securely incorporating functionality from disparate applications in government organisations	<ul style="list-style-type: none"> <li>Reduces the cost of integration</li> <li>Handles payment process</li> <li>Stock charting and quotes</li> <li>Bid and auctions process</li> <li>Implemented via XML/HTTP</li> <li>Supports data, objects, and processes incorporation</li> <li>Transports and transforms information between applications</li> <li>Provide quick response to change</li> <li>Reduce development and integration cost</li> </ul>	<ul style="list-style-type: none"> <li>Ratnasingam and Pavlou (2002)</li> <li>Themistocleous <i>et al.</i> (2002)</li> <li>Chesher <i>et al.</i> (2003)</li> </ul>
Data warehousing	Essentially database that stores integrated, often historical, and aggregated information extracted from multiple, heterogeneous, autonomous, and distributed information sources	<ul style="list-style-type: none"> <li>Gathers and integrates data from disparate sources</li> <li>Helps to find and use information and records regardless of physical formats and locations</li> <li>Used for strategic decision-making</li> </ul>	<ul style="list-style-type: none"> <li>LechtenbOrger and Vossen (2003)</li> <li>Dawes <i>et al.</i> (1999)</li> <li>Wimmer <i>et al.</i> (2001)</li> </ul>
Electronic data interchange (EDI)	Electronic transfer of structured data and services using agreed message standards between computer applications	<ul style="list-style-type: none"> <li>Designed to exchange documents between organisations</li> <li>Support application-to-application interface</li> <li>Speeds up business processes and transactions</li> <li>Provide efficient service</li> </ul>	<ul style="list-style-type: none"> <li>Chesher <i>et al.</i> (2003)</li> <li>Iacovou <i>et al.</i> (1995)</li> </ul>
Document management systems	Stores and manages multi-media format records that associated with automated workflow and electronic document repositories	<ul style="list-style-type: none"> <li>Shares documents among organisations</li> <li>Increases efficiency of supply chain</li> <li>Increases efficiency of maintaining, accessing and distributing documents via internet</li> </ul>	<ul style="list-style-type: none"> <li>Yao <i>et al.</i> (2003)</li> <li>Dawes <i>et al.</i> (1999)</li> </ul>

(continued)

Table I.

Table I.

Application/system	Description	Characteristics	References
Data and knowledge management	Systemic approach to capturing information and knowledge about organisation, its processes, products, services, customers, procedures used to conduct planning and programme evaluation in areas ranging from capital construction, to economic forecasting, to performance of school	Controls processes beyond internal structures of government Provides formalised and mapped results and data to the government portal Makes knowledge available to citizens	Dawes <i>et al.</i> (1999) Wimmer and Traummuller (2000)
Groupware	Collaboration tools that enable employees working in teams to share information and resources to work interactively, regardless of the physical locations of individuals, e.g. e-mails, notice boards, and web collaboration	Supports decision-making Updates staff for new news and notices Facilitates communication between citizens and officials Reduces communications' cost	Singh (2002) Murphy and Tan (2003) Bandyopadhyay (2002)

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citizens by using different channels. Among these are CRM, which focuses on managing citizen's interaction with the government. It represents a new concept of relationships between government and citizen's, "citizen-focused", through delivering services to citizens efficiently across different channels (see access layer), and enabling joined-up and automated service delivery. It entails public sector organisations to offer their "customers" a host of online options, which allowing them to: manage individual personal profiles that contain user-specific information, such as the status of an accident report, and pay council, income, and road taxes. However, CRM system cannot work independently in this layer, there is a need for integrated information systems and applications that support its operations and provide essential data. As Table I illustrates, such common applications and systems are database management system (DBMS), document management systems, and data warehousing, which they can hold citizen's records, official documents, historical information, and maintain business processes and procedures (Table I describes these applications).

Practically, this layer includes several applications and tools that are emerging to help determine, assess, and achieve consistent and integrated processes and information systems in public sector organisation. However, it is difficult to predict which applications and information systems will be the most useful and adaptable in this layer. In Table I, the authors describe a selection of applications that play a significant role in e-business layer of e-government framework architecture.

#### *Infrastructure layer*

Building an information community by using e-business layer applications in an efficient manner requires a technology infrastructure that reaches out to all parts of public sector organisation. However, electronic communication within and between public sector organisations is expensive and inefficient without an effective infrastructure and agreed standards and protocols between communicating systems. Therefore, this layer focuses on technologies that should be in place before e-government services can be offered reliably and effectively to the public. The potential of these technologies is to support and integrate the operations of information systems and applications in e-business layer across organisations (Figure 1) by offering the necessary standards and protocols through network and communication infrastructure approaches (e.g. intranet, extranet, and internet). Table II explains these technologies, for example, the incorporation of distributed network infrastructure approaches supporting the organisation knowledge infrastructure, such as, a customer database on a client server system providing information required for CRM application. This layer provides basic technologies, such as LAN – as discusses in Table II that allow integration with current hardware resources such as PCs, laptops, and mobile phones straightforward and without complications which supporting the organisation existing IT provision. As well as they should support the provision of user-friendly and innovative online services involving the transmission of data of various formats such as text, graphics, audio and video.

IBM (2001) concluded that to have a successful e-government strategy, the public sector must create an IT infrastructure that is optimised to support a new information systems and applications that are necessary for e-government – as shown in Figure 1. They suggest that an e-government IT infrastructure may comprise of a number of technologies with a network infrastructure at its genesis; including an application

Technology	Description	Characteristics	References
LAN	Computer network concentrated in geographical area, such as building or government department	Interconnects variety of devices Shares citizens files and records Provides information exchange among devices	Stallings (2000) Kurose and Ross (2003)
Server	High professional and powerful computer that runs and hosts application program that accepts connections in order to service requests by sending back responses	Provides high speed access to government data and services Processes communication across government network	Stallings (2000) Kurose and Ross (2003)
Internet	Collections of public and global communications network that provides direct connectivity to anyone over LAN or internet service provider	Allows citizen to access government information and services from any location and anytime Exchanges data and messages Provides low cost communications	Singh (2002) Walczuch <i>et al.</i> (2000) Stallings (2000)
Intranet	Network designed to be open and secure with web browsing software providing easy point-and-click access by end users to multimedia information on internal web sites within limited geographical area	Enhances connectivity and communication within government organisation Enhances resources sharing and planning process Provides information to users in real-time manner	Bandyo-padhyay (2002) Chan and Chung (2002) and Chesher <i>et al.</i> (2003)
Extranet	Extension of intranet, dynamic wide area networks that link company's employees, suppliers, customers, and other key business partners in electronic online environment for business communication	Handles of purchase order, receiving, invoicing to be done electronically over secured network Supports G-to-G and G-to-B Supports supply chain management with business	Chan and Chung (2002) Bandyo-padhyay (2002) Singh (2002)

**Table II.**  
Infrastructure layer  
technologies

server, hardware and operating systems, and data and application development tools. Table II illustrates a selection of technologies that can play an important part in the infrastructure layer. These technologies support the acquisition, storage, and transformation of data, regardless of whether the data source is residing in an internal business unit or an external organisation boundary. Therefore, resulting in new ways of dealing with business partners and citizens. Additionally, they necessitate the implementation of the applications and procedures that enable not only G-to-C and G-to-G communication worldwide but also, strengthen the communication of information within an organisation.

IBM (2001) indicates that the key component of IT infrastructure in government organisations is the application server. It is consisting of server hardware, server operating system, and different applications server software that runs the

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e-government application logic and manages the user interaction. These servers are operated through efficient network technology and internet connectivity, which improves communication and information transmission within and between organisations, resulting in new ways of dealing with business partners and users such as online transactions and procurement services. However, security of infrastructure is still one of the most crucial and least understood issues associated with internet-based communication and applications (Medjahed *et al.*, 2003). Security is an ongoing risk associated with most of IT projects and in term of e-government, the degree of risk is escalating as the use of public networks increases together with databases that hold citizens profiles and government information. Therefore, this layer needs to incorporate advanced security approaches and technologies such as PKI, reliable firewall, biometrics, digital signature and certificate, and sophisticated encryption technique, which secure e-government interoperation, government electronic transactions, and delivery systems to ensure protection against fraud and other vulnerabilities at all levels of the government information infrastructure.

The significance of e-government architecture framework is about the integration between government existing technologies and essential applications and information systems required for e-government operations. As well as, the consistency of layers should be given the required attention during the implementation of e-government, as Figure 1 shows that each layer connected to the adjacent layer, which poor implementation of one layer could affect the performance of the rest of layers, and therefore, will degrade the performance of e-government.

### **Barriers to e-government adoption**

A number of different models such as those proposed by Themistocleous and Irani (2001), Shung and Seddon (2000) and Ward and Griffiths (1997) exist in the literature to classify the barriers to information systems infrastructure development.

Themistocleous and Irani (2001) and Shung and Seddon (2000) propose a model to classify the barriers that derived from IT infrastructure such as ERP. These models are considered adaptable for the classification of e-government barriers, since the main purposes of e-government adoption is to automate business processes and integrates IT infrastructures in public sector organisations. Table III analyses e-government barriers and then classifies them accordingly in order to provide a comprehensive insight to those barriers restricting the adoption of e-government.

Many e-government initiatives are in their strategic phase of implementation (infancy), however, some key problems and barriers are already beginning to emerge. There are a number of barriers experienced in public sector organisations that prevent the realisation of anticipated benefits and degrade successful adoption of e-government projects. This section analyses and summarises the barriers of e-government adoption experienced in public sector organisations.

Technology itself would not guarantee success with e-government but, it is necessary that any e-government initiative must ensure that it has sufficient resources, adequate infrastructure, management support, capable IT staff, and effective IT training and support.

Despite the cost of IT going down, an adequate IT infrastructure still represents the key barrier for e-government adoption. The infrastructure is composed of hardware and software that will provide secure electronic services to citizens, businesses, and

Dimension	Examples	Reference
IT infrastructure	<p>Shortage of reliable networks and communication</p> <p>Inadequate network capacity or bandwidth</p> <p>Lack resources standards and common architecture policies and definitions</p> <p>Existing systems are incompatible and complex</p> <p>Existing internal systems have restrictions regarding their integrating capabilities</p> <p>Lack of integration across government systems</p> <p>Integration technologies of heterogeneous databases are confusing</p> <p>Lack of knowledge regarding e-government interoperability</p> <p>High complexity in understanding the processes and systems in order to redesign and integrate them</p> <p>Lack of enterprise architecture</p> <p>Availability and compatibility of software, systems and applications</p> <p>Lack of documentation especially in the case of custom systems</p>	<p>Dillon and Pelgrin (2002)</p> <p>Fletcher and Wright (1995)</p> <p>Heeks (2001)</p> <p>Layne and Lee (2001)</p> <p>McClure (2000)</p> <p>Moon (2002)</p> <p>NECCC (2000)</p> <p>Themistocleous and Irani (2001)</p>
Security and privacy	<p>Threats from hackers and intruders</p> <p>Threats from viruses, worms and Trojans</p> <p>Absence of privacy of personal data</p> <p>High cost of security applications and solutions</p> <p>Unauthorised external and internal access to systems and information</p> <p>Lack of knowledge for security risks and consequences</p> <p>Assurance that transaction is legally valid</p> <p>Lack of security rules, policies and privacy laws</p> <p>Inadequate security of government hardware and software infrastructure</p> <p>Lack of risk management security program</p> <p>Unsecured physical access to building or computers rooms</p>	<p>Gefen <i>et al.</i> (2002)</p> <p>Joshi <i>et al.</i> (2001)</p> <p>Lambrinouidakis <i>et al.</i> (2003)</p> <p>NECCC (2000)</p> <p>Robins (2001)</p> <p>Zeichner (2001)</p>
IT skills	<p>Lack of IT training programmes in government</p> <p>Shortage of well-trained IT staff in market</p> <p>Lack of employees with integration skills</p> <p>Developing web site by unskilled staff</p> <p>Unqualified project manager</p> <p>Shortage of salaries and benefits in public sector</p> <p>Flow of IT specialist staff</p>	<p>Bonham <i>et al.</i> (2001)</p> <p>Heeks (1999)</p> <p>Ho (2002)</p> <p>Layne and Lee (2001)</p> <p>NECCC (2000)</p>
Organisational	<p>Lack of coordination and cooperation between departments</p> <p>Lack of effective leadership support and commitment amongst senior public officials</p> <p>Unclear vision and management strategy</p> <p>Complex of business processes</p> <p>Politics and political impact</p>	<p>Burn and Robins (2003)</p> <p>Heeks (2001)</p> <p>Lenk and Traummuller (2000)</p> <p>Li and Steveson (2002)</p> <p>Themistocleous and Irani (2001)</p>

**Table III.**  
Classification of  
e-government barriers

(continued)

Dimension	Examples	Reference
Operational cost	Cultural issues	
	Resistance to change by high-level management	
	Time consuming for reengineering business process in public organisations	
	Main supply come from central government	Bonham <i>et al.</i> (2001)
	Shortage of financial resources in public sector organisations	Heeks (1999)
	High cost of IT professionals and consultancies	Irani <i>et al.</i> (2003)
	IT cost is high in developing countries	NECC (2000)
	Cost of installation, operation and maintenance of e-government systems	Palvia <i>et al.</i> (1994)
	Cost of training and system development	

Table III.

employees. Bonham *et al.* (2001), Bourn (2002), Dillon and Pelgrin (2002), McClure (2000) and National Research Council (2002), in their research, agree that governments view a lack of technical infrastructure as a significant barrier to the development of government organisations’ capabilities to provide online services and transactions. They also agree that unreliable IT infrastructure in public sector organisations will degrade e-government performance.

Practically, Layne and Lee (2001) and Dillon and Pelgrin (2002) emphasise the importance of network capacity and communication infrastructure (infrastructure layer) as an important foundation for integrating information systems across government organisations. It should be in place before e-government services can be offered reliably and effectively to the public (McClure, 2000). Therefore, the key to success in an e-government strategy is to implement an adequate IT infrastructure that will support a users’ experience of easy and reliable electronic access to government. For example, as discussed in earlier section, intranet and extranet should be maintained in public sector organisation to provide reliable groundwork for required information systems and applications. As Table III illustrates, many examples of barriers exists that associate with IT infrastructure, and as discussed in earlier section that LAN, reliable server, and internet connections are important to build a strong foundation for e-government infrastructure.

A barrier frequently cited is the need to ensure adequate security and privacy in an e-government strategy (Daniels, 2002; James, 2000; Joshi *et al.*, 2001; Lambrinouidakis *et al.*, 2003; Layne and Lee, 2001; Sanchez *et al.*, 2003).

Bonham *et al.* (2001) and Gefen *et al.* (2002) agree that one of the most significant barriers for implementing e-government applications is computer security, privacy and confidentiality of the personal data. One of the sophisticated applications of e-government is e-voting, which uses electronic ballots that allow voters to transmit their vote to election officials over the internet. This application requires extensive security approaches to secure the voting process and protect the voter personal data.

In addition, government organisations at all levels use, collect, process, and disseminate a wide range of sensitive information on personal, financial, and medical aspects. Hence, IT departments in organisations should aware that security and privacy are not only critical for the availability and delivery of government services but also to build citizen confidence and trust in the online services and transactions



they provide or will be providing. In a study of 2,015 government consumers conducted by Jupiter Research in New York in 2003, more than three-fourths are concerned about the security of their credit card information, and nearly two-thirds are worried about the privacy of personal information. McClure (2000) criticises the weakness of information systems' security in public sector organisations. E-government is considered to only succeed when all its participants-including government agencies, private businesses and citizens-feel comfortable using electronic means to carry out private and sensitive transactions. As a result, investing in the best available privacy and security applications and tools is worthwhile, as a shortage of them could lead to failure of the entire e-government project. Gefen *et al.* (2002), in the study of online tax services, agree, and demonstrate the importance of trust in the public sector alleviating data privacy concerns and facilitating e-government diffusion. In addition, information management policy guidelines and standards must be reviewed periodically to ensure that they are adequate to the electronic services delivery world. The guidelines require that government web sites use privacy notices to ensure that citizens will know what personal information may be collected and how will be used.

Chen and Gant (2001), Heeks (1999), Ho (2002) and Moon (2002) identify the shortage of IT skills as another potential barrier that confronts some demanding challenges concerning government's ability to provide the next generation of e-government services. It is ranked as the number one barrier to e-government, based on the e-government survey in the year 2000 conducted in the USA by the International City/County Management Association and Public Technology, Inc. (Norris *et al.*, 2001). One of the reasons for this is that the difficulty of attracting and retaining the right IT talent, especially considering the competition for these workers, and also there is a lack of skilled staff in market who are familiar with major IT skills, as McClure (2000, p. 18) notes: "The increasing need for qualified IT professionals puts governments in direct competition with the private sector for scarce resources". These skills include computer information systems analysis, systems design, network construction, applications integration, maintain middleware technologies such as database-oriented, transaction-oriented, and message-oriented, operational management, web development, project management, and systems maintenance, which are absent, or cannot be recruited easily by the public sector. These positions have high complexity and scarcity of qualified applicants. However, some governments may have IT staff, but most of their training may not equip them to program industry-strength web-enabled applications. The challenge of new technology has led to an increased commitment to training by public sector organisations.

Moon (2002) concluded that to enhance the effectiveness of e-government practices, public sector organisations would need to move towards a higher level of e-government development, which will require more and highly trained technical staff. Moreover, without fully developing staff capabilities, agencies stand to miss out on the potential customer service benefits presented by technology, so employees must have the training and tools they need to do their jobs.

Another common problem associate with government that the turnover rates of IT staff from public sector organisations are generally increase because it is felt that payment and conditions can not compete with those of private sector organisations, which severely affects the progress of the implementation process of e-government.

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Other authors have found that a further key barrier to e-government adoption tends to be organisational. Li and Steveson (2002), for instance, have confirmed that to maximise the potential offered by an e-government initiative, government organisational culture, management strategy and individual attitudes within the organisation need to be changed.

Organisational barrier relate to structural issues, such as fragmentation and poor relations and communication between functional departments, and an acceptance by senior management of the strategic benefits of new initiatives (Aichholzer and Schmutzer, 2000; Fletcher and Wright, 1995). As well, it relates to government business process, management strategy, and organisational culture (Lenk and Traummuller, 2000; McClure, 2000).

While effective top management leadership involvement is a cornerstone of any IT investment strategy, strong government leadership and responsive management processes must support an e-government initiative. The reason of this is that the complexity and scale of the changes that will take place in the organisation during the implementation of e-government (Bonham *et al.*, 2001; Burn and Robins, 2003). However, some government officials perceive e-government as a potential threat to their power and viability because it might reduce their authority in government. Therefore, becoming reluctant to the idea of online transactions (Ebrahim *et al.*, 2003; Sanchez *et al.*, 2003).

As with e-business, public sector administrations are required to change and reengineer their business process to adapt new strategies and culture of e-government. Government staff should be prepared for new ways of dealing with new technologies that emerge with e-government. For example, they are used to dealing with physical papers and forms, paper receipts, and traditional physical signatures, while e-government allows citizens access to the organisation back-office remotely to complete the transaction processing, which emerged with new technology solutions such as electronic forms, digital signatures, electronic receipts and certificates. From another perspective, organisational culture also forms barriers to e-government within the organisation since some departments are reluctant to share their business data or processes with other departments within the same organisation or with external partners. They believe that connection or data sharing will weak their authority. For these departments and organisations the ownership and the control of business data and processes is relate with their power, which imply that politics also form a barrier to e-government adoption.

Another barrier to the adoption of e-government is central government funding (Bonham *et al.*, 2001; Heeks, 1999; Ho, 2002). Traditionally, the main financial resource for public sector organisations is coming from central government, which is hard to control, and sometimes comes and goes in cycles of “feast and famine” that make it difficult to plan sustainable IT initiative such as e-government (Heeks, 1999). Hence, the lack of financial resources from central government for e-government investments was seen as a major barrier, particularly by stakeholders from the government sector. According to the e-government survey of 2000 conducted in the USA by the International City/County Management Association and Public Technology, Inc., over 50 per cent of government organisations that responded to the e-government survey indicated that lack of financial resources is a main barrier to adopting an e-government initiative for a public sector organisation (Norris *et al.*, 2001).

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Adoption of e-government requires a compatible of IT infrastructure and integrated information systems, as well as advance technologies for preserving security and integrity. Hence, for a public sector organisation, the cost of sophisticated hardware and software is still a big problem. Another important financial problem is the high operational cost of the existing IT infrastructure. The maintenance cost of such an infrastructure is high, which presents additional financial barriers. Therefore, organisations evaluate the cost relative to the benefits before adopting a new technology. Technologies that are perceived to be low in cost are more likely to be adopted (Irani *et al.*, 2003; Palvia *et al.*, 1994). Alternatively, some public sector organisations turn to outsource their information systems activities to run e-government implementation in order to cut costs and thereby achieve more within financial constraints.

The authors analyse e-government barriers and classify them into dimensions with examples as shown in Table III. This classification based on dispersed literatures analysis and case-based studies of some countries, which can help the researchers and practitioners to have prior knowledge and better understanding of e-government barriers.

### Conclusions

The understanding of e-government architecture framework by public sector organisations is significance strategic phase toward reliable and effective e-government adoption. The purpose of this study has been to help IT practitioners in the public sector to learn how to use and manage information technologies to revitalise business processes, improve business decision-making, and gain competitive advantage from the adoption of e-government. The architecture framework defines standards, identifies the infrastructure components, applications and technologies that are the guidelines for e-government adoption. Since it could be viewed in various perspectives, the authors of this paper have highlighted the importance of integrating the existing information systems and applications in public sector organisations in order to establish an efficient framework for e-government architecture. Therefore, advocating essential information systems, applications, and necessary infrastructure technologies that can be used for reliable and flexible access to government data and information processing within and between organisations, thus, suggesting their identification and classification that in turn, support their control, characteristics, and management. The purpose of the architecture framework is to reduce any confusion surrounding the e-government infrastructure in the public sector, by understanding the implementation process, identifying the requirements of ICT tools, highlighting the importance of the organisational management resources and the impact of barriers. The authors suggest that the architecture of e-government can be divided into four layers:

- (1) access layer;
- (2) e-government layer;
- (3) e-business layer; and
- (4) infrastructure layer.

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The logical connection of each layer will facilitate the exchange of data and services between and within public sector organisations, as well as support the consistency of government data and transactions from and to users.

The access layer involves the channels that government users can access the various services. E-government layer discusses the approaches to improve these channels through integrating the digital data of different public sector organisations into a single government web-portal. However, this integration cannot be achieved without underpinning of compatible and integrated information systems and applications. This underpinning can be done by emerging e-business layer that focuses on integration, coordination and interaction within and between individual systems in public sector organisations. It integrates front-end e-government layer applications with back-end activities to support the relationship and interaction of G-to-G and G-to-E. Many of required technologies in the e-business layer have been developed for private sector to support their e-business projects and their adoption in e-government projects was considered beneficial. The authors then, classify a selection of common applications and information systems, such as web services, EAI, ERP, CRM, and warehouses that play a significant role in e-business layer architecture and thereby, support the e-government operations. The final layer of this architecture is the infrastructure layer that provides a reliable foundation for the rest of layers, such as access layer, e-government layer, and e-business layer. The purpose of infrastructure layer is to offer the necessary standards and protocols through effective network and communication infrastructure technologies, such as intranet, extranet, and local area network. In doing so, the authors classify these technologies to describe their functionalities in infrastructure layer and demonstrate their role in e-government architecture.

Despite the potential benefits for the adoption of e-government infrastructure in public sector organisations, such as efficiency improvements in processing tasks and public administration operations, cost saving on data collection and transmission, and improve business processes and services, there are a number of barriers restricting the implementation of e-government infrastructure, which prevent the realisation of benefits. The authors identify and analyse significant barriers to the adoption of e-government. Some of these barriers would appear to stand directly in the way of movement toward the various stages of e-government infrastructure maturity. Then, the authors classify these barriers into dimensions with practical examples that include:

- (1) IT infrastructure;
- (2) security and privacy;
- (3) IT skills;
- (4) organisational issues; and
- (5) cost.

The contribution of this paper is to construct an integrated framework for e-government architecture, which is aligned with the organisational business process management. The framework will guide IT managers to recognise the technological and organisational requirements for e-government adoption in public sector organisations. In doing so, understanding the implementation process that will take

place in each layer. The authors also identify and classify the perceived barriers that might complicate the implementation process of e-government projects. The awareness of these barriers is important for any e-government project since they will alert the e-government project team with any problems or challenges might be existed during the implementation process so they will be ready to overcome them.

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## References

- Aichholzer, G. and Schmutzer, R. (2000), "Organisational challenges to the development of electronic government", paper presented at 11th International Workshop on Database and Expert Systems Applications, IEEE Computer Society, London.
- Bandyo-padhyay, N. (2002), *E-Commerce: Context, Concepts and Consequences*, McGraw-Hill, Berkshire.
- Bonham, G., Seifert, J. and Thorson, S. (2001), "The transformational potential of e-government: the role of political leadership", paper presented at 4th Pan European International Relations Conference, University of Kent.
- Bourn, J. (2002), *Better Public Services Through E-Government*, The National Audit Office, London.
- Burn, J. and Robins, G. (2003), "Moving towards e-government: a case study of organisational change processes", *Logistics Information Management*, Vol. 16 No. 1, pp. 25-35.
- Cabinet Office (2000), *Electronic Government Services for the 21st Century*, Cabinet Office, London.
- Chan, M. and Chung, W. (2002), "A framework to develop an enterprise information portal for contract manufacturing", *International Journal of Production Economics*, Vol. 75 No. 1, pp. 113-26.
- Chen, M. (2003), "Factors affecting the adoption and diffusion of XML and web services standards for e-business systems", *International Journal of Human-Computer Studies*, Vol. 58 No. 3, pp. 259-79.
- Chen, Y. and Gant, J. (2001), "Transforming local e-government services: the use of application service providers", *Government Information Quarterly*, Vol. 18 No. 4, pp. 343-55.
- Chesher, M. and Kaura, R. *et al.* (2003), *Electronic Business & Commerce*, Springer, London.
- Daniels, M. (2002), *E-Government Strategy: Simplified Delivery of Services to Citizens*, Office of Management and Budget, Washington, DC.
- Dawes, S.S. and Bloniarz, P.A. *et al.* (1999), *Some Assembly Required: Building a Digital Government for the 21st Century*, SUNY, University at Albany, Albany.
- Dillon, J. and Pelgrin, W. (2002), *E-Government/Commerce in New York State*, Office of Technology, New York, NY.
- Ebrahim, Z., Irani, Z. and Shawi, S.A. (2003), "E-government adoption: analysis of adoption staged models", paper presented at 3rd European Conference on E-Government, Dublin.
- Erasala, N., Yen, D. and Rajkumar, T. (2003), "Enterprise application integration in the electronic commerce world", *Computer Standards and Interfaces*, Vol. 25 No. 2, pp. 69-82.
- Fletcher, K. and Wright, G. (1995), "Organisational, strategic and technical barriers to successful implementation of database marketing", *International Journal of Information Management*, Vol. 15 No. 2, pp. 115-26.
- Gant, J. and Gant, D. (2001), "Web portals and their roles in e-government", paper presented at Seventh Americas Conference on Information Systems, Boston, MA, pp. 1617-23.

- 
- Garcia-Molina, H. and Ullman, J. *et al.* (2002), *Database Systems: The Complete Book*, Prentice-Hall, Englewood Cliffs, NJ.
- Gefen, D. and Pavlou, P. *et al.* (2002), "Egovernment adoption", paper presented at Americas Conference on Information Systems, Tampa, FL.
- Goble, C. (2003), "The semantic web: an evolution for a revolution", *Computer Networks*, Vol. 42 No. 5, pp. 551-6.
- Heeks, R. (Ed.) (1999), *Reinventing Government in the Information Age: International Practice in IT-Enabled Public Sector Reform*, Routledge, London.
- Heeks, R. (2001), *Understanding E-Governance for Development*, Institute for Development Policy and Management, Manchester.
- Ho, A.T-K. (2002), "Reinventing local governments and the e-government initiative", *Public Administration Review*, Vol. 62 No. 4, pp. 434-44.
- Holland, C. and Light, B. (2001), "A stage maturity model for enterprise resource planning systems use", *The Database for Advances in Information Systems*, Vol. 32 No. 2, pp. 34-45.
- Huang, Y. and Chung, J. (2003), "A web services-based framework for business integration solutions", *Electronic Commerce Research and Applications*, Vol. 2 No. 1, pp. 15-26.
- Iacovou, C. and Benbasat, I. *et al.* (1995), "Electronic data interchange and small organisations: adoption and impact of technology", *MIS Quarterly*, Vol. 19 No. 4, pp. 465-80.
- IBM (2001), *Creating an Infrastructure for E-Government: Enabling Government Innovation. 2001*, IBM Corporation, New York, NY.
- Irani, Z., Themistocleous, M. and Love, P.E.D. (2003), "The impact of enterprise application integration on information system lifecycles", *Information & Management*, Vol. 41 No. 2, pp. 177-87.
- James, G. (2000), "Empowering bureaucrats", *MC Technology Marketing Intelligence*, Vol. 20 No. 12, pp. 62-8.
- Janssen, M. and Wagenaar, R. (2002), "Customer relationship management in e-government: a Dutch survey", paper presented at 2nd European Conference on E-Government, St Catherine's College, Oxford.
- Joshi, J. and Ghafoor, A. *et al.* (2001), "Digital government security infrastructure design challenges", *IEEE Computer*, Vol. 34 No. 1, pp. 66-72.
- Kurose, J. and Ross, K. (2003), *Computer Networks*, Addison-Wesley, Reading, MA.
- Lambrinouidakis, C. and Gritzalis, S. *et al.* (2003), "Security requirements for e-government services: a methodological approach for developing a common PKI-based security policy", *Computer Communications*, Vol. 26 No. 16, pp. 1873-83.
- Layne, K. and Lee, J. (2001), "Developing fully functional e-government: a four stage model", *Government Information Quarterly*, Vol. 18 No. 2, pp. 122-36.
- Lechtenborger, J. and Vossen, G. (2003), "Multidimensional normal forms for data warehouse design", *Information Systems*, Vol. 28 No. 5, pp. 415-34.
- Lenk, K. and Traummuller, R. (2000), "A framework for electronic government", paper presented at 11th International Workshop on Database and Expert Systems Applications, IEEE Computer Society, London.
- Li, F. and Steveson, R. (2002), "Implementing e-government strategy in Scotland: current situation and emerging issues", paper presented at 2nd European Conference on E-Government, St Catherine's College, Oxford.



- 
- McClure, D. (2000), "Electronic government: federal initiatives are evolving rapidly but they face significant challenges", Accounting and Information Management Division, available at: [www.gao.gov/new.items/a200179t.pdf](http://www.gao.gov/new.items/a200179t.pdf)
- Medjahed, B. and Rezqui, A. *et al.* (2003), "Infrastructure for e-government web services", *IEEE Internet Computing*, Vol. 7 No. 1, pp. 58-65.
- Moodley, S. (2003), "The challenge of e-business for the South African apparel sector", *Technovation*, Vol. 23 No. 7, pp. 557-70.
- Moon, M.J. (2002), "The evolution of e-government among municipalities: rhetoric or reality", *Public Administration Review*, Vol. 62 No. 4, pp. 424-33.
- Murphy, J. and Tan, I. (2003), "Journey to nowhere? E-mail customer service by travel agents in Singapore", *Tourism Management*, Vol. 24 No. 5, pp. 543-50.
- National Research Council (2002), *Information Technology Research, Innovation, and E-Government*, National Academy Press, Washington, DC.
- NECCC (2000), *E-Government Strategic Planning*, National Electronic Commerce Coordinating Council, Las Vegas, NV.
- Norris, F., Fletcher, P.D. and Holden, S.H. (2001), *Is Your Local Government Plugged in? Highlights of the 2000 Electronic Government Survey*, University of Maryland, Baltimore, MD.
- Office of Information Technology (2001), *The Government of Manitoba: E-government by Design*, Manitoba Finance, Manitoba.
- Palvia, P., Means, D.B. and Jackson, W.M. (1994), "Determinants of computing in very small businesses", *Information & Management*, Vol. 27 No. 3, pp. 161-74.
- Ratnasingam, P. and Pavlou, P. (2002), "The role of web services in business to business electronic commerce", paper presented at Americas Conference on Information Systems, Dallas, TX.
- Rob, P. and Coronel, C. (2002), *Database Systems: Design, Implementation, and Management*, Course Technology, Boston, MA.
- Robins, G. (2001), "E-government, information warfare and risk management: an Australian case study", paper presented at 2nd Australian Information Warfare Security Conference, Perth.
- Sanchez, A. and Koh, C. *et al.* (2003), "The relationship between IT for communication and e-government barriers", paper presented at Americas Conference on Information Systems, Tampa, FL.
- Shung, S. and Seddon, P. (2000), "A comprehensive framework for classifying the benefits of ERP systems", paper presented at Americas Conference on Information Systems, Dallas, TX.
- Sharma, S. and Gupta, J. (2002), "Transforming to e-government: a framework", paper presented at 2nd European Conference on E-Government, Public Sector Times, pp. 383-90.
- Singh, M. (2002), "Evolving e-business models: a process of technology", *E-Business in Australia*, Pearson Education, Sydney.
- Stallings, W. (2000), *Data and Computer Communications*, Prentice-Hall, Englewood Cliffs, NJ.
- Themistocleous, M. and Irani, Z. (2001), "Benchmarking the benefits and barriers of application integration", *Benchmarking: An International Journal*, Vol. 8 No. 4, pp. 317-31.
- Themistocleous, M. and Irani, Z. (2002), "Novel taxonomy for application integration", *Benchmarking: An International Journal*, Vol. 9 No. 2, pp. 154-65.



- 
- Themistocleous, M. and Irani, Z. *et al.* (2002), "Enterprise application integration: an emerging technology for integrating ERP and supply chains", paper presented at European Conference on Information Systems, Gdansk.
- Tyndale, P. (2002), "Will e-government succeed?", paper presented at 2nd European Conference on E-Government, St Catherine's College, Oxford, pp. 429-38.
- Walczuch, R. and Braven, G.V. *et al.* (2000), "Internet adoption barriers for small firms in the Netherlands", *European Management Journal*, Vol. 18 No. 5, pp. 561-72.
- Ward, J. and Griffiths, P. (1997), *Strategic Planning for Information Systems*, Wiley, Chichester.
- Wimmer, M. and Traummüller, R. (2000), "Trends in electronic government: managing distributed knowledge", paper presented at 11th International Workshop on Database and Expert Systems Applications, IEEE Computer Society, London.
- Wimmer, M. and Traummüller, R. *et al.* (2001), "Electronic business invading the public sector: considerations on change and design", paper presented at 34th Hawaii International Conference on System Sciences.
- Yang, J. and Papazoglou, M. (2003), "Service components for managing the life-cycle of service compositions", *Information Systems*.
- Yao, Y-H. and Trappey, A. *et al.* (2003), "XML-based ISO9000 electronic document management system", *Robotics and Computer Integrated Manufacturing*, Vol. 19 No. 4, pp. 355-70.
- Yen, D. and Chou, D. *et al.* (2002), "A synergic analysis for web-based enterprise resources planning systems", *Computer Standards and Interfaces*, Vol. 24 No. 4, pp. 337-46.
- Zeichner, L.M. (2001), "Developing an overarching legal framework for critical service delivery in America's cities: three recommendations for enhancing security and reliability", *Government Information Quarterly*, Vol. 18 No. 4, pp. 279-91.

### Further reading

- Beynon-Davies, P. and Williams, M. (2003), "Evaluating electronic local government in the UK", *Journal of Information Technology*, Vol. 18 No. 2, pp. 137-49.
- McDonagh, M. (2002), "E-government in Australia: the challenge to privacy of personal information", *International Journal of Law and Information Technology*, Vol. 10 No. 3, pp. 327-43.
- Pradhan, J. (2002), "Information technology in Nepal: what role for the government?", *The Electronic Journal of Information System in Developing Countries*, Vol. 8 No. 3, pp. 1-11.
- Seifert, J. and Petersen, R. (2002), "The promise of all things E? Expectations and challenges of emergent electronic government", *Perspectives on Global Development and Technology*, Vol. 1 No. 3, pp. 193-212.
- Stamoulis, D. and Gouscos, D. *et al.* (2001), "Revisiting public information management for effective e-government services", *Information and Management & Computer Security*, Vol. 9 No. 4, pp. 146-53.
- Warkentin, M. and Gefen, D. *et al.* (2002), "Encouraging citizen adoption of e-government by building trust", *Electronic Markets*, Vol. 12 No. 3, pp. 157-62.
- Wimmer, M. and Tambouris, E. (2002), "Online one-stop government: a working framework and requirements", paper presented at 17th World Computer Congress of IFIP, Montreal, pp. 117-30.