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# Guidelines for government-to-government initiative architecture in developing countries

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ABSTRACT

The term electronic government (e-government) mainly refers to the information and communications technology (ICT) usage to modify structures and procedures of government agencies. Acknowledging the necessity of utilizing the new electronic, information, and communication technologies, the movement toward implementation of e-government in Iran has recently received the attention of authorities and policy makers. Public administrations have been very much concerned about the architecture of e-government, especially because of the boost of e-government that has taken place in recent years. The paper seeks to provide a set of heuristic principles affecting e-government overall architecture with respect to Iranian government-to-government (G2G) context requirements, which might be applicable for other developing countries with some customization. It is worth mentioning that the grounded action research method was applied to develop a systematic theory from data that contains both inductive and deductive thinking.



## 1. Introduction

Electronic government (e-government) is the provision of electronic information and services for citizens and businesses and among government agencies. This electronic advent of government, which faces complex challenges (Gil-Garcia & Pardo, 2005), offers new access levels to government information and services (Jaeger, 2004). Sprecher (2000) considers e-government as a technology to simplify and mechanize transactions between governments and constituents, businesses, or other governments. Also, Meho and Haas (2001) believe that governments should employ new information technologies in order to locate their government information appropriately. Overall, because of the increasing importance of e-government, it is imperative to examine the application of e-government from a range of empirical and theoretical perspectives (Jaeger & Thompson, 2004). However, this technology could help governments, especially developing countries' governments, to compensate considerable amount of their weaknesses. Besides, e-government needs to be shaped with vision and long-term planning (Metaxiotis & Psarras, 2005); this viewpoint could contribute to reduce the associated risks, costs, and wasted time, increase citizen participation and quality of e-government services.

A holistic development approach is required to address different aspects impacting advanced government systems (Wimmer, 2002). More importantly, it is vital for the e-government development project, as with other large-scale projects, to have an abstract picture in the initial stages in order to keep all people, activities, and sub-projects in the same way, which provides ground for organizing and prioritizing all activities.

In this regard, a few influential initiatives have been proposed by e-government agencies of some developed countries in the architecture arena. For example, the standard and architecture for e-government applications (SAGA) was published by Germany's Federal Government Co-ordination and Advisory Agency for information technology (IT) in the Federal Administration (KBSt).[1] In the United States, the Federal Enterprise Architecture Framework (FEAF) was issued by the Federal Chief Information Officers Council[2] (CIOC, 1999). Furthermore, significant research has been conducted too; for instance, Joia (2004) proposed a heuristic model for successful implementation of government-to-government (G2G) endeavors from multiple case studies and drew some conclusions in order to assist policy makers and public administrators in dealing with this new field of knowledge adequately. Moreover, the use of interoperability frameworks and enterprise

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architectures within the e-government initiatives in the scope of Europe and the United States has been surveyed (Guijarro, 2007).

On the other hand, there is no significant research that tried to provide developing countries with e-government architectural frameworks. We believe that these countries' need for different guidelines depends on their circumstances and requirements. Accordingly, the aim of this research is the provision of a meaningful set of guidelines affecting e-government architecture in developing countries. The reason why this could be helpful, firstly, according to Ciborra (1999), is the fact that the increasing complexity and change rate of business circumstances could limit decision making about e-government planning, so, suggesting a comprehensive architecture for e-government might not be accessible; but, such a set of guidelines for e-government architecture could build an overall flexible frame for e-government planning. The second reason is to enable improvisation—lifting out the constraints of settling new technology by coping with time—which increases our chances to make sense of such complex situations and puts us in closer touch with human experience, which can lead to successful e-government planning (Ciborra, 1999), and this is what has been intended in this research in a real case in order to make a meaningful set of guidelines affecting e-government architecture.

In order to suggest a framework to architecture G2G initiative, a heuristic model methodology could be used. According to Winter (1998):

> A heuristic frame corresponds to a degree of problem definition that occupies an intermediate position on the continuum between a long and indiscriminate list of things that might matter at one end and a fully formulated control-theoretic model of the problem at the other. Within a heuristic frame, there is room for a wide range of more specific formulations of the problem but there is also enough structure provided by the frame itself to guide and focus discussion. On the other hand, a rich variety of different heuristic frames may represent plausible approaches to a given problem. Winter (1998, pp. 172–173)

In the same way, this paper encapsulates the essential principles (Rechtin, 1991) for heuristic architecture of G2G e-government initiatives resulting from a project in the case of Iranian e-government development. However, it could be applied by other developing countries' governments with some customization. The data were collected through meetings of the strategic committee of e-government development (SCEGD) in a project for exploring G2G e-government initiative elements and their relationship; in this regard, a wide range of interviews was held with influential members. Also, three iterations of grounded action research were applied in order to process the data and make descriptive guidelines.

Regarding the paper's structure, in the following sections, e-government is discussed as a system of systems (SOS) for the purpose of architecture, and the relative literature is reviewed. Iranian G2G experiences, as the research case, are browsed through in Section 3. Section 4 presents the research methodology. In Section 5, a classification of guidelines for e-government architecture is presented, followed by a discussion section. Finally, conclusions and future research are discussed.

## 2. Literature review

### 2.1. SOS for e-government architecture

A system is defined as a set of connected components that form a whole or work together. The reason why e-government is a system, according to Blanchard and Fabrycky (1998), is the nature of relationships among the e-government components as follows:

1. the properties and behavior of each e-government component have an effect on the properties and behavior of the rest;
2. the properties and behavior of each e-government component depend on the properties and behavior of at least one other component;
3. each possible subset of e-government components has properties 1 and 2; the components cannot be divided into independent subsets.

The elements of an e-government system include hardware, software, information, procedures, and people who make up the system (Systems engineering handbook, 2003). System architecture is the structuring of a system so that it satisfies a purpose. The term is often restricted to the creation and building of unprecedented complex systems (Rechtin, 1994), which is the most difficult case (Rechtin, 1991). System architect is the agent of the client, responsible for translating the client's wishes into a conceptual design that the builder can build. This is a necessary role, but one which has often lacked formal recognition. The focus of most system architecting efforts is creating a top-level conceptual design of the system. In the earliest stages of the e-government project, this top-level conceptual model for most practical purposes expresses the system's architecture.

The "e-government architecture" could be defined as the structure of what is built, its functions, the environment within which it will live, and the processes by which it will be built and operated (Rechtin, 1991). E-government could be seen as a SOS because it has five principal characteristics of a true SOS in distinguishing it from very large and complex but monolithic systems (Maier, 1998).

1. *Operational independence of the elements*: If the e-government is disassembled into its components, they are able to operate independently.
2. *Managerial independence of the elements*: The components (e-government systems) are separately acquired and integrated but maintain a continuing operational existence independent of the whole.
3. *Evolutionary development*: The e-government does not appear fully formed. Its development and existence is evolutionary with functions and purposes added, removed, and modified with experience.
4. *Emergent behavior*: The system performs functions and carries out purposes that do not reside in any component system. These behaviors are emergent properties of the e-government as a SOS and cannot be localized to any component system.
5. *Geographic distribution*: The geographic extent of the e-government systems is large. Large is a nebulous and relative concept as communication capabilities increase, but at a minimum it means that the components can readily exchange only information and not substantial quantities of mass or energy.

Models for integrated systems can be used to describe SOS (Maier, 1996), but do not provide guidance for their structuring. So, while the structure is driven by communications, it is first necessary to explore the organizing principles for SOS. Some literature suggests the use of heuristics as structuring guides in these situations.

### 2.2. E-government architecture

The e-government architecture includes standards, infrastructure components, applications, technologies, business model and guidelines for electronic interactions among and between government organizations, and other consumers (Ebrahim & Irani, 2005). Being a relatively new research area, e-government architecture and adoption strategy have not been widely discussed in the literature. Accordingly, we reviewed and studied these concepts from other relevant areas such as e-business, e-services, and e-commerce. Notwithstanding this, some papers have discussed the architecture or components of e-government, like Cabinet Office (2000), Heeks (2001), Sharma and Gupta (2002), and Daniels (2002). However, these studies did not address the managerial aspects and how it is aligned with the IT infrastructure. Incidentally, there are two main reasons for conducting this investigation; firstly, e-government goes beyond the IT infrastructure; secondly, e-government is a changing phenomenon and its architecture should be updated in short time periods; hence, tight architecture frameworks fail early. However, the contribution of this study is to provide a set of architectural guidelines for e-government that represent more aspects of e-government.

## 3. History of G2G in Iran

Although the concept of e-government is relatively new in the literature of Iranian administration and its planning and management activities, the application of IT dates back to more than 15 years (Sharifi & Zarei, 2004). However, the SCEGD was formed at the beginning of 1990s for the purpose of managing and developing e-government G2G initiative in Iran because of the intense importance of this phenomenon in government activities. This committee is composed of top country managers, including the president, ministers, deputy ministers, technical advisors, provincial governors, and heads of local organizations. The attempts in this regard can be highlighted as follows:

- In 1993, an important plan was made to continue the e-government, designing a LAN to facilitate the circulation of information and determine the existing inter-organizational communications.
- In 1994, this development was continued, through initiating a program to improve the process of analyzing an article to be prepared for discussion in the cabinet. The program was composed of discussing extensive IT applications.
- In 1995, two information recovery programs were proposed to discover, using available information from formal meetings, the main concerns of past cabinets, assuming the existence of an accumulation of concerns that had remained the same over time.

In this regard, a business process re-engineering (BPR) project was initiated to settle bottlenecks of the cabinet decision making process and to speed up the process in the cabinet secretary office (CSO). When these two programs were completed, it was realized that the quality of the information coming into the CSO remained unreliable, and inadequate to support decisions. As a result, four programs were started in 1996:

- information requirement analysis;
- plan to make the government more effective, and to change the current procedures from passive to proactive;
- more efficient usage of the strategic models to employ the most updated techniques and tools;
- automating the government office to facilitate the information exchange in CSO.

In 2000 and 2001, the government network development plan was extended to proper delivery and analysis of the government data. To this end, it was vital to study selected countries which were pioneers in implementing the e-government, to procure the equipment needed for extending the network to all provinces, to design a high-level network architecture, to include content management of the network, to develop an executive plan, and to analyze the network of the national information system.

Between 2002 and 2007, some innovative G2G projects had been implemented. However, these projects have not been completely successful in order to move the country forward in the IT era and have widespread improvements in the governmental services. A reason is the changing priorities of the government, which left the e-government attempts in a fuzzy situation and top managers uncertain about their e-government programs.

## 4. Methodology

While government is a dynamic institution, most of the means that have been already used in order to design e-government architectures are static and are not powerful enough. Consequently, we need more innovative ways than the traditional ones, which could be easily updated after fundamental changes. Presently, some enterprise architecture frameworks such as FEAF and C4ISR could be applied for e-government architecture; this approach does not seem to be untrue; but, government is beyond an enterprise and is much more complicated; hence, it needs different types of architecture with more flexibility, consistent with its changing nature.

During the meetings of the SCEGD in a project for exploring G2G e-government initiative elements and their relationship, numerous intensive interviews have been held to understand the main driving rules. These rules are formed based on the principles of heuristic development as suggested by Rechtin (1991). Additionally, three iterations of grounded action research method were carried out to explore intended guidelines.

### 4.1. Action research

Action research was firstly used in the 1940s with applied studies by Collier (1945) and Whyte and Hamilton (1964). Action research applies scientific methods to help organizations identify problems, discover their underlying causes, and implement appropriate changes. It can also produce new knowledge about organizations and change that can be applied elsewhere. In addition to its problem-solving focus, action research is highly collaborative, involving both practitioners and organization members in the research and action process.

### 4.2. Grounded theory

Grounded theory began as a "constant comparative method" that alternated theory building and comparison of theory to reality. This is the basis of the grounded theory discovery process in Glaser and Strauss (1967) and the more recent version in Strauss and Corbin (1990).

According to Strauss and Corbin (1990), analysis in a grounded theory approach is composed of three groups of coding procedures called open, axial, and selective coding. Open coding is the process of identifying, naming, and categorizing the essential

components of the intended model found in the case study data. Axial coding develops a deeper understanding of the relationships through the process of connecting various data categories that were determined during coding. Selective coding develops the theory that best fits by identifying a story that reveals the central phenomenon (the core issue or "core" category) under study. These procedures do not entirely occur as a sequence, but each overlaps others and iterates throughout the research project.

### 4.3. Grounded action research

Grounded action research has been applied in this work as was proposed by Baskerville and Pries-Heje (1999), "the refinement of the action research method which involves integrating certain grounded theory activities in the phases of action research primarily in two ways". First, grounded theory notation (e.g., memos and diagrams) is used to represent the theory data during the action research cycle. Second, grounded theory coding becomes the essence of the evaluating, learning, and diagnosis phases of action research.

However, in order to achieve scientific rigor, additional structure is usually imposed on action research projects. The most prevalent description (Susman & Evered, 1978) details a five-phase cyclical process. The method first requires the establishment of a client-system infrastructure or research environment. Then, five identifiable phases are iterated: (1) diagnosing, (2) action planning, (3) action taking, (4) evaluating, and (5) specifying learning. Fig. 1 is a diagram of this action research structural cycle.

### 4.4. Application of the methodology in the case

In the *diagnosing* phase, field notes and transcripts have been used in order to expose perceived primary problems for further analysis. During this phase, the memos received an initial round of axial and selective coding to further develop any initial core category and an initial story line about the problem situation. Besides, it was found through holding numerous meetings with the e-government development committee that the major problem is, "What are major e-government elements and how they should be related?" Based on the problem, preliminary data were collected—in the shape of memos and transcripts—to illustrate the problem via intensive interviews with 27 committee members, who had stronger ideas about the subject, including some deputy ministers, technical advisors, provincial governors, and heads of local organizations. After analyzing the data appropriately, goals were set and valid information was provided.

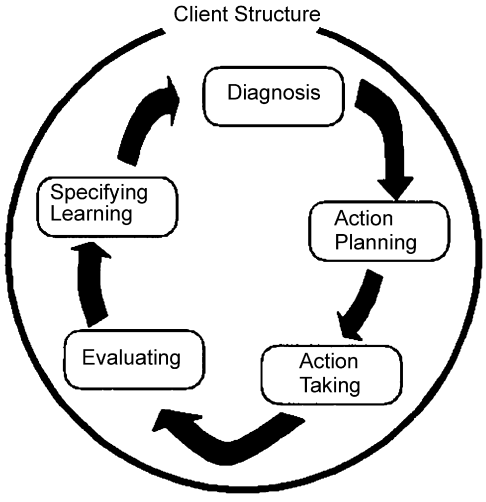


**Fig. 1.** Action research cycle.

During the *action planning* activity, coding memos were maintained and open coding continued as the collaborative team materialized a scheme of organizational actions that should relieve or improve the primary problems. Attention was kept on the core category and connecting sub-categories as means for determining both the desired future state for the organization and the changes that would bring about this state.

In the *action taking* stage, observations produced additional field notes and transcripts. Besides, open coding continued. The memos of action outcomes were particularly and precisely considered.

Then, memo-based data collection continued by researchers and practitioners as they undertook the *evaluation* of the outcomes. Code memos illustrated a growing understanding of effects of the action on the problems. Importantly, they *specified the learning* by continued axial and selective coding of both old and new data to determine if a new core category or story line would emerge from the process.

In all, three-round action research operations were held because the results of the action did not reflect a satisfactory outcome. Afterward, this adjusted story line became the foundation for a new diagnosis stage, leading to a further iteration of the action research cycle. Finally, and more importantly, categories of heuristic principles (our research results) have been coded from the categories and sub-categories resulting from three-round action research.

## 5. Findings

Compiling a unique list of guidelines to be applied in e-government architecture is almost impossible because it depends on the country's objectives. Besides, they are not commonly accepted, or are contradicted. Meanwhile three iterations of grounded action research in the case of SCEGD, 29 heuristic principles were explored by distillation of experts' different ideas. After doing a taxonomic work on them, it was found that they can be grouped into four different categories based on similarities. According to the following paragraphs, they are presented in the four major classes, including infrastructure, security, content and application, and management (as depicted in Fig. 2). It is worth mentioning that each guideline was the result of open coding, a process of labeling the events and ideas represented in the data.

### 5.1. Infrastructure

Infrastructure, as a reasonable level of global connectivity and network infrastructure capacity for key sectors to take advantage of leading edge technologies, is rolled out as part of an overall program that includes a wide range of actions. Table 1 shows the major heuristic principles on how infrastructure should be seen in the e-government.

### 5.2. Security

E-government security is an important factor that should be considered in the architecture because of numerous potential technical challenges that may occur in e-government implementation. Table 2 depicts the major heuristic principles on how security should be applied in the e-government.

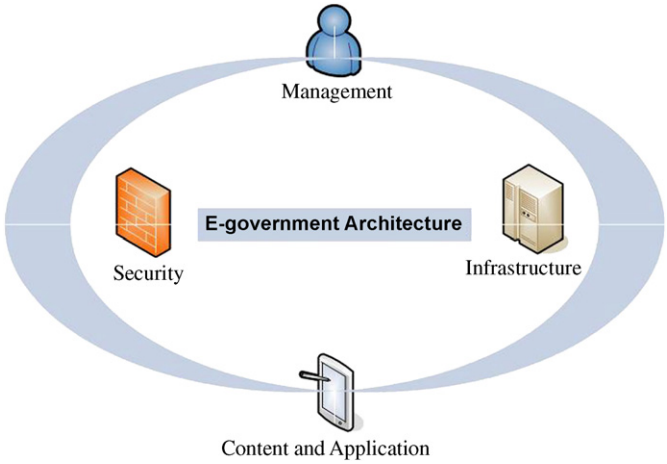


**Fig. 2.** Classification of the heuristic principles for e-government architecture.

**Table 1**
Infrastructure heuristic principles

| Number | Principle | Discussion |
|---|---|---|
| 1 | Government should not trust the current communication infrastructure | It is not designed for e-government applications in sufficient security, reliability, and scalability |
| 2 | Government should avoid designing the network before security planning or vice versa. But, both should be planned simultaneously | Network design and security plan are closely related |
| 3 | Technological infrastructure is an appropriate starting point for e-government | It makes e-government visible and provides the ground for significant progress in applications development |
| 4 | A holistic view to the infrastructure is needed for the e-government success | Infrastructure is not solely a technical concern, but it can be used as a managerial, political, and also social driver |

**Table 2**
Security heuristic principles

| Number | Principle | Discussion |
|---|---|---|
| 5 | A tight plan is needed for security development and management | Security in e-government application is a technical issue as well as a managerial one. It directly depends on managers' attitude, because they are not interested in being questioned for data misuse, so an intensive security plan is required |
| 6 | E-government development should not wait for reaching full security level | Providing fully functional security for all the e-government program is impractical. Moreover, traditional government service delivery has risks as well as e-government. But, in the new form of government, traditional misusers are replaced with hackers |
| 7 | Applying security standards and management procedure requires a security team with sufficient experience | They should study the e-government architecture and hold meetings with managers and specialists in all project components and select the optimum security level |
| 8 | Source, destination, and communication channel of information exchange should be determined | The reason is that information should be protected |

### 5.3. Content and application

Information and communications technology (ICT) capability will not effectively be leveraged without a proper content that is responsive to user needs. There is a need to build applications that are focused on customers. Table 3 shows the major guidelines on how content and applications should be employed in the e-government.

### 5.4. Management

Human-related issues are important in e-government initiatives. Trustworthy, secure, and accountable identity management solutions are key e-government enablers (Corradini, Paganelli, & Polzonetti, 2007). In addition, changing the approach of management in the government as well as the existence of capable managers are important, because of their power for resolving emergent problems. Indeed, better management could be provided by identifying opportunities for effective administration (Xenakis & Macintosh, 2007). Table 4 depicts the major managerial guidelines that should be involved in the e-government.

**Table 3**
Content and application heuristic principles

| Number | Principle | Discussion |
|---|---|---|
| 9 | Integration of different softwares, including applications and databases in all government agencies is required | This is only possible through basic implementation standards for interoperability |
| 10 | Government information should be included in e-government's single data warehouse | There are important information for the country management that could provide significant reports for different management levels through a single data warehouse (to avoid redundancy) |
| 11 | Determination of the initial applications is vital | They should be prioritized and scheduled by innovative experts |
| 12 | They need a comprehensive project management plan for the design, development, and implementation | Numerous applications should be planned to serve a wide range of employees and consumers, and create value-added services |
| 13 | Finding all the essential applications and reaching to an overall plan at first is difficult and requires cooperation of a large number of experts from varying disciplines | It also needs numerous meetings, discussions, focus groups, and brain storming sessions |
| 14 | There should be a mechanism for updating and removing the abolished applications, and creating new ones. | E-government applications change during the time. One application might be outdated or totally transformed |
| 15 | A systematic approach should be adopted to prioritize applications dynamically based on appropriate criteria | This is due to the radical decisions in the government |
| 16 | Huge efforts should be planned for monitoring and caring the applications | E-government applications evolve gradually from acceptable to mature systems mainly because they are unique |
| 17 | Not all applications need to be connected | Only those applications which are crucial and send/receive information from other applications should be considered |
| 18 | All information in the government agencies should be exchanged through government network even if they are not confidential | Because of the necessity of unique integration |
| 19 | E-government should assist in the governmental process improvement | Specially, because many government processes are not streamlined |

## 6. Discussion

In addition to the guidelines presented in the section on findings, there is also the additional information established through the three-round grounded action research. In this section, the set of heuristic principles are discussed in terms of their relationship with other categories. In addition, for each guideline, three main issues that can provide more useful information are discussed:

- *Nature*: It is important if a guideline is political or/and technical because decision makers are different for each category.
- *Timeline*: Establishing if a principle is long term or short term is vital for e-government architects because of how it should be planned to be applied.
- *Externality status*: This means whether a guideline relates to non-governmental organizations or not. Principles that are external last more to be fulfilled because it takes much time for government to be coordinated with non-governmental organizations.

**Table 4**
Management heuristic principles

| Number | Principle | Discussion |
|---|---|---|
| 20 | All related government organizations should gradually join the scheme | It is not possible to implement the e-government in all organizations at the same time because of finance, time, human resources, and infrastructure limitations |
| 21 | Human resources should be convinced about the e-government and its outcomes | Individual readiness is as significant as technological readiness. |
| 22 | Start with the minimum amount of information | If managers feel that their information may be abused or may not reach their intended authorities, they will not cooperate |
| 23 | Developing systems that can automatically process government data and generate management reports could be useful | A major concern for managers is the lack of timely and precise reports for decision making |
| 24 | Time is crucial, especially regarding G2G initiatives. E-government project management and control is a critical issue | For instance, when to start the e-government project and when should it be terminated, and how long each task should take |
| 25 | Preparation of government network infrastructure, application development, and implementation should be aligned with setting up of the security system | It can affect e-government project success |
| 26 | Supportive activities of the e-government plan such as procurement, human resource planning, and financial support system should be elaborated | These can play a significant role in the plan progression |
| 27 | Shortcuts should be sought | Since normal development models are time consuming, and may deteriorate the e-government success |
| 28 | Government should recruit a number of talented experts who can analyze and categorize government information, and suggest innovative solutions | Managers usually have many troubles in communicating with the electronic system because of insufficient IT literacy. These experts facilitate communication between managers and the new system |
| 29 | There are two main elements affecting the e-government progress, authorities' support, and more importantly, citizens' partnership | However, the more important one is not the support of top country decision makers, but the hungriness of citizens |

**Table 5**
Infrastructure guideline relationship with other heuristic classes

| Principle no. | Other classes | | | Tech./ poli. | Long term/ short | Externality |
|---|---|---|---|---|---|---|
| | Security | Content & app. | Manage-ment | | | |
| 1 | H | H | H | T | LT | Yes |
| 2 | H | – | – | T | LT | Yes |
| 3 | – | H | – | T | LT | Yes |
| 4 | – | – | H | P | ST | Yes |

Abbreviations: H, high; M, medium; L, low; P, political; T, technical; LT, long term; ST, short term.

Tables 5–8 depict information on how infrastructure heuristic principles interact with other guideline classes (high, medium, low, or no relationship), what is their nature (political or technical), what is the required time for implementation (long term, short term), and what kind of relationship do they have with non-governmental entities (externality, internality).

There are significant notes about each table, for example, according to Table 5, the first guideline has a high rate of relationship with the other triple classes (security, content and application, and management). Also, having a long-term technical nature rather than political, it has a wide range of relationship with entities outside the government.

Additionally, according to Table 6, the sixth principle has a medium rate of relationship with the content and application, and a high rate with the management class. Also, having a long-term political nature rather than technical, it has a wide range of relationships with entities outside the government.

Also, Table 7 (see appendix) demonstrates that the 18th guideline has a high rate of relationship with the other triple classes (infrastructure, security, and management). Also, having a long-term technical–political nature, it has no relationship with entities outside the government.

And finally, Table 8 (see appendix) shows that the 25th principle has a high rate of relationship with the other triple classes (infrastructure, security, and content and application). Also, having a long-term technical–political nature, it has a wide range of relationship with entities outside the government.

Fig. 3 shows a double-dimensional arrangement of all 29 proposed heuristic architectural guidelines. According to this figure, more crowded section of the diagram is "management" pivot; and then, content and application/security area, and security/infrastructure.

## 7. Conclusion

System architecture requires balancing characteristics and elements so that they fit together in appropriate compromises to create good systems. One major domain for system architecture is G2G e-government operations in developing countries. In this domain, current theories are not sufficient and rich enough; hence for e-government to be well architected, more theories or significant customization on the related theories is needed. The paper here proposed and introduced relatively most important guidelines affecting Iranian G2G architecture in terms of infrastructure, content and applications, management, and security, considering which can be strongly helpful. However, more experiences are required for proposing more heuristic principles. Finally, since e-government is a multidisciplinary area, architectural principles should be more diversified. For future research, it is recommended to seek an architectural framework for the e-government based on guidelines presented in this paper. This probably leads to new ideas for e-government architecture.

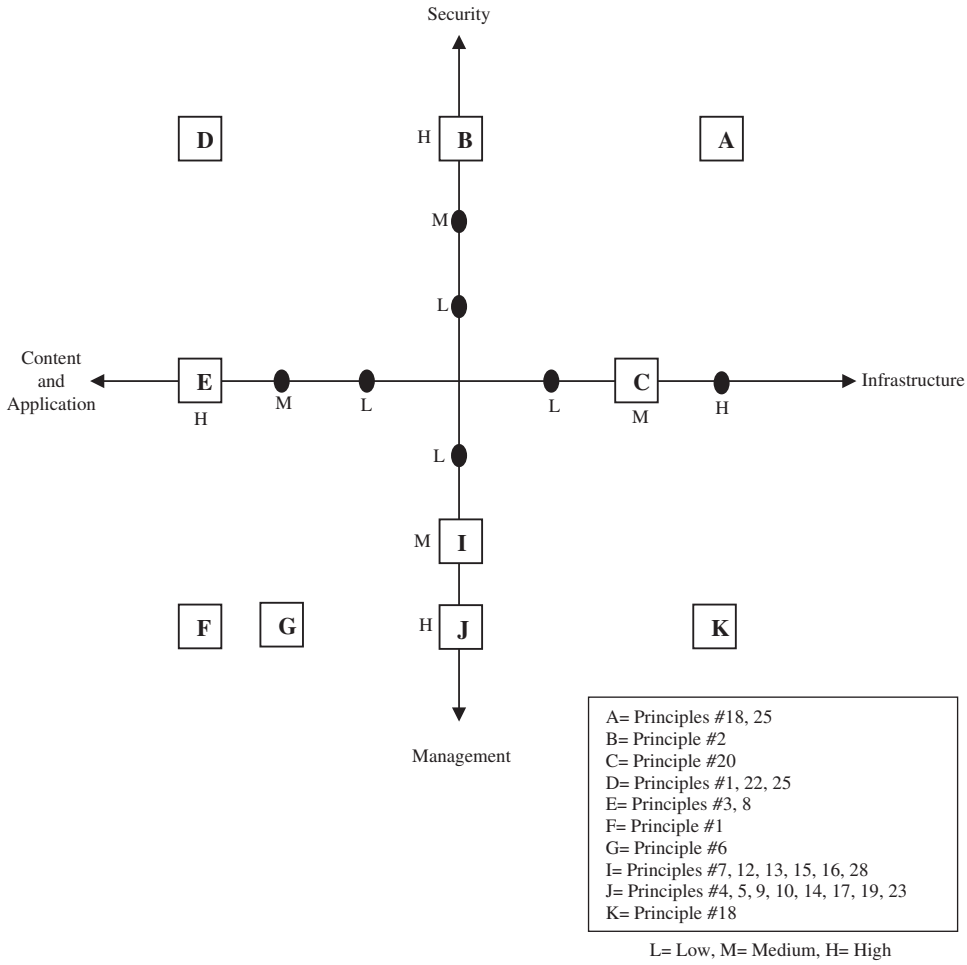


**Fig. 3.** Two-dimensional relationships between e-government architectural guidelines.

**Table 6**
Security guideline relationship with other heuristic classes

| Principle no. | Other classes | | | Tech./ poli. | Long term/ short. | Externality |
|---|---|---|---|---|---|---|
| | Infra-structure | Content & app. | Manage-ment | | | |
| 5 | – | – | H | P | ST | No |
| 6 | – | M | H | P | LT | Yes |
| 7 | – | – | M | P | ST | No |
| 8 | – | H | – | T | ST | Yes |

**Table 7**
Content and application guideline relationship with other heuristic classes

| Principle no. | Other classes | | | Tech./ poli. | Long term/ short | Externality |
|---|---|---|---|---|---|---|
| | Infra-structure | Security | Manage-ment | | | |
| 9 | – | – | H | T | LT | No |
| 10 | – | – | H | T/P | LT | Yes |
| 11 | – | – | – | T/P | ST | No |
| 12 | – | – | M | T | LT | Yes |
| 13 | – | – | M | P | ST | No |
| 14 | – | – | H | T/P | LT | Yes |
| 15 | – | – | M | T | LT | No |
| 16 | – | – | M | T/P | LT | No |
| 17 | – | – | H | P | LT | No |
| 18 | H | H | H | T/P | LT | No |
| 19 | – | – | H | T/P | LT | No |

**Table 8**
Management guideline relationship with other heuristic classes

| Principle no. | Other classes | | | Tech./ poli. | Long term/ short | Externality |
|---|---|---|---|---|---|---|
| | Infra-structure | Security | Content & app. | | | |
| 20 | M | – | – | T | LT | No |
| 21 | – | – | – | P | LT | No |
| 22 | – | H | H | T/P | ST | No |
| 23 | – | – | H | T | ST | Yes |
| 24 | – | – | – | T/P | LT | Yes |
| 25 | H | H | H | T/P | LT | Yes |
| 26 | – | – | – | T | LT | Yes |
| 27 | – | – | – | T/P | ST | No |
| 28 | – | – | M | P | ST | Yes |
| 29 | – | – | – | T/P | LT | Yes |

## Appendix

Tables 6–8.

## References

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