

Use Cases of the Application Reference Model in IRAN

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Abstract: In this article, the main elements of the Iranian Application Reference Model, called INARM, are briefly introduced. This model includes three levels of systems, application components, and interfaces. In the “system” section of this model, there are 11 system groups, 74 systems and more than 250 modules. The section of application components contains 4 application component groups, 36 application components and more than 100 modules. Finally, the section of interfaces contains 16 interfaces. The mere provision of the application reference model is not very helpful, and it is necessary to specify the use cases of the model. It is also necessary to make clear the considerations and risks of using the model for government agencies. In this regard, this paper describes 10 use cases for the INARM. As a specific use case, the government’s participation in procuring public software for the agencies (based on INARM and with the aim of cost reduction in system’s procurement and maintenance, and increasing system quality) is explained.

1 INTRODUCTION

Application Reference Models (ARMs) assist in categorizing software applications and components used in government agencies to aid in identifying opportunities for software sharing and reuse.

ARMs provided in various countries usually consist of three levels (CIO Council, 2013): Systems, Application Components, and Interfaces. Systems are organized for the collection, processing, maintenance, use, sharing, and dissemination of information in support of a specific business process. Application Components are self-contained software that can be aggregated or configured to support, or contribute to achieving, many different business objectives. For example, the document management system can support multiple IT systems and business processes. Interfaces are protocols used to transfer information from system to system.

The national application reference model of Iran, called INARM, has been developed by studying other ARMs in the world, reviewing software applications in the country, investigating the upstream documents and documents of related projects and researches.

This paper first introduces the main elements of INARM in addition to reviewing the method to design this model. Then, it describes the use cases and applications of INARM. As of the main application, the government participation in the procurement and

provisioning of public software systems for agencies (based on INARM) is elaborated in detail.

The remainder of this paper is organized as follows. In Section two, INARM is briefly introduced. Section 3 describes use cases of INARM. Section 4 illustrates how the government can participate in procuring public software systems for agencies, based on INARM. In section 5, some comparison with related studies is done. Finally, Section 6 concludes the paper.

2 IRAN APPLICATION REFERENCE MODEL

The following activities have been performed to develop INARM:

1. Performing comparative studies on application reference models of selected countries
2. Reviewing other national reference models to identify items that should be considered in INARM with respect to the elements in other reference models
3. Reviewing upstream documents which force some elements to INARM
4. Analyzing software systems provided within the country with the aim of ensuring the feasibility of executing INARM in IRAN

To ensure integrity and appropriateness of the proposed model, in addition to the above activities, we

studied the process categorization framework presented by APQC Center (APQC Center, 2016) as well as comprehensive software solutions (especially enterprise resource planning solutions) provided by leading companies.

For performing comparative studies, reference model documents for countries of the United States (CIO Council, 2013), Saudi Arabia (National Enterprise Architecture Office Management at Yesser, 2015), India (Ministry of Electronics and Information Technology Government of India, 2017), South Africa (Government Information Technology Officer’s Council of South Africa, 2010), Australia (Australian Government Information Management Office, 2011), New Zealand (Deleu and Clendon, 2015), and the United Kingdom (Walters and Turton, 2012), were studied.

Then, to ensure the consistency of the application reference model with other national reference models, the national performance reference model (Shams Aliee et al., 2017), the government interoperability framework (Information Technology Organization of Iran, 2016), the national service reference model or business reference model (Shams Aliee et al., 2018) and the national security reference model (Information Technology Organization of Iran, 2017) were investigated. For example, in relation to the service reference model, we had to make sure that for each business service in the service reference model, a module is introduced in the systems or components of INARM that provides this service.

Subsequently, the materials and sentences in each of the related upstream documents were studied and their effects on the INARM were identified. In this study, all upstream documents, IT development programs and e-government development programs at the national level were studied. At last, to analyse the software systems used more in internal agencies (and it would be better to consider them in the customization and localization of the national ARM), 18 software providers were selected as candidates and their software products were investigated.

An overall schema of the first part of INARM, the software systems, is presented in Figure 1. This schema has four main layers. At the highest level, a dedicated system for strategic planning is located. The results of this planning, as one of the main inputs, are presented to almost all the other systems of INARM to provide the basis for operational planning in each of these systems.

The second layer includes the service management system. Since the main mission of government

agencies is to provide services to citizens, businesses, and other government organizations, this layer is considered the most important layer after the highest level.

The third layer deals with other public systems that act as back-office systems. This layer consists of 9 system groups, each of which in turn consists of several systems. Each system is also contains several modules. Finally, there is the “Basic Information System” which is responsible for recording common data and information used by other systems. All system groups and systems are shown in Figure 2.

Due to space limitation, we do not present the lists of INARM application components and interfaces.

3 USE CASES OF INARM

In this section, use cases of INARM for government agencies and software providers are expressed. To derive these use cases, the following steps have been performed:

1. Reviewing the use cases of other countries' reference models, mentioned in Section 2
2. Interviews with senior managers of the Ministry of Information and Communications Technology of Iran
3. Interviews with elected governmental agencies of Iran
4. Interviews with the executive managers of some software companies whose products are used by a significant number of agencies.

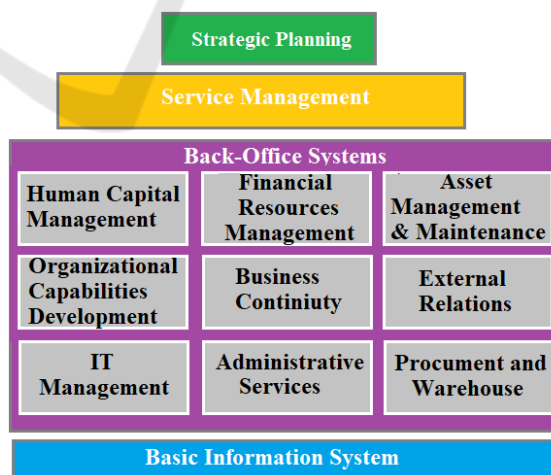


Figure 1: An overall schema of INARM.

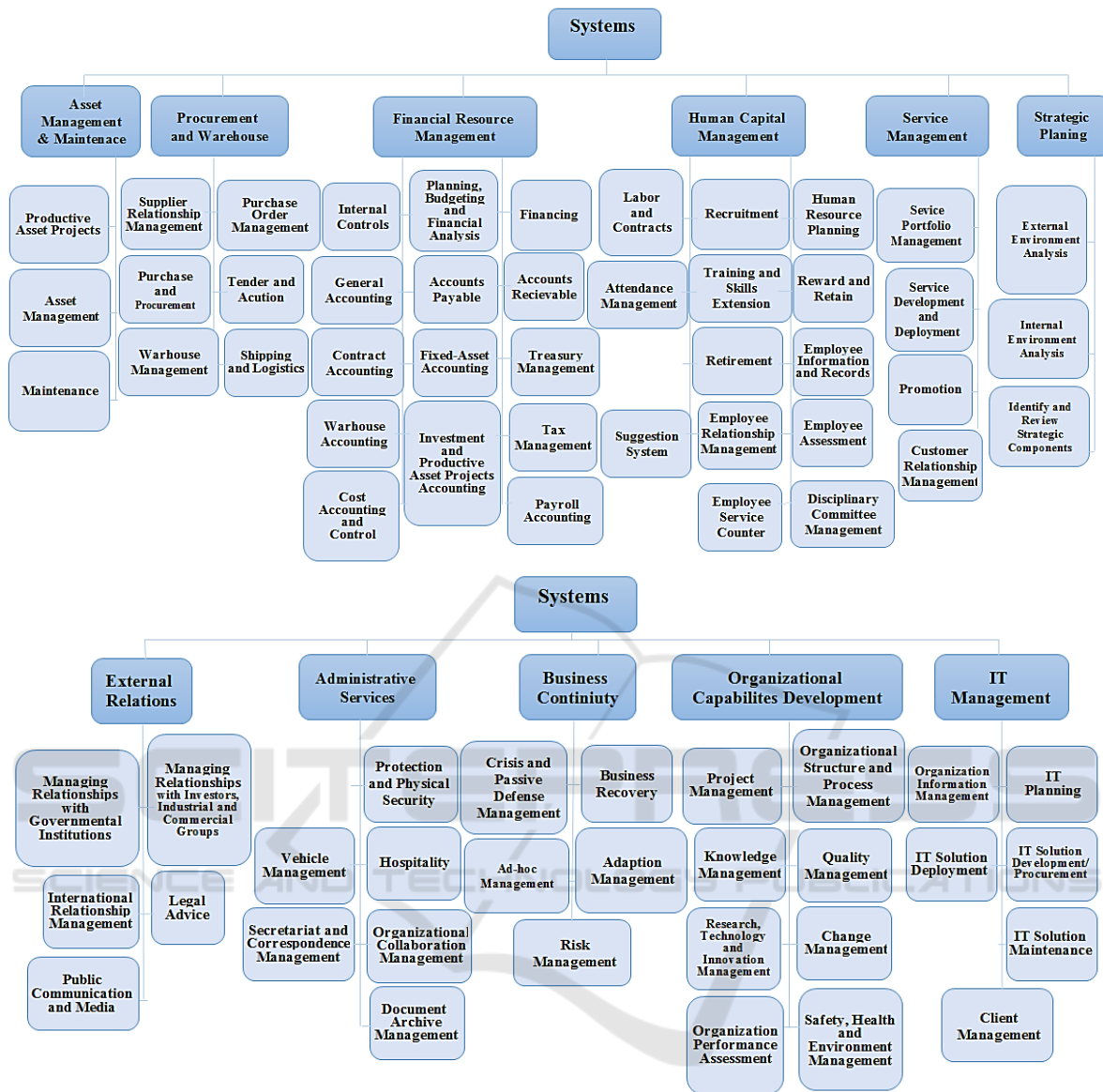


Figure 2: Systems Hierarchy of INARM.

3.1 Use Case 1: Reducing the Cost of IT in Agencies

Each agency has its own portfolio of software systems. There is almost no doubt about the existence of duplicate systems in the government agencies and even within the sub-agencies of an agency. Obviously, the government and any agency are looking for an opportunity to reduce the cost of IT by removing duplicated software. To detect duplicated software in agencies, the information of all the software available in agencies and sub-agencies should be mapped to INARM. After mapping, INARM needs to be searched

in order to find opportunities for sharing and reusing software, integrating information systems, negotiating for sharing licenses, and negotiating with companies for price reductions. In this way, mappings are reviewed across government and government agencies in Iran to identify opportunities for sharing and reusing software.

3.2 Use Case 2: Identifying Appropriate Software Solutions to Meet the Requirements of Agencies

The purpose of this use case is to identify the appro-

appropriate software solutions and technologies to meet the identified business requirements in an agency, as well as supporting the sharing perspective. This case also shows how INARM can be used in conjunction with other national reference models to reuse existing IT assets.

In order to achieve this goal, IT custodians and enterprise architects use the mapping repository of INARM (as described in use case 1) to identify systems, services, and solutions that may meet the requirements of an organization. But the prerequisite is to map the business requirements of the organization to the elements of INARM. In this way, and indirectly, the mapping between the business requirements of an organization and the existing software and IT solutions in Iran are obtained. By mapping between INARM and other national reference models, this case is not limited to the ARM; but also, the mapping of requirements to the elements of the other reference models can be identified (indirectly).

3.3 Use Case 3: Evaluating the Organizations in Terms of the Maturity of Software Systems

INARM has been developed based on the IRAN service reference model, considering other national reference models (to align with these models and having effective communication with them), benchmarking reference models of other countries, benchmarking known domestic and foreign software, and finally based on the upstream laws of the country and the up to date standards of software development. Therefore, it is a good baseline for assessing the maturity level of organizations' software systems and the digitalization level of their business needs and processes. By mapping existing software systems into INARM, on one hand, and mapping business requirements of organizations to INARM, on the other hand, and finally, assessing the extent of the requirements covered by the current systems of each organization, and the number of uncovered but coverable requirements by INARM, we can measure the maturity of organizations from the software systems perspective.

3.4 Use Case 4: Facilitating the Design of Enterprise Architecture

Government agencies can utilize the elements of INARM, as a main input and pattern, to design the application layer (at least the part of public and common applications) of their enterprise architecture.

3.5 Use Case 5: Detecting Opportunities for Developing New Systems

Companies providing enterprise software systems can detect opportunities for developing new systems by comparing the current state of systems existing in government organizations and the elements of ARM. Because, based on policies of the Iranian enterprise architecture framework, government agencies are moving toward the maximum compliance with INARM, agencies more likely will need new software to cover their requirements and upgrade their organization through more alignment with the ARM. As a result, software providers can take precedence in this area and add new systems needed by organizations in their solution portfolio.

3.6 Use Case 6: Providing a Mechanism for Ranking Software Providers

It is possible to examine the coverage of the systems, components, and functions proposed in INARM by the enterprise systems provided by the companies and, accordingly, rank these companies. Using the relationship between INARM and other national reference models, we can identify broader criteria for assessing software providers. Some metrics for ranking these providers are as follows:

- The degree of support for required functions (based on the mapping to INARM)
- The degree of support for calculating performance measures
- The degree of coverage of the required data
- The degree of compliance with the criteria proposed in the IRAN security reference model

3.7 Use Case 7: Identifying New Requirements and Improving Processes in Organizations

By mapping the organization's existing systems into INARM, some deficiencies can be identified. So that some systems that are in INARM and are not available in the organization may be useful to the organization, even if the organization so far did not feel the need. Perhaps, the necessity of using such systems will lead to business process reengineering and improvement of the organization business.

3.8 Use Case 8: Finding Opportunities for Partnership with Other Software Providers

Using the mappings of the solutions provided by software providers to the elements of INARM, these companies can both upgrade their systems and partner with other companies to provide integrated solutions (through engagement with each other to cover gaps in accordance with INARM).

3.9 Use Case 9: Determining Performance Metrics

Using the relationship between INARM and the IRAN performance reference model, when developing a new software system or component, it is possible to determine the relevant metrics and their computation mechanism.

3.10 Use Case 10: Determining Security Issues

Using the relationship between INARM and the IRAN security reference model, security standards, technologies and principles that government agencies and software providers have to consider in procurement, developing, and deploying any enterprise software can be identified.

4 GOVERNMENT PARTICIPATION

In this section, as the main application of the national ARM, the ways of government involvement in the provision and procurement of public software systems for the agencies (based on INARM) are expressed. In this regard,

1. First, the types of the current states of the public software in agencies are explained.
2. Then, the types of government actions to procure public software systems are expressed.
3. At the third stage, we determine appropriate actions required for each current status.
4. Finally, the current status of any software system in government agencies is determined based on available information.

By aggregating the results of the above stages, it is determined what will be the best practice and level of government participation for each of the existing public software systems.

4.1 Different Categories of the Current State of Public Software

We categorize the current state of public software systems in governmental agencies as follows:

1. Average or the high percentage of the agencies uses this software system.
 - (S1) compared to INARM, modules and functions available in at least some of the instances of this software system are relatively complete, and these instances also have acceptable quality.
 - (S2) in comparison with INARM, modules and functions available in all instances of this software system have significant defects, or these instances do not have acceptable quality.
2. A small percentage of the agencies have this software system.
 - (S3) compared to INARM, modules and functions available in at least some of the instances of this software system are relatively complete, and these instances also have acceptable quality.
 - (S4) in comparison with INARM, modules and functions available in all instances of this software system have significant defects, or these instances do not have acceptable quality.
3. (S5) none of the agencies have this software.

4.2 Various Types of Government Actions

We consider the following actions that the government can take to participate in software procurement for agencies:

1. (A1) Development of the software system by the government and delivering it to the agencies.
2. (A2) Development of common application components (such as document management system) by the government and delivering them to the agencies.
3. (A3) The government can negotiate and come to an agreement with one or more selected software providers to buy a software license for bulk purchases (for several agencies). Certainly, the basis of the negotiation should be considering significant discounts due to one-off sales of the software to several agencies. The advantage of this mechanism for the government is saving software costs, simpler maintenance, and more effective integration between software systems of various agencies. The advantage for software providers is to sale their software product to more agencies at the same time.
4. (A4) The government negotiates and agrees with one or more selected software provider to extend the software license time period in bulk (i.e., with respect to several agencies). Certainly, the basis of the negotiation should be considering significant discounts

due to the renewal of the license and / or the software support period for several agencies.

5. (A5) The government forces using the template provided in INARM to prepare RFP for the development of public software.

6. (A6) The government forces using the standards, principles and best practices mentioned in INARM to develop public software.

7. (A7) The government obligates agencies to replace their existing systems which are low-quality or do not have acceptable compliance with INARM, with more appropriate systems.

8. (A8) The government can negotiate and make an agreement with the software providers whose software products are used by a significant number of

agencies, but do not have acceptable compliance with INARM to improve and upgrade their software system.

4.3 Mapping the Current States to the Suitable Actions

Regarding the two previous subsections, Table 1 determines appropriate actions required for each current status. In Table 2, the current state of each of the INARM systems, in Iran organizations, is presented. By observing the status of each system, on one hand, and using Table 1, on the other hand, it is possible to infer the actions required for that system.

Table 1: Appropriate actions required for each current status.

Current State	Related Actions
S1/S3	The following actions should be taken in parallel: <ul style="list-style-type: none"> Action A3 for agencies that do not have the desired system. Negotiations are conducted with the provider(s) whose software products have the highest quality and the most alignment with INARM. Action A4 for agencies that have the desired system. Negotiations are conducted with the software provider(s) whose software products have the highest quality and the most alignment with INARM. Action A7 for agencies whose systems have low quality or low compliance with INARM.
S2	1- First, take action A8. Actions A5 and A6 will also be used to upgrade existing systems. In addition, if the deficiencies are due to the lack of high quality common application components, action A2 will also be used accordingly. 2- Then, the actions mentioned in the first row should be done in parallel.
S4	1- First, take action A1. In the development of the new system common application components (whether existing or made from the first) should be used, as far as possible. Also, for the development of these systems, actions A5 and A6 will also be used. 2- Then, action A7 will be done for agencies whose systems have low quality or low compliance with INARM.
S5	First, take action A1. In the development of the new system common application components (whether existing or made from the first) should be used, as far as possible. Also, for the development of these systems, actions A5 and A6 will also be used.

Table 2: The current state of each of the INARM systems, in Iran organizations.

AS-IS	Systems
	Strategic Planning
S4	External Environment Analysis
S4	Internal Environment Analysis
S4	Identify and Review Strategic Components
	Service Management
S5	Service Portfolio Management
S5	Service Development and Deployment
S5	Promotion
S5	Customer Relationship Management
	Human Capital Management

S4	Human Resource Planning
S4	Recruitment
S1	Labor and Contracts
S2	Training and Skill Extension
S1	Attendance Management
S1	Employee Information and Records
S4	Retirement
S4	Reward and Retain
S2	Employee Assessment
S5	Employee Relationship Management
S4	Suggestion System
S4	Disciplinary Committee Management
S4	Employee Service Counter

Table 2: The current state of each of the INARM systems, in Iran organizations (cont.).

Financial Resource Management	
S5	Financing
S2	Planning, Budgeting and Financial Analysis
S2	Cost Accounting and Control
S2	Accounts Receivable
S2	Accounts Payable
S1	General Accounting
S2	Treasury Management
S2	Fixed Asset Accounting
S2	Contract Accounting
S1	Payroll Accounting
S4	Investment and Productive Asset Projects Accounting
S4	Warehouse Accounting
S4	Tax Management
S4	Internal Controls
Procurement and warehouse	
S3	Purchase Order Management
S2	Supplier Relationship Management
S3	Tender and Auction
S3	Purchase and Procurement
S3	Shipping and Logistics
S1	Warehouse Management
Asset Management and Maintenance	
S4	Productive Asset Projects
S2	Asset Management
S3	Maintenance
IT Management	
S5	IT Planning
S4	Organization Information Management
S5	IT Solution Development/Procurement
S5	IT Solution Deployment
S5	IT Solution Maintenance
S5	Client Management
Organizational Capabilities Development	
S4	Organizational Structure and Process Management
S4	Project Management
S5	Quality Management
S3	Knowledge Management
S5	Change Management

S5	Research, Technology and Innovation Management
S4	Safety, Health and Environment Management
S4	Organization Performance Management
Business Continuity	
S5	Adaption Management
S5	Crisis And Passive Defense Management
S5	Business Recovery
S5	Risk Management
S5	Ad-Hoc Management
Administrative Services	
S2	Protection And Physical Security
S3	Vehicle Management
S5	Hospitality
S4	Organizational Collaboration Management
S1	Secretariat And Correspondence Management
S1	Document Archive Management
External Relations	
S4	Managing Relationships With Investors, Industrial And Commercial Group
S4	Managing Relationships With Governmental Institutions
S4	Legal Advice
S5	International Relationship Management
S4	Public Communication And Media

5 COMPARISON WITH RELATED STUDIES

In the following, the use cases derived from other countries, are listed. We present those items defined for INARM in *Italic*.

- United States (CIO Council, 2013)
 - *IT cost reduction through IT/Application Portfolio Management*
 - *Determining the correct technologies to meet a well understood business need*
- Saudi Arabia (National Enterprise Architecture Office Management at Yesser, 2015)
 - *Improving government services to citizens and businesses*
 - *Enhancing interoperability across government agencies*
 - *Leveraging on current IT application investments and assets*
 - *Reducing total cost of ownership on future IT investments through the use of national shared*

application systems and reusable application components

- *Aligning government agencies' IT application systems with national shared application systems*
- India (Ministry of Electronics and Information Technology Government of India, 2017)
 - Acting as the bridge between the Business Reference Model and the Technical Reference Model
 - *Mapping the commonality of functions of various domains and identifying the applications and components*
 - Enabling government to provide effective and integrated services to its stakeholders
 - Suggesting appropriate methods for software development
 - *Defining building blocks required to develop high-level application architecture*
- South Africa (Government Information Technology Officer's Council of South Africa, 2010)
 - *Providing guidance to develop the EA products/deliverables that form the fundamental building blocks of an Enterprise Architecture Plan.*
 - *Providing guidance to direct, coordinate, validate and monitor the performance and conformance of Enterprise Architecture Plans within and across departments/agencies*
- New Zealand (Deleu and Clendon, 2015)
 - Providing a government wide common language for applications and ICT services
 - *Identification of opportunities for sharing, re-use and consolidation of services*
 - *Providing a basis for the objective review of ICT investment by the government*
- United Kingdom (Walters and Turton, 2012).
 - *Identifying opportunities for re-use*

6 CONCLUSIONS

In this paper, 10 use cases were introduced for the Iranian application reference model, called INARM. As a specific use case, we described how the government can participate in procuring or development of public software for the government agencies. As some directions of future work, the following cases are aimed:

- Designing a framework for assessing the quality of developed systems based on INARM
- Developing a tool to support the mapping of organizations' systems and business requirements to INARM

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REFERENCES

- CIO Council (2013). Federal enterprise architecture framework.
- APQC Center (2016). APQC's Process Classification Framework.
- Australian Government Information Management Office (2011). Australian government architecture reference models. www.finance.gov.au/sites/default/files/agaref-models.pdf.
- Deleu, R. and Clendon, J. (2015). Gea-nz v3.1business reference model and taxonomy. <https://www.ict.govt.nz/assets/Guidance-and-Resources/GEA-NZ-v3.1-Business-Reference-Model-and-Taxonomy.pdf>.
- Government Information Technology Officer's Council of South Africa (2010). Government-Wide Enterprise Architecture (GWEA) Framework Implementation Guide.
- Information Technology Organization of Iran (2016). Electronic Government Interoperability Framework (e-GIF) (In Persian).
- Information Technology Organization of Iran (2017). Iran Security Reference Model (In Persian).
- Ministry of Communication and Information Technology Government of Iran (2014). Technical standards for e-government development in IRAN (In Persian).
- Ministry of Electronics and Information Technology Government of India (2017). IndEA Framework (India Enterprise Architecture Framework).
- National Enterprise Architecture Office Management at Yesser (2015). National Application Reference Model.
- Shams Aliee, F., Bagheriasl, R., Mahjoorian, A., Mobasheri, M., Hoseini, F. and Golpayegani, D. (2018). A Classification Taxonomy for Public Services in Iran. ICEIS (2) 2018: 712-718.
- Shams Aliee, F., Bagheriasl, R., Mahjoorian, A., Mobasheri, M., Hoseini, F., and Golpayegani, D. (2017). Towards a national enterprise architecture framework in Iran. In Proc. of the 19th International Conference on Enterprise Information Systems, Portugal, April, 2017.
- Walters, S. and Turton, P. (2012). UK Government Reference Architecture. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/266169/govt-ict-sip.pdf.