

## Evaluation methodology for national enterprise architecture frameworks

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**Abstract.** This article introduces a new methodology for NEA (National Enterprise Architecture) evaluation based on two sets of indicators. The first set consists of quantitative indicators regarding to the e-government initiatives and their characteristics, including interoperability strategy, NEA strategy, legal framework and legislatives, sustainability, quality control, dissemination and predicted goals. The second set is based on the definition of NEA and NEA characteristics, consisting of the following quantitative indicators: methodology and models, model interfaces, architectural standards and principles, repository and use of development indicator. The final result of the evaluation is calculated as a sum of the results of the both sets of indicators.

In this paper we analyze how similar efforts resulted in smaller methodology and evaluate several NEA initiatives with comparison of results. Further we comment how our approach results in a new sophistication methodology that can be used to evaluate NEA initiatives and help others in giving directions to build new sophisticated solutions.

**Keywords:** National enterprise architecture evaluation framework, quantitative evaluation framework, e-Government, e-Services benchmarking

### 1 Introduction

E-government has been studied from many perspectives. OECD has published several evaluations for distinct e-governments and country comparison reports. [1][2][3][4][5][6][7][8][9][10][11] Surveys of national enterprise architectures (NEA) have been scattered and unrelated. Most detail study of NEA activity has been published by Christiansen and Gotze [4]. The goal of their research is to gain a detailed report of the NEA activities, but the results in their report are summarized for all the countries.

There have also been other studies, but most of the reports of NEA that have been produced use descriptive evaluation framework.

Leist and Zellner have conducted a study that evaluates part of the well-known, reputable and often used frameworks (regarding the elements of a method), including few national architecture frameworks. [5] Methodology introduced in their report

consists of five constitutive elements: 1) Meta model, 2) Procedure model, 3) Technique/modeling technique, 4) Role and 5) Specification document.

Each of the elements is evaluated as fully accomplished, partly accomplished or not accomplished. A summary of their results is given in Figure 1.

	ARIS	C4ISR/DoDAF	FEAF	MDA	TEAF	TOGAF	Zachman
Specification document	●	●	●	●	●	○	●
Meta model	●	⊙	○	●	⊙	○	⊙
Role	○	⊙	●	⊙	●	○	○
Technique	●	●	○	⊙	○	⊙	○
Procedure model	○	●	●	●	●	●	⊙

Legend: ● Fully accomplished  
 ⊙ Partly accomplished  
 ○ Not accomplished

**Fig. 1.** Evaluation of architecture frameworks according to the study of Leist and Zellner [5].

Another detailed study of the national enterprise architecture models is conducted by the Finnish Enterprise Architecture Research Project. The research report is an overview of enterprise architecture work in 15 countries. The goal was to support the development of the Finnish state IT function and, in particular, the enterprise architecture work of public administration carried out in the Interoperability Development Programme by evaluating this work in relation to foreign development. [2] The overview describes and compares different countries' enterprise architecture programmes on a descriptive evaluation framework which helps to evaluate the contents, focus areas and perspectives of the enterprise architecture programmes in different countries. [2] The framework is based on Janssen and Hjort-Madsen's framework [6] of five viewpoints: 1) Policies, actors and structures; 2) Governance; 3) Architecture frameworks and methodologies; 4) Architecture principles and standards, and 5) Implementations.

Also two new viewpoints are added: 1) Reported benefits of NEA work and 2) Evaluation of national EA work based on observations. The extended framework used in the report is presented in Table 1.

## 2 A new evaluation model

Creation of a new NEA methodology is a challenging process. Main reasons can be found due to the fact different plans, goals, expected benefits and different governance models of each country.

Our survey introduces a new methodology for NEA evaluation. We have created new evaluation framework that consists of two sets of quantitative indicators. The

first set consists of quantitative indicators regarding the e-government initiatives and their characteristics. The second set consists of the NEA definition and characteristics.

**Table 1.** FEAR-project evaluation framework [2].

<b>Viewpoint</b>	<b>Explanation</b>
<b>1. Policies, actors and structures</b>	Political and environmental drivers for NEA. The strategic objectives for architecture are provided by political actors and constrained by democratic structures.
<b>2. Governance</b>	NEA's governance model and practices that are needed for keeping the architecture up-to-date. Governance guidelines also encourage desired behavior.
<b>3. Architecture frameworks and methodologies</b>	Definition of the NEA, framework used and architecture process.
<b>4. Architecture principles and standards</b>	Standards, principles and guidelines used for implementation, and change management. Compatibility with international models (e.g. EIF and FEA)
<b>5. Implementations</b>	NEA implementations and cross-public sector projects.
<b>6. Benefits</b>	Benefits of the NEA work and their measurement, experiences from NEA work and its usefulness.
<b>7. Evaluation</b>	Special characteristics and advantages/disadvantages of the NEA work.

## 2.1 E-government initiatives indicators

We introduce the following seven indicators in the first set, and define quantitative and quality measure:

1. **(IS1) Interoperability strategy**
  - 0 – have not been published and it is not planned at all
  - 1 – published, but yet uncompleted strategy
  - 2 – long-term plan for strategy publishing
  - 3 – short-term plan for strategy publishing
  - 4 – published complete strategy
2. **(IS2) NEA strategy**
  - 0 – have not been published and it is not planned at all
  - 1 – published, but yet uncompleted strategy
  - 2 – long-term plan for strategy publishing
  - 3 – short-term plan for strategy publishing
  - 4 – published complete strategy
3. **(IS3) Legal framework and legislatives**
  - 0 – no mandatory use
  - 1 – suggested as common practice
  - 2 – only some parts of the NEA are mandatory
  - 3 – the usage of NEA is still not mandatory, expected in the future
  - 4 – the usage of NEA is mandatory

4. **(IS4) Sustainability**
  - 0 – no defined model
  - 1 – governance model is only defined, but not used yet
  - 2 – decentralized governance,(administrative bodies are responsible)
  - 3 – insufficient budget and centralized model defined
  - 4 – centralized model is defined and used
5. **(IS5) Quality control**
  - 0 – no defined quality control model
  - 1 – quality control model is only defined, but not used yet
  - 2 – decentralized governance of quality control model, (administrative bodies are responsible)
  - 3 – insufficient budget and centralized quality control model defined
  - 4 – centralized quality control model is defined and used
6. **(IS6) Dissemination**
  - 0 – no defined model nor budget
  - 1 – governance model and budget is only defined, but not used yet
  - 2 – each administrative body defines model and budget
  - 3 – insufficient budget and centralized model defined
  - 4 – centralized model defined and used
7. **(IS7) Predicted goals** – for each of the listed goals 1 point is gain
  - Resource management
  - Improved service delivery
  - Infrastructure renewal
  - Improve cross governmental interoperability
  - Improve process effectiveness
  - Reduce time to deliver IT projects
  - Enable greater flexibility in business processes
  - Reduce IT cost
  - Improved IT security

A further description of the used indicators is given in Table 2.

**Table 2.** E-government initiatives indicators description.

<b>Indicator</b>	<b>Description</b>
<b>IS1 Interoperability strategy</b>	Evaluates the national interoperability framework, the way that it is composed into the national strategy, so as the standards that includes.
<b>IS2 NEA strategy</b>	Evaluates the NEA framework and the way that it is composed into the national strategy.
<b>IS3 Legal framework and legislatives</b>	Evaluates the existence or type of legal model of conducting the published NEA framework.
<b>IS4 Sustainability</b>	Evaluates the existence or type of governance of the published NEA model.
<b>IS5 Quality control</b>	Evaluates the existence or type of quality control model of the published NEA performance.
<b>IS6 Dissemination</b>	Evaluates the existence or type of marketing budget model for national strategy propagation like awareness rising, EA staff training etc...
<b>IS7 Predicted goals</b>	Evaluates the predicted goals and motivations of the published NEA framework.

## 2.2 NEA indicators

We introduce the following five indicators in the second set and define quantitative and quality measure:

1. **(IA1) Methodology and models**
  - 0 – there is no published methodology for NEA usage
  - 1 – publishing of NEA usage methodology is planned
  - 2 – published NEA usage methodology, but only for a part of the development process
  - 3 – published complete NEA usage methodology
  - 4 – published several complete NEA usage methodologies
2. **(IA2) Model development interfaces**
  - 0 – no defined tools
  - 1 – usage of graphical model development tools with no automatic translation between models
  - 2 – usage of graphical model development tools with partial automatic translation between models
  - 3 – usage of graphical model development tools with complete automatic translation between models
3. **(IA3) Architectural standards and principles** – for each of the listed standards and principle 1 point is gain
  - Technical standards and principles
  - Conceptual standards and principles
  - Organizational standards and principles
  - Procedural standards and principles
4. **(IA4) IT Repository**
  - 0 – no defined repository
  - 1 – usage of several tools is planned, but no central repository exists
  - 2 – usage of repository that contains partial information of tools and libraries
  - 3 – usage of repository that contains partial information of tools, libraries and usage examples
  - 4 – usage of repository that contains complete information of tools, libraries and usage examples
5. **(IA5) Usage of development indicator** – 1 point is given for each of the listed development indicator
  - Qualitative measurements indicators
  - Performance measurements indicators like number of services/models etc...
  - Existence of NEA reevaluating administrative body
  - Other indicators

A further description of the used indicators is given in Table 3.

**Table 3.** NEA indicators.

<b>Indicator</b>	<b>Description</b>
<b>IA1 Methodology and models</b>	Evaluates the published methodology and models for NEA development.
<b>IA2 Model interfaces</b>	Evaluates the presence of graphical model development tools for NEA development.
<b>IA3 Architectural standards and principles</b>	Evaluates the presence and type of architectural standards and principles for NEA development.
<b>IA4 IT Repository</b>	Evaluates the presence of IT repository, containing the common architectural artifacts such as development tools, common information etc....
<b>IA5 Usage of development indicator</b>	Evaluates the presence of defined development indicators that measures the progress of NEA.

### 2.3 Evaluation

In our new methodology we propose normalization and calculation of indicator values' average. The final evaluation represents a sum of the both sets of indicators, described as follows.

The result from the first set of indicators (IS) is calculated with the use of the following formula:

$$IS = \frac{IS1 + IS2 + IS3 + IS4 + IS5 + IS6 + \frac{4 * IS7}{9}}{7}. \quad (1)$$

(1) represents the average of all e-government initiatives indicators and all the indicators that have the same weight. Following the same principle, the indicator IS7 is normalized to have value in the range between 0 and 4 (as the values of the rest of the indicators), since it's value may vary between 0 and 9. The maximum value that can be achieved is 4.

The result from the second set of indicators (IA) is calculated with the use of the following formula:

$$IA = \frac{IA1 + \frac{4 * IA2}{3} + IA3 + IA4 + IA5}{5}. \quad (2)$$

(2) represents the average of all NEA indicators and all indicators that have the same weight. By using the equality principle, the indicator IA2 is normalized to have values within the range of 0 and 4 (as the rest of the indicators), since it's value may vary between 0 and 3. The maximum value that can be achieved is 4.

The final result of the evaluation (IV) is calculated as a sum of the results of the both sets of indicators (with the following formula):

$$IV = IS + IA. \quad (3)$$

The maximum value that can be obtained with the use of the formula is 8.

### 3 Comparison to existing evaluating methodologies

As mentioned before, creation of a NEA methodology is a challenging process. Some reasons that make this process difficult are the following:

- Each country creates a national enterprise architecture according to the needs and the defined goals
- Not all the countries have the same goals and needs
- Different national governance models exists
- The defined national architectures are diverse and not easily comparable
- Different definition levels of NEA exists
- The national strategy documents are not always fully available in public or there not available at all
- Some countries publish their national strategies only in the national language
- The NEA state and progress in a lot of countries is constantly changing

A detailed and sophisticated NEA evaluation methodology has not been published yet. In this paper we introduce a new methodology that presents the most advanced indicators.

One of the most detailed studies on this subject is conducted by Christiansen and Gotze [4], but the results in their report are summarized for all the countries.

The study of Leist and Zellner [5] evaluates part of the well-known and often used frameworks, including few national architecture frameworks. This methodology includes only five constitutive elements and each of the elements is evaluated with only three levels of sophistication: fully accomplished, partly accomplished or not accomplished.

Another detailed study is conducted by the FEAR-project [2] to support the development of the Finnish NEA. This methodology includes evaluation framework that consists of seven viewpoints, and for each of them description of that part of the NEA is filled. That lack of this framework is that the results are only descriptions, so they are not easily comparable.

### 4 Results

Using the proposed framework we have conducted an evaluation of the values of few countries: Austria, Belgium, Canada, Denmark, Estonia, Finland, Germany, Macedonia, Netherland, New Zealand, Norway, Sweden, Switzerland, USA and United Kingdom. The results for each of the indicator sets are shown in Figure 2. The overall results are shown in Figure 3.

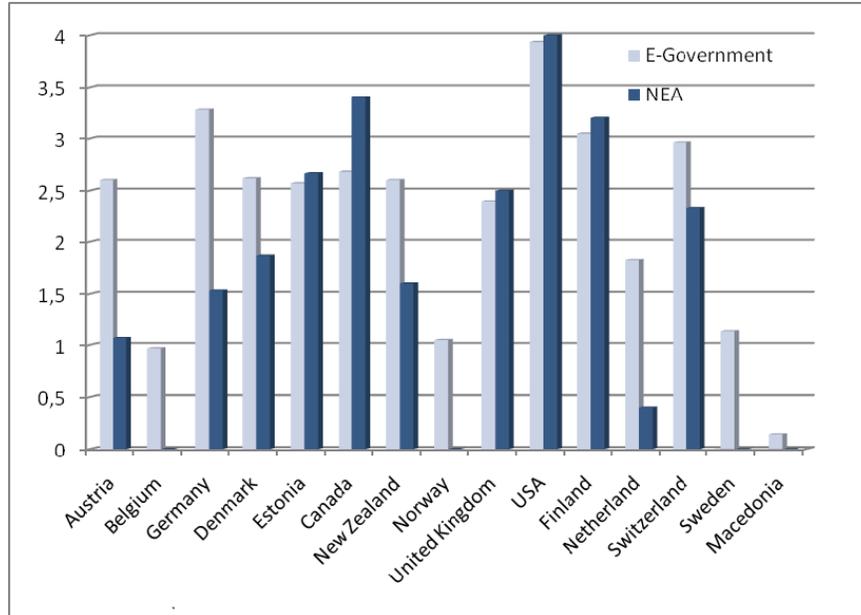


Fig. 2. Results for the E-government initiatives indicators and for the NEA indicators

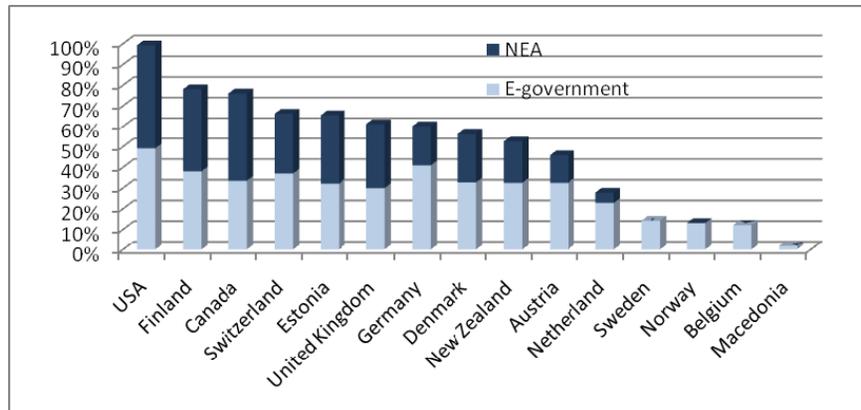


Fig. 3. Overall results

We can conclude that according to the proposed evaluating framework United States of America is the leading country in this area. The lowest values are for the Republic of Macedonia at the moment, although there is slight moving forward. In [12] we show that even if Republic of Macedonia accepts to apply the proposed national architectural framework, than the value of the country will rise for at least

50% of the current value, but will not reach highest level due to fulfillment of other indicators.

## 5 Conclusion

The proposed evaluating framework is unique and represents a hybrid and detailed evaluation model. As a starting point we used Information Society indicators [7]. Some of the indicators are defined according to the experience of the previous mentioned studies and for each of them we have defined several levels of sophistication. New indicators are additionally defined and also for each of them we have defined several levels of sophistication. The results gained by the proposed framework are comparable.

We believe that this new methodology will help all countries willing to introduce and update their NEA initiative to catch up with most advanced trends expressed by evaluation methodology and indicators introduced in this paper.

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