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Evaluation of e-Government information systems Agility: a Method and Case study

soumia Aggoune
University of mhamed bougrara BOUMERDES -ALGERIA, soumia.aggoune@gmail.com

Maohamed Amine Riahla
University of Mhamed bougara BOUMERDES ALGERIA, ma.riahla@univ-boumerdes.dz

1. Introduction

In order to e-government projects succeed, public services should be organized in a way to serve and satisfy each end-user (citizen or business) individually. Hence, service delivery should be tailored to the needs and requirements of the widest possible population of end-users regardless their access possibilities, skills, cultures and motivations, all based on dedicated information systems. These systems (E-government information systems (e-govIS)) help governments using modern ICTs to better interact with their citizens and businesses. They are different from the other information systems, in the fact that they encompass strategic goals that go beyond transparency, participation, social inclusion, trust-in-government, community-wellbeing; rather than financial ones such as value and financial returns. Therefore, the evaluation of such systems must include appropriate parameters that refer to the mentioned particularities.

So far, reviews and researches that were interested in evaluation of e-government projects, showed that the success of these projects strongly depends on the quality of their information systems [1], [2]. In addition, many literature reviews deals especially with the failure of e-government projects, in which, several studies [3] have shown that, it is not just e-government applications, but information systems in general that fail. The quality of e-govIS is thus, qualified as a critical success factor of e-government projects. However, the instability of the internal and external environments of these e-govIS, makes the agility an essential quality that conducts to dynamically accommodate environment changes and evolutions. Hence, it enhances their survival and sustainability.

Focusing on this scope, this work presents a novel method for evaluation of e-government information systems' agility. This method is based on "methods engineering" domain. Thus, it is made in the form of method-components. These components treat the two aspects of engineering: the **product** and the **process**. The product is "the result to research". The process is "the way which should be traversed to reach the result" [23]. Indeed, the product model prescribes what the awaited characteristics of the manufactured product are. The process model prescribes a manner of making, methodological steps to reach the target product.

Our proposed method is applied within a practical case study "e-Algeria" project-which, we conducted at the Ministry of Posts and Technologies of Information and Communication (MPTIC) leader of the project. E-Algeria [5] reflects the strategy of the Algerian government to make e-government a major level for establishing information society and digital economy, through the use of the most innovative ICTs for better public-service delivery and management. For that purpose, TAWASSOL framework (https://www.tawassol.dz/fr) is deployed to be the "one stop-shop" for government services. As far as the investments behind the implementation of this framework were too important, the MPTIC was called to present a review of 10 years since its launch in 2013 (2013-2023). This review allows the Algerian Government to build reports of what being made, avoid mistakes, learn from success and failure experiences (return on investment), and shape the direction of the "NEW ALGERIA" project portfolio 2023, in support of better government agenda. Wherein, the objective of our study is to evaluate the agility of TAWASSOL framework.

The structure of our paper comes as follows. The next section discusses the literature background of this paper-which is twofold. First, it reviews prior research dealing with the concept of agility. Then, it presents the existing state of the art dealing with agility evaluation approaches. In Section 3, we present our proposed approach in details. Right after in Section 4, we implemented a practical case study of TAWASSOL framework agility-evaluation where the empirical findings were consistent with the theoretical findings. Finally, conclusions are drawn and future research plans are discussed in the last Section.

2. Literature background

2.1 Agility concept

Agility is simply defined as the ability of an entity (system, organization, human, etc.) to quickly accommodate unanticipated changes in order to face threats of its environment. The concept of agility has been developed for the first time in the fifties within the domain of air combats. It was originally defined as the ability to change maneuvers in time [6]. At the early nineties, this concept has been extended to manufacturing systems. It was described as a new industrial order for competitiveness in a volatile manufacturing marketplace [8]. At the mid-nineties, and face to the software crisis of the 1960's, agility was introduced into software development upon the notion of agile methods [7]. Thereafter, the concept of agility was extended to business processes [20] and networks [9], enterprise information systems [10] decision support systems [11], supply chains [12] and so on. At the early twenties, the formation of Agile Alliance and the publication of the *Agile Manifesto* [13] have played a key role in the emergence of agility in the all fields of research -among them the e-government field which makes the object of this paper.

In the literature, there is no consensus yet on what agility exactly is. However, different facets of agility have been emphasized in the literature. According to[15], agility is more synonymous with the ability of reconfiguration. It is also defined as synonymous with vigilance [16], leanness [17], flexibility [18], reactivity [19] and sometimes with adaptability (Kidd 1994). Although all these synonymous have the same driving objective "**response to change"**, agility is distinguished in term of **speed** in responding to change. In this sense, [21] argued that the concept of speed is at the heart of agility.

2.2 Agility evaluation approaches

The existing works on agility evaluation can be mainly classified in evaluation of: e-government information systems agility [21], enterprise information systems agility [24], manufacturing systems agility [25], and the evaluation of information systems agility from socio-technical perspective [26].

Within the context of e-government, [21] proposed four principles for creating agility in e-government information systems -particularly in BPM (Business Process Management) systems-: (1) formulating the business process using business services, (2) integrating and orchestrating business services, (3) separating process, knowledge and resource; and (4) implementing policy by collaboration. Then, based on scenarios derived from the case study, the authors evaluate the level of agility using a set of quantitative and qualitative measures that are defined for each one of the four principles.

Within the context of enterprises, [24] proposed POIRE framework for the measurement of agility of enterprise information systems. POIRE refers to the five dimensions of an enterprise information system (EIS): Process, Organization, Information, Resources and Environment. According to POIRE, agility is measured according to agility factors that are defined for each dimension of the EIS using a set of evaluation criteria. Moreover, the authors proposed a mechanism for the regulation and preservation of agility. Regulation consists in equilibrating in time the levels of production and consummation of the EIS agility. Preservation consists in maintaining in time the EIS agility in a level, which will make it possible to maintain its durability (sustainability).

Within the context of manufacturing, [25] proposed a fuzzy logic-based framework to evaluate the agility of manufacturing information systems. In this framework, the agility is evaluated according to the four infrastructures of the manufacturing system: (1) production, (2) market, (3) people, and (4) information. These infrastructures are combined with their corresponding parameters to determine the overall agility of the system. Then, the assessment of agility is based on an approximate reasoning method taking into account the knowledge that is included in the fuzzy IF-THEN rules inference engine.

Finally, [26] proposed a framework to evaluate the agility of information systems from the socio-technical perspective. In this latter, the information system is considered as composed of two sub-systems: a technical system and a social system. The technical sub-system encompasses both technology and process. The social sub-system encompasses the people who are directly involved in the IS and reports the structure in which, these people are embedded within. To measure the information system agility using the socio-technical perspective, the authors used the agility of the four components: (1) technology agility, (2) process agility, (3) people agility, and (4) structure agility. The authors argued that, the overall agility of the system is not a simple summing of the obtained scores of agility in these four components, but it depends on their non-linear relationships. To this end, the authors used the fuzzy logic membership functions to evaluate agility.

2.3 Discussion

Although all the above presented works on agility evaluation are important -each one in the context in which it is applied-; two main common lucks can be observed: (1) the *universality* and (2) the *rigidity* of the proposed approach. Indeed, the presented works proposed generic evaluation approaches (global evaluation processes) that luck of the detailed guideline of activities. However, studies on the practice of methods (e.g. Ernest & Young reviews) highlighted faults and limits of universal methods. In this sense, [4] argued that universal methods are informal and non-precisely defined. They are narrowed by suggesting global sequential process without a *fine guideline* of activities. Practically, this leads to: (1) an ill apply of the method: inquiries showed that universal methods are never applied as it should be [28]; and (2) a supplementary work for managers [29]. To avoid these problems, a method should provide sufficient and detailed guideline of activities.

In addition, most of the mentioned works are characterized by the rigidity of the proposed approach, i.e. the non-ability to be adjusted to a specific constraints/situation of use. According to [30] universal methods generally treat all the projects (situations) as the same thing. However, practice proved that internal and external constraints of each project are different. By treating all the projects as same, methods conducts to an absence of value added for a particular project. To avoid this problem, a method should provide sufficient flexibility to be adapted/ adjusted to the specific situation in which it is applied.

It is against this backdrop that the domain of *situational methods engineering* was born [32]. The aim of situational methods engineering (SME) is to construct methods that can be adapted to the specific situations in which they are applied -while providing a fine guideline of activities.

Our presented work in the following section is based on situational methods engineering. It proposes a method for evaluation of e-government information systems (e-govIS) agility. This latter is made of 4 methods' components where each one of them provides a fine guideline of activities (process model), and proposes evaluation parameters and criteria that can be adjusted to the constraints of each e-govIS as well as its level of development/integration (product model).

3. The proposed method

3.1 The Product model

The product model (Figure1) shows the main concepts used by the method and the interactions between them. It is represented using the binary-existantially model, which defines two types of links between the concepts: the existency/dependency link and the generalization/ specialization link [2]. The former links two concepts where the source cannot exist without the target. For example, the concept "E-govIS part" cannot exist without the concept "E-govIS". The second links a more specialized concept (the source concept) to a more generalized concept (the target concept). For example, as shown in Figure 1, the concepts "FO part" and "BOpart specialize the concept "E-govIS part.

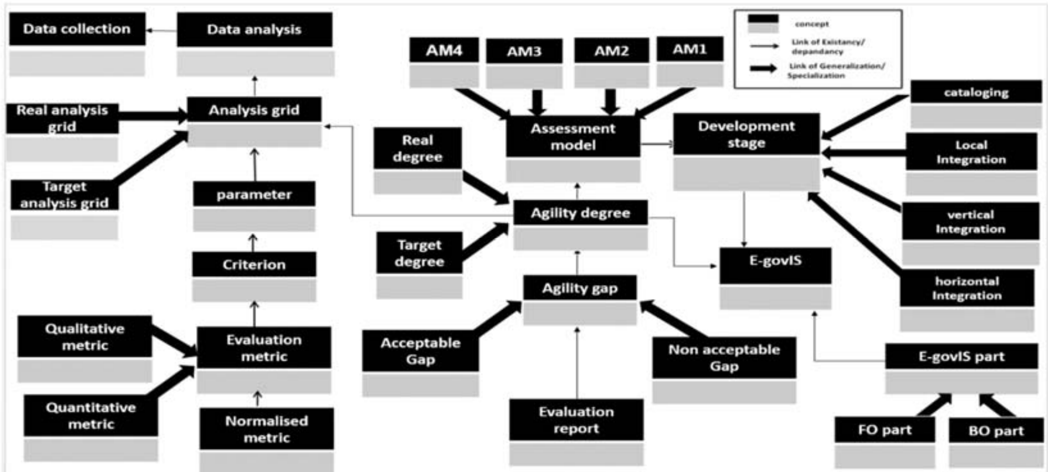

Figure1. The product model of the proposed method.

As shown the product model (Figure 1), the products of our method are:

- ANALYSIS GRIDS for agility-evaluation parameters and criteria.
- ASSESMENT MODEL for evaluation formulas.
- EVALUATION REPORT for recommendations and improvements.

3.1.1 ANALYSIS GRIDS

CONCEPTUAL ANALYSIS GRID

Front Office part

parameter	weight	criterion		weight	score
Availability		Availability of information	Availability of information for citizens		
			Availability of information for business		
		availability of services	Availability of citizens services for citizens (G2C)		
			Availability of citizens services for business (G2B)		
			Degree of Availability		
Accessibility		ultiplicity of acess mear	different ways of accessing services		
			different means of notification		
		layout of access means	provision of access means for the public		
			one click / free downloadable application		
			Degree of accessibility		
Facility		implicity of the interfac	Well-organized web-site (site-map)		
			clear and easy structure to follow		
		rch speed / execution sp	speed of performing services/obtaining information		
			interactivity (users-support)		
			Degree of facility		
Flexibility		xibility to end users choi	multi languages		
			multi-choice functions for services		
		flexibility to technology	flexibility to operation systems		
			flexibility to browsers		
			Degree of Flexibility		
integration		gle counter (One-stop sh	one stop shop for all services		
			one-stop-shop for all informations		
		Single folder	single file for all transactions		
			unique and automatic modification of information		
			Degree of integration		
security		privacy	confidentiality of transactions/exchanges		
			iintegrity of transactions/exchanges		
		electronic signature	non-repudiation of transactions/exchanges		
			single identity check		
			Degree of security		
Front Office degree of agility					

Back Office part

parameter	weight	criterion		weight	score
Adaptability		ptability of the internal organisa	tolerance for Adding new entities (process, activity)		
			tolerance for the elimination of existing entities		
			tolerance to modifications of existing entities		
			rapidity of adaptability of the organization		
			Degree of Adaptability		
Flexibility		Flexibility of IT ressources	Flexibility of softaware ressources		
			Flexibility of hardware ressources		
		Flexibility of solutions	Flexibility of processed data (adding/delete/modification)		
			echnology compatibility (Operating Systems, Browsers, et		
			Degree of Flexibility		
Reliability		official information sources	official sources/databases		
			reliable data (correct, non-contradictory, unambiguous)		
		Updating and completeness	up-to-date information and data		
			complete information and data		
			Degree of Reliability		
Sustainability		Evolutivity	ability to extend/adjust technology		
			technology watch and monitoring		
		Lifetime	maintenance / warranty		
			re-use		
			Degree of Sustainability		
Integration		integration level	level1: cataloging (static online presence)		
			level2: local intagration		
			level3: vertical intagration		
			level4: horizontal intagration		
			Degree of Integration		
Security		content safety	security of exchanges/transactions		
		container safety	sécurity of networks		
			security of physical supports		
			security of logical supports		
			Degree of Security		
Back Office degree of agility					

Overall Degree of Agility

Figure 2. Prototype screen of the conceptual analysis grid

To evaluate agility, we start first by constructing the conceptual **analysis grid** (Figure 2). This latter is obtained from **data collection** (as shown the product model in Figure 1)**,** i.e. after the presented literature survey in Section 2, we established a list of **parameters** consisting our subject of interest "**agility of e-government information system"** according to its two fundamental parts: the "e" part (Front Office) and the "government part" (Back Office).

To measure the Agility of a given parameter (P_i), we use formula (1):

$$A_{Pi} = \sum_{j=1}^{NC} C_j / NC \qquad (1)$$

Where:

- A_{pi} : Agility of the parameter P_i ;
- C_j : metric of the j^{th} criterion of the parameter Pi;
- NC: number of criteria of the parameter Pi.

To measure the Agility of a given part of the e-AIS (FO or BO), we use formula (2):

$$A_{part} = \sum_{i=1}^{NP} A_{Pi} / NP \qquad (2)$$

Where:

- A_{part} : Agility of the considered part; part € {FO, BO}
- A_{pi}: Agility of the i^{th} parameter of the part;
- NP: number of parameters of the part;

Finally, to measure the overall Agility of the e-AIS, we use formula (3):

$$A_{e-AIS} = A_{FO} + A_{BO} / 2 \qquad (3)$$

Where:

- $A_{e\text{-}AIS}$:overall degree of Agility of the e-AIS
- A_{FO}: Agility of the FO part.
- A_{BO} : Agility of the BO part.

3.1.2 The assessment model

In order to better apprehend agility, our approach, defines four agility assessment models according to the four levels/stages of the e-government system's development (Table 1). Practically, these levels are explained by the level of integration of the considered e-govIS-as shown in Table 1.

E-government development stage	Description	Assessment model (AM)
Stage1 : Cataloguing	Static Online presence, Information/Catalogue presentation, Downloadable forms	AM1 Formulas **(1), (2) , (3)**
Stage2: Interaction (Local Integration)	Online Services and transactions at Local systems.	AM 2 Formulas **(1), (2), (3bis)**
Stage3: Vertical integration	Local systems linked to higher level systems, (state, federal)	AM3 Formulas **(1), (2bis), (3bis)**
Stage4: Horizontal integration	Integrated systems across different functions/applications, **One-stop shopping for citizens.**	AM4 Formulas **(1bis) ,(2bis), (3bis)**

Table 1. Agility assessment models according to the e-govIS stage of development

Hence, the complexity of the assessment model is on linear relationship with the stage of development of the e-govIS (Figure 3)

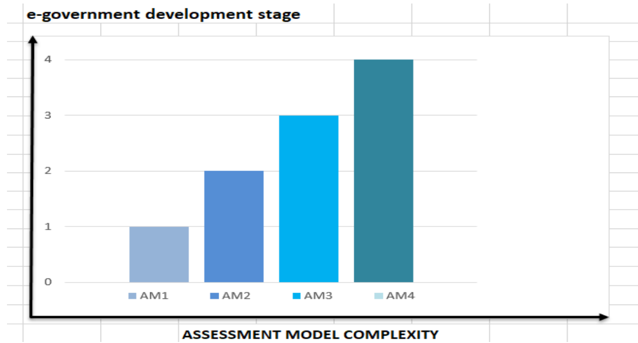

Figure 3. Complexity of the Assessment model according to the e-govIS development stage.

Stage 1: Cataloguing

In this beginner stage, the focus of governments is only on the online presence. For that, we define a simplified assessment model (AM1), which assumes that FO and BO parts; as well as, all their corresponding parameters and criteria have the same weights. This model evaluates agility using precedent formulas (1), (2) and (3).

Stage 2: local integration

In this stage of development, systems at local level tend to integrate all/or part of their business process (BO) within their electronic portal (FO). For this purpose, we extended the precedent assessment model (AM1) to AM2 by attributing weights for FO and BO parts. This model evaluates agility using previous formulas (1), (2), and the following formula (3 bis):

$$A_{e-govIS} = (A_{FO} * \lambda_{FO}) + (A_{BO} * \lambda_{BO})/(\lambda_{FO} + \lambda_{BO}) \qquad (3bis)$$

Where:

- $A_{e\text{-}govIS}$: Agility of the e-govIS;
- A_{FO}: Agility of the FO part;
- λ_{FO}: is the weight of FO part;
- A_{BO}: Agility of the BO part;
- λ_{BO}: is the weight of BO part.

Stage 3: Vertical Integration

A natural progression of local integration would be the vertical integration of scattered local systems at higher levels of the government (state and federal) (Figure 4). If a citizen conducts a transaction with a local agency, the transaction information will be propagated to state and federal counterparts and vice-versa.

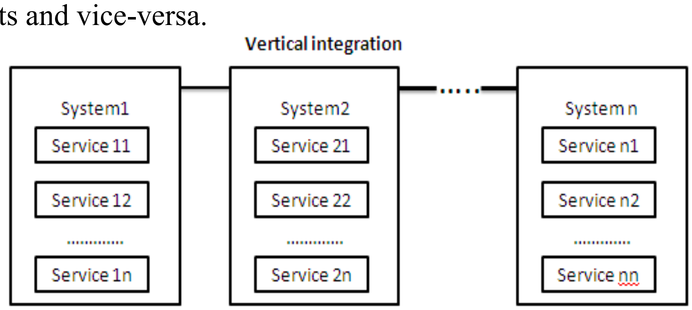

Figure 4. Vertical integration

In this level, some parameters like integration and **security** may become more important than the others. For this purpose, we extended the previous assessment model (AM2) to AM3 by attributing weights for both: parts and their corresponding parameters. This model evaluates agility using precedent formulas (1), (3bis) and the following formula (2bis)

$$A_{part} = \sum_{i=1}^{NP} A_{Pi} * \lambda_{Pi} / \sum_{i=1}^{NP} \lambda_{Pi} \quad (2bis)$$

Where:

- A_{part} : Agility of a given part of the e-govIS ;
- A_{pi} : Agility of the parameter i;
- λ_{Pi}: The weight of the parameter i;
- ND: number of parameters;
- part € {FO, BO}.

Stage 4: Horizontal Integration

While the vertical integration consists in integrating the e-govIS across different levels of governments. The horizontal integration (Figure 5) consists of integrating the e-govIS across different functions and services. Doing so, a transaction in one agency can lead to automatic checks against data in other functional agencies.

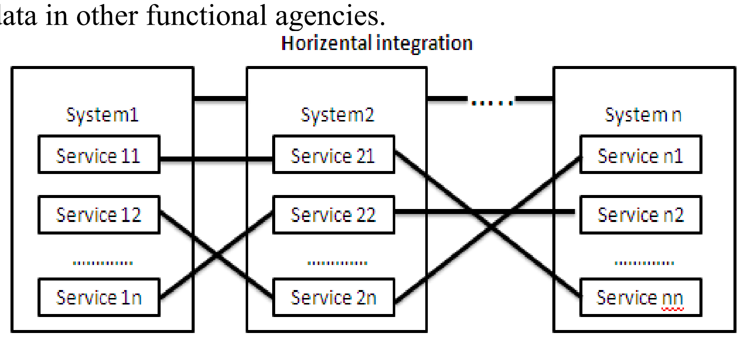

Figure 5. Horizontal integration of the e-govIS.

The horizontal integration of government services across different functions of government will be driven by particular criteria such as communication and integration technologies, format of compatibility of electronic data interchange, etc. i.e., within the same parameter. Some criteria may become more important than others. For this reason, we extended the previous assessment model (AM3) to AM4 by attributing weights for parts, parameters and criteria as well. This model evaluates agility using formulas (2bis), (3bis) and the following formula (1bis):

$$A_{pi} = \sum_{j=1}^{NC} C_j * \lambda_{cj} / \sum_{j=1}^{NC} \lambda_{cj} \qquad (1bis)$$

Where:

- A_{pi}: Agility of the i^{th} parameter;
- C_j : metric of the j^{th} criterion of P_i;
- λ_{Cj}: is the weight of the criterion j;
- NC: number of criteria of P_i.

In this section, we presented the overall principle of e agility evaluation. The detailed steps of evaluation (process model) are presented in the following section.

3.2 The process model

In this section, we present the process model of our method (Figure 6) by the MAP formalism [32]. The MAP is a labeled directed graph where the nodes are intentions whereas the edges are labeled with strategies to achieve these intentions. **Start** and **end** are standard intentions of MAP that mark respectively the beginning and the end of the process. Several strategies are can be used to achieve the same intention.

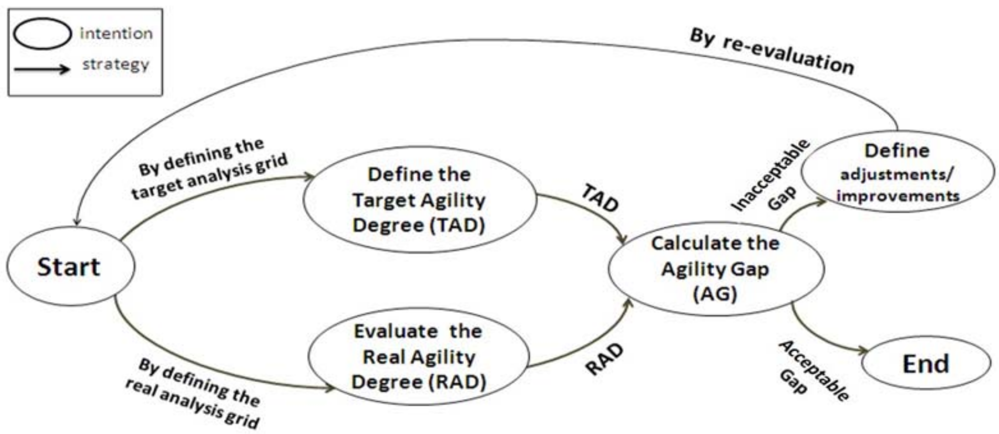

Figure 6. Process model of the proposed method

Within methods engineering, the decomposition of a method into components means the decomposition of its process model **into method components**. As shown Figure.7, the process model of the proposed method is decomposed into four components as follows:

3.2.1 Defining the Target Degree of Agility (TAD)

The TAD is a quantitative objective of agility. i.e, the degree to be achieved /should be reached by the system under study. Definition of the TAD is based on constructing the target analysis grid as follows:

- (1) Setting agility metrics (from [1 to 5]) for each criterion in the conceptual analysis grid so that each metric represents the ideal score a criterion should have in the considered e-govIS. To this end, collaboration with experts and head managers may be necessary to determine the extent (from [1 to 5]) to which a criterion should be scored.
- (2) Evaluating the agility of parameters by using formulas (1) or (1bis)[1].
- (3) Evaluating the agility of e-govIS parts using formulas (2) or (2bis).
- (4) Finally, evaluating the overall Target Agility Degree (TAD) of the e-govIS using formulas (3) or (3bis)[2].

3.2.2 Evaluating the Real Degree of Agility (RAD)

The evaluation of the RAD is based on constructing the real analysis grid as follows:

- (1) Setting agility metrics (from [1 to 5]) for each criterion of the conceptual analysis grid according to the collected data from the case study. We distinguished two types of data: formal and informal. Formal data comes mainly from the questionnaire which is designed based on agility parameters' and criteria that are defined in the conceptual analysis grid. Informal data come from interviews, observation and analysis of the legacy system, internal statistics, reports, and publications. Once data is collected, each criterion is scored on a scale of [0.5] points based on the perception of its level of applicability.
- (2) After data collection, we proceed for data analysis. We start first by confirming Whether each sample of criteria captures its corresponding parameter or the sample of parameters captures the construct of agility. To end this, we first calculate reliability coefficients (coefficient Cronbach's alpha) [33] with an acceptance level at least 0.7.

[1, 4] the choice of the appropriate formula depends on the level of integration of the E-govIS (as explained in section 4.1).

Then, we establish the correlation matrix using the Churchill's recommendation [34]*: "a sample of items can be purified by examining each corrected item to total correlations; and then desecrating items whose elimination improved reliability of the construct until no item's removal increased the construct's overall reliability".* As final task of data analysis, we check for discriminant validity problems [35].by making sure that there are no criteria that correlate more highly with criteria measuring different parameters than they do with criteria of their corresponding parameter. After an appropriate number of data analysis rounds, (Churchill's recommendation) parameters can be refined by reducing their corresponding samples of criteria, and the conceptual grid can be refined by reducing its parameters sample.

- (3) Evaluating the agility of parameters using formulas (1) or (1bis).
- (3) Evaluating the agility of e-govIS parts using formulas (2) or (2bis).
- (4) Finally, evaluating the overall Real Agility Degree (RAD) of the e-govIS using formulas (3) or (3bis).

3.2.3 Calculating the Agility Gap (AG)

Here, we define the Agility gap (AG) as the difference between the target agility degree (TAD) and the real agility degree (RAD).

We calculate AG by:

- (1) Calculating the difference: AG = TAD – RAD.
- (2) Concluding by the mentions of:

$$\begin{cases} \text{Acceptable Gap} & \text{if AG is low or very low (AG } \in [0, 2]). \\ \text{Inacceptable Gap else} & \text{(AG } \in]2, 5]). \end{cases}$$

With: $0 \leq$VeryLow≤ 1; $1 <$low≤ 2; $2<$Average≤ 3; $3<$High≤ 4; $4<$Very high≤ 5.

Practically, the Acceptable Gap means that the "gap" between the target and the real agility degrees is low. Indeed, the considered e-govIS is agile in which the case evaluation is ended. In Figure 6, the Inacceptable Gap means the contrary, i.e. the gap between the target and the real agility degrees is high, the considered e-govIS is not agile. Thus, improvements and adjustments are needed (Figure 6).

3.2.4 Defining the adjustments and improvements (evaluation report)

To determine the necessary adjustments and improvements, a mapping between the target analysis grid and the real analysis grid is necessary in order to determine non-agile parameters on which work must be focused. Non-agile parameters are determined as follows:

- (1) Calculating the gaps (AG) for all pairs of -target and real agility degrees of the parameters.
- 2) Concluding by the mentions of:

$$\begin{cases} \text{Agile parameter} & \text{if AG is low or very low.} \\ \text{Non agile parameter else} & \end{cases}$$

With: $0 \leq$VeryLow≤ 1; $1<$low≤ 2; $2<$Average≤ 3; $3<$High≤ 4; $4<$Very high≤ 5

4. Case-study : E-Algeria

4.1 Background and objective

Like many other developing countries, the positioning of our country on the international scene of e-government development showed that Algeria is at the bottom of the ranking and ranks among the countries with a low score. In order to improve this positioning, our government lunched e-ALGERIA project as a National Development Strategy in E-government.

E-ALGERIA was launched in 2013 by the Ministry of Posts and Technologies of Information and Communication (MPTIC). It reflects the strategy of the Algerian government to make e-government a major lever for establishing information society and digital economy. To achieve this objective, E-Algeria is based on a rigorous action plan, that is articulated around thirteen (13) major axes[5]. For each one-of-them, an inventory on the current situation was drawn up, followed by a definition of specific objectives to be achieved over the next five years as well as a list of actions for their implementation.

The first major axe of E-ALGERIA strategy (e-Algeria 2013) is the development of a “one-stop-shop” for government services -through which citizens can access to services of all "events of life-. For that purpose, “**TAWASSOL”** framework (https://www.tawassol.dz/ar) - which means in Arabic framework for transactions and communication. It has been implemented as an independent communication space of the physical location that affirms the availability of information and services anywhere, anytime and anyhow. This framework aimed to facilitates the understanding of the administration by the citizen, reduce waiting times, reduce operating costs for both citizen and government simplify/lighten administrative processes and make them more transparent. Indeed, it provides a large panoply of public services, ranged in 12 categories: Civil status; Vehicle Numbering; National identity card; Housing; Driving license; Biometric passport; accelerated passport, Civil life; burial and transfer of bodies, activities (https://www.tawassol.dz/en/steps).

The objective of our study in which we conducted within the Ministry of Posts and Technologies of Information and Communication (MPTIC) was to apply our proposed method to evaluate the Agility of TAWASSOL framework.

4.2 Data collection

For data-collection, Primary and secondary data were used in the study. The primary data were collected from the online survey which was conducted by e-mail-questionnaire to selected staff of the MPTIC (Table 2). Whereas, the secondary data were gathered from the MPTIC formal sources (databases, internal reports, official statistics, and publications) and informal sources (face to face interviews, observation and analysis of existing system).

Directions	**Number of respondents**	**Percent**
Information system	45	39%
Technology Services	20	18%
Legal businesses	15	13%
ICT Development	15	13%
Statistics	8	7%
Human Resources	11	10%
Total	113	100%

Table 2. Proportion of respondents by direction.

The questionnaire

The questionnaire is designed upon the sample of agility criteria of the conceptual analysis grid. Each criterion is scored in a likert-five scale point [0, 5] according to the respondent perceptions about the level of applicability of the criterion (0≤VeryLow≤1; 1<low≤2; 2<Average≤3; 3<High≤4; 4<Very high≤5). We advised the respondents to carefully select their responses, ensuring that they are willing engaged participants in the study and will answer the questions with the minimum degree of bias. The feedback from the questionnaire is used to purify the conceptual grid using an appropriate number of data analysis rounds.

4.3 Data analysis

4.3.1 Test of Reliability (first round)

During data analysis, we started –first- by reliability test. For that Cronbach's coefficient alpha with an acceptance level at least 0.7 [33] is estimated as an indication of how each sample of criteria performs in capturing their corresponding parameter; and (2) how the sample of parameters capture the construct of Agiliy for both parts of the system: FO and BO.

Coefficient alpha values (Table 3) ranged from 0.86 to 0.89, exceeding the conventional minimum of 0.7 and demonstrating high internal consistency among criteria and among parameters; thus reliability of parameters and reliability of the overall conceptual grid.

FO parameters	Coefficient alpha	BO parameters	Coefficient alpha
Availability	0,873	**Adaptability**	0,867
Accessibility	0,878	**Flexibility**	0,861
Facility	0,867	**Reliability**	0,869
Flexibility	0,869	**Sustainability**	0,863
Integration	0,882	**Integration**	0,866
Security	0,881	**Security**	0,872
Overall	**0,876**	Overall	**0,861**
Total Cronbash alpha			**0.868**

Table 3. Cronbach's alpha values (1st round).

4.3.2 Correlation matrix

In order to achieve higher levels of reliability (the maximum close to 1), correlation analysis was conducted first among criteria (to discard criteria with low scores from parameters), and then among parameters (to discard parameters with low scores from the grid). As a result, the conceptual analysis grid was purified according to Churchill's recommendation [34]. Due to the size of the criteria's correlation matrix (33 criteria), we present only the parameters' correlation matrix (Table 4 and Table 5).

	Availability	Accessibility	Facility	Flexibility	Security	Integration
Availability	1,000					
Accessibility	0,793	1,000				
Facility	0,789	0,764	1,000			
Flexibility	0,786	0,728	0, 758	1,000		
Security	0,756	0,710	0,756	0,793	1,000	
Integration	-0,015	-0,035	-0,038	-0,019	-0,021	1,000

Table 4. Parameters correlation matrix (FO part)

	Adaptability	Flexibility	Reliability	Sustainability	Integration	Security
Adaptability	1,000					
Flexibility	0,787	1,000				
Reliability	0,789	0,772	1,000			
Sustainability	0,764	0,781	0, 785	1,000		
Security	0,781	0,750	0,886	0,893	1,000	
Integration	-0,028	-0,021	-0,023	-0,027	-0,025	1,000

Table 5. Parameters' correlation matrix (BO part)

As shown in the correlation matrix of both FO and BO parts (table 4), (table 5), integration parameter is low correlated (negative value) with the other dimensions; thus it is discarded from the analysis grid. This can be interpreted as: although integration is a crucial parameter, it has nonlinear relationship with the other parameters of agility. This is because **TAWASSOL** framework is in its first stage of integration (cataloging), thus the issues of integration are not yet considered. On the other hand, the criteria correlation matrix showed some low correlations (<0, 4) that correspond to the integration parameter in which these criteria are discarded too from the analysis grid.

After discarding the parameter integration with their corresponding criteria, we proceed for a second round of data analysis to check improvements in reliability coefficient results.

4.3.3 Test of reliability (second round)

Reliability coefficients are re-calculated as shown in (table 6)

FO parameters	**Coefficient alpha**	**BO parameters**	**Coefficient alpha**
Availability	0,957	**Adaptability**	0,912
Accessibility	0,936	**Flexibility**	0,951
Facility	0,961	**Reliability**	0,969
Flexibility	0,915	**Sustainability**	0,887
Security	0,989	**Security**	0,934
Overall	**0,972**	Overall	**0,964**
Total Cronbash alpha			**0.968**

Table 6. Cronbach's alpha values 2nd round.

Table 6 shows clearly that reliability coefficients obtained in this second round are much higher (close to 1) compared to those obtained in the first round. In fact, parameters coefficient alpha values ranged from 0.887 to 0.989, exceeding those that had been obtained in the first round (ranged from 0,861 to 0,882); and, the overall coefficient alpha (0,968) is higher than the one obtained in the first round (0,868). Hence, a high reliability of the collected data.

4.3.4 Test of validity

As final task of data analysis, we checked discriminant validity [35] problems by making sure that there are no criteria that correlate more highly with criteria measuring different dimensions than they do with criteria of their corresponding dimension. For that purpose, we tested all possible pairs of the 20 criteria. According to [35], a low to moderate correlation value is considered as an evidence of discriminant validity. As a result of this step, there was no discriminant validity problem; thus, the validity of the collected data.

4.4 Real Agility Degree (RAD)

Once data is reliable and valid, we can evaluate the real agility degree (RAD). So, we need first to choose the appropriate assessment model (as explained in section2). **TAWASSOL** framework is still the early stage of development (stage 1 cataloguing), then we use (AM1). The following prototype screen (Figure 7) shows the assessment of the RAD.

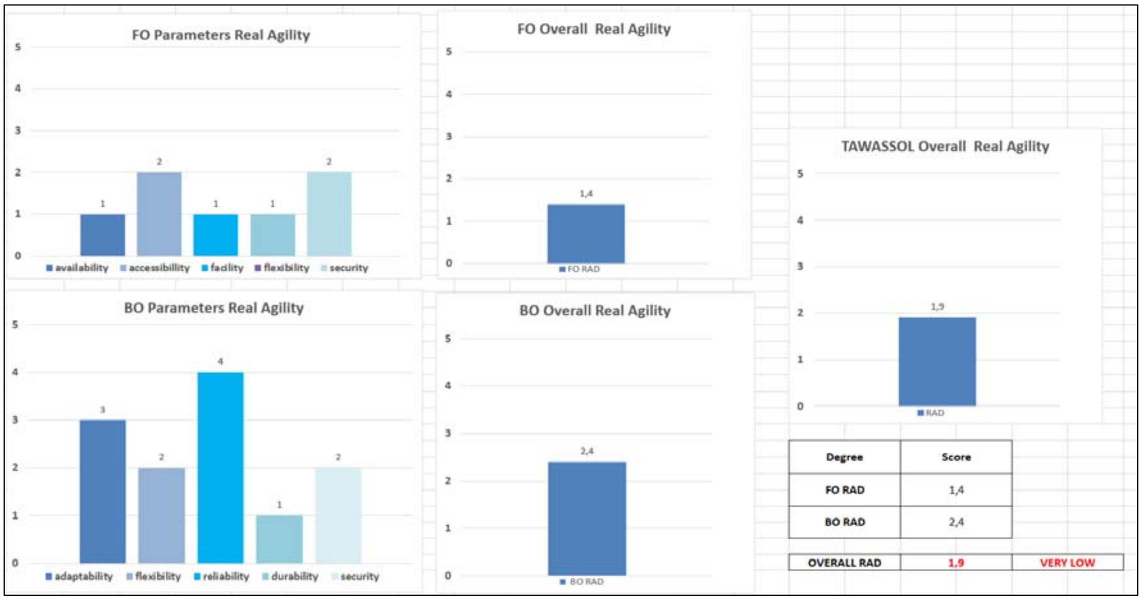

Figure7. Prototype screen of RAD assessment.

4.5 Target Agility Degree (TAD)

The following prototype screen (Figure 8) shows the assessment of the TAD

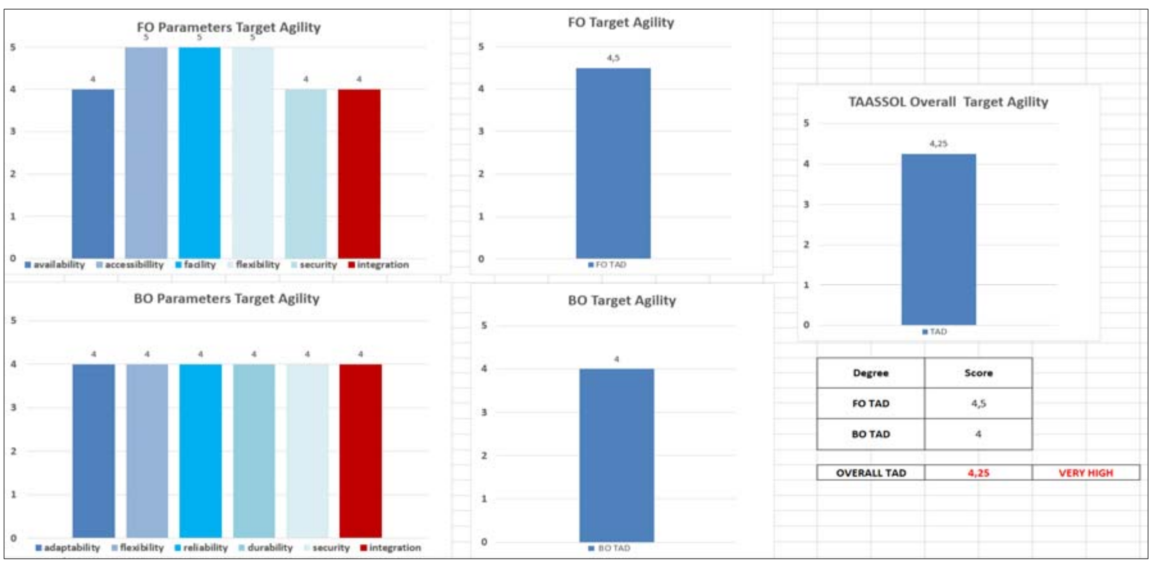

Figure 8. Prototype screen of TAD assessment.

4.6 Agility Gap

After measuring the RAD and the TAD, we can measure the agility gap (AG) as follows:
AG = TAD – RAD
AG= 4.25 - 1.9.
AG=2.35
The following prototype screen (Figure 9) shows the assessment of THE AGILITY GAP (AG)

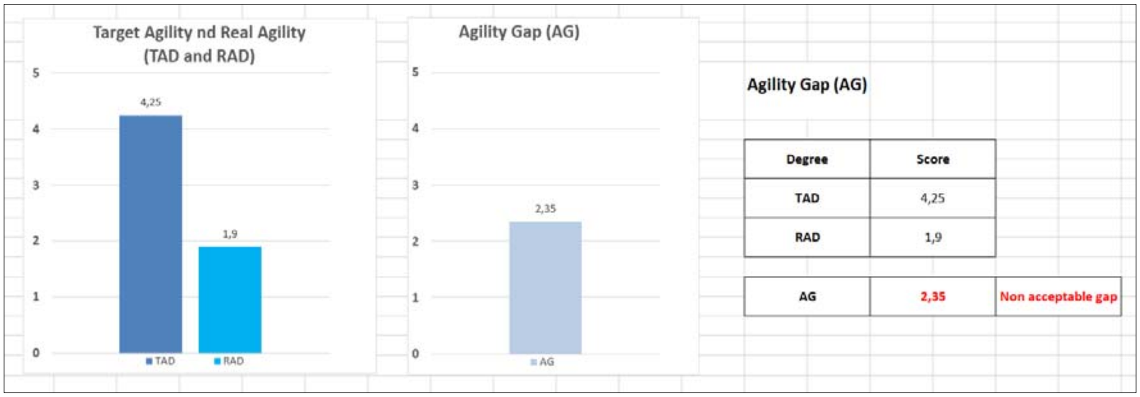

Fig 9. Agility Gap assessment.

Indeed, the obtained gap IS not acceptable. Therefore, recommendations for improvements are defined within the EVALUATION REPORT in order to achieve a better score of agility degree (close to the target degree).

4.7 Recommendations for improvements (Evaluation Report)

This practical study showed that, although TAWASSOL framework is in the earliest stage of development (cataloging), there is a high gap (AG=2.35) between the objectives of the framework as a project (TAD = 4.25) and its actual implementation (RAD= 1.9). This means for the MPTIC heads, the engagement of adequate improvements on the current configuration of the framework for both FO part, as well as, the related BO part in order to meet the whole objectives of its implementation. To this end, a mapping between the target and real agility degrees of parameters has been made to determine non-agile areas (figure.10 and figure 11) on which work and effort must be focused.

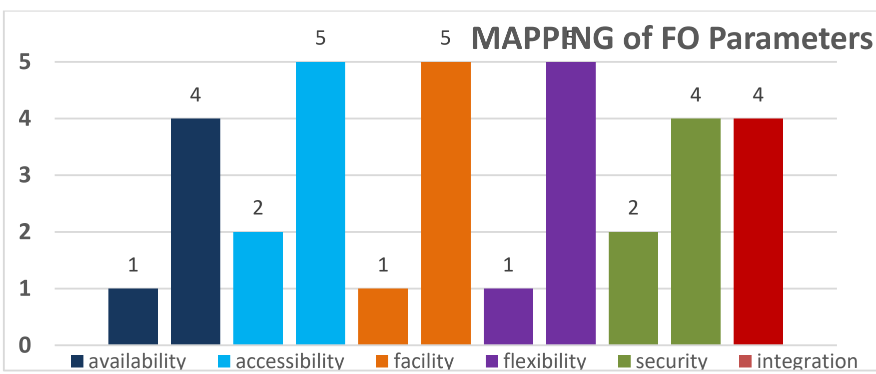

Figure 10. Mapping between the target and the real agility degrees of FO parameters

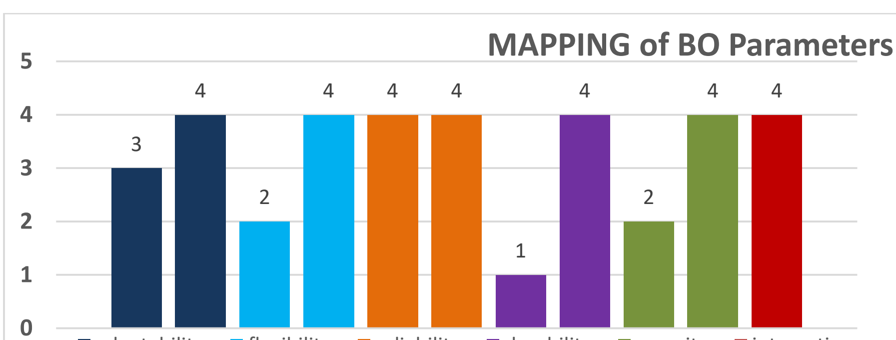

Figure 11. Mapping between the target and the real agility degrees BO parameters.

Based on this mapping (Figure10 and Figure11); non-agile parameters are visibly and easily determined. i.e, parameters with low and very low real-scores of agility compared to target-scores. Indeed, availability, flexibility, and security are qualified as non-agile parameters. Accordingly, we recommend the following improvements:

In terms of Availability: Information and services on TAWASSOL need to be reviewed. First; the amount of information that interest stakeholders in the field is very poor and not up to date: poor news; poor data and information, lack of explanations, etc. As improvement, we recommend the definition of an appropriate publication policy and update frequency. Practically, this necessitates the deployment of an entire entity (department, cell) that has business process the publication and the update of information on the framework.

In terms of services: although services icons exist and well ranged in categories on the interface of TAWASSOL, they cannot be completely performed except fulfilling some forms. This because functions and applications are not yet integrated. As a logical improvement, we recommend vertical and a horizontal integration of TAWASSOL framework across local, state and federal levels of the government to achieve the objective of this framework "one stop shop" for government services.

In terms of Flexibility: Except the flexibility of the framework with languages, this parameter is neglected in all its other dimensions. For example flexibility with end users choices for performing an option/service, such as: choosing the date and time to have an appointment, choosing a method of paying fees, choosing the means of receiving notices, etc. in addition TAWASSOL is not flexible with end-users errors; bad manipulations; complaints/grievant, etc. As improvement, we recommend a working group/ team specializing in sanding on stockholders' behavior, culture, educational level, requirements, preferences, etc. This can be achieved by different ways, integrating complaints field within the framework, collecting data from complaints registers that are available in all the government's public institutions and administrations and finally by conducting on-line as well as off line surveys (sondages). By the time, Data processed contributes to improve flexibility.

In terms of Facility: Although TAWASSOL presents a simplified interface with, clear items and well organized structure. It lacks facilitation options like**: help** and **research** topics**, follow-up** of requests option, **interactive agents for Q&R; virtual assistant technology** as well as the lack of facilities **for disabled people/ people with specific needs** (such as the use of voice for the blind, for example). As enhancement, we recommend the enrichment of the framework by all possible facilitation options in order to meet the widest population of stockholders, promote social inclusion, and decrease social discrimination.

Finally, being convinced by the importance of evaluating of agility as an effective tool for continuous improvement in the perspective of sustainability, the MPTIC was planned within a strategy of sustainable development, the evaluation of TAWASSOL framework continually with the frequency of one time by year.

5. Conclusion

In this paper, we presented the main approaches dealing with agility evaluation of information systems according to different contexts/domains (e-government, enterprises, manufacturing). Although all these approaches are important each one in the context in which it is applied. They are all characterized by the universality and rigidity of the methodological process. However, studies on the practice of methods highlighted faults and limits of universal methods. In addition, internal and external constraints of each project are different. By treating all the projects as the same, universal methods leads to an absence of added value for a particular project.

To respond to the problems of generality and rigidity of methods, the domain of Situational Methods Engineering (SME) was born (Welke & Kumar, 1992). The aim of SME is to construct methods that can be adapted to the specific situations in which they are applied. Accordingly, our proposed method defines operational parameters and criteria that can be adjustable in function of the goal and the context of evaluation as well as the complexity of the considered system.

Practically, the main advantages of this method are:

- Agility is measured by quantitative metrics which allow decision-makers to assess and monitor the improvement of the e-govIS in real time, and examine and compare different systems at different agility levels.
- By dividing the e-govIS in two parts (FO and BO), agility is measured based on their corresponding operational parameters and criteria. This allows to easily detect (i) less, or non-agile parts, as well as (ii) less, or non-agile parameters (within the same part), on which work and effort must be focused.
- Applicable method regardless the stage of development of the e-govIS, as, it defines four assessment models according to the four stages of e-government development.
- Finally, as the process of evaluation is based on a comprehensive questionnaire that encompasses almost all operational parameters of Front Office and Back Office parts of the system. The feedback from this questionnaire is very useful as it can be part of the knowledge acquisition procedure of any knowledge-based evaluation for the organization.

The proposed method was applied in a real case study E-Algeria 2013 as part of the review of 10 years since its launch. The objective was to evaluate agility of TAWASSOL framework that is designed to be one-stop-shop for government services. The evaluation showed a low degree of agility, improvements are recommended for MPTIC heads to improve agility of the framework. So far, our proposed method is implemented via a software prototype with limited functionalities. An immediate perspective for this work is to implement it on an expert system which assists the collection of information & data analysis, automates the calculations, interprets the results and recommends the improvements.

The ULTIMATE perspective for our method, is that it be a tool for management and continuous improvement for all the levels of the government of the Algerian state providing a dashboard with indicators and alerts of agility management facilitating the decision-making process.

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