A Methodological Approach for the Assessment of Organizational Interoperability Maturity

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The accomplishment of interoperability between public administrations is considered to be a crucial factor for the delivery of efficient, cost-effective and transparent public services. There are still many challenges and limitations to be faced, due to technical, semantic, legal and organizational factors. This paper highlights the importance of organizational interoperability in e-Government as wells as the need for its successful assessment, in order to define the gaps and to suggest improvements. A brief literature review on existing assessment tools, frameworks and models is provided. A methodological approach for the assessment of organizational interoperability maturity is thoroughly presented.

Keywords: organizational interoperability, assessment, digital service, maturity models

INTRODUCTION

Improved interoperability between public organizations and between public and private organizations is of critical importance for a successful e-Government 0. The integration of government information resources and processes and thus the interoperation of independent information systems are essential to accomplish agile, citizen-centric, accountable, transparent, effective and efficient governmental services 0.

There are a number of European Commission directives that indicate the crucial impact of interoperability on information society. Interoperability is presented as one of the main principles in the Digital Single Market (DSM) Strategy for Europe – EU e-Government Action Plan 2016-2020 0. Several public programs and projects such as ISA^2 (Interoperability Solutions for Administrations) were funded by

the European Commission as well as observatories on e-Government issues such as NIFO (National Interoperability Framework Observatory) were created. Moreover, several national interoperability strategies, action plans, and IS frameworks were established in the last 5 years in order to highlight the importance of interoperability for public organizations.

Despite the recognition of the importance, the money and the effort already invested in the pursuit of improved collaboration between different organizations, the level of interoperability remains far from adequate. Rezaei 0 identifies three main categories of interoperability barriers: organizational, conceptual and technological incompatibility.

Interoperation between public organizations remains an enduring challenge due to organizational differences such as different organizational structures and different management processes 0. Many researchers consider organizational interoperability to be a crucial factor for a successful e-Government 0, 0 0. Since organizational interoperability is so important for a successful e-Government, public administrations should be equipped with a method/tool that will help them to identify the gaps and determine the weaknesses and deficiencies in order to overcome the existing barriers. All this diagnosing procedure would finally lead to suggestions for improvements or to an Interoperability Transition Plan for further adopting and implementing e-Government initiatives 0.

BACKGROUND

Integration, information sharing and interoperability in government have become of major interest 0. Current research focuses on open issues in organizational interoperability between public organizations. Digital government initiatives face serious challenges since the required level of interorganizational collaboration and trust is often not supported by existing institutional arrangements, organizational structures and management processes 0. Lack of commonly agreed processes, difficulties in interpreting administrative procedures and legislation, difficulties in defining authorities and responsibilities are some of the reasons which justify why cross-border and national interoperability have not yet been achieved 0.

According to Hjort-Madsen 0, the complexity of organizational aspects of interoperability may surpass the technical issues as the public organizations move toward inter-organizational governance. Gottschalk 0 describes that the interoperability in not only a technical subject, but there is a need to conceptualize the organizational aspects of interoperability. Margariti 0 highlights the importance of organizational interoperability in e-Government, along with its relevance to governance, open data policies and information sharing. Recent research attempts to clarify and re-conceptualize the layer of organizational interoperability by introducing an empirically based conceptual framework 0 where the need for redefining organizational interoperability is also presented and proposed to be renamed to "business process interoperability".

Evaluation of the degree of organizational interoperability is necessary in order to overcome the barriers towards information integration. Evaluation process includes definition of metrics so as to assess the maturity level and afterwards to make suggestions for further improvement. The assessment of the maturity level is accomplished with the aid of a maturity model through which an organization can identify its current capability status and its desired capability maturity level 0.

Models and Frameworks

There are many research papers presenting interoperability assessment models 0, frameworks 0, technology maturity indexes and matrixes 0, 0, methodologies and guidelines that can help an organization improve the way it operates and thus achieve desired interoperability objectives.

Existing interoperability maturity models that are commonly referred to literature and utilized by organizations in national and/ or international level are the following:

- LISI (Levels of Information Systems Interoperability) 0 which focuses only on the technical issues of interoperability
- OIM (Organizational Interoperability Model) 0 which extends LISI model to incorporate the organizational aspect.

- LCIM(Levels of Conceptual Interoperability Model)0, which focuses on technical and conceptual issues of interoperability
- EIMM (Enterprise Interoperability Maturity Model)0, which evaluates conceptual issues of interoperability

A survey and comparison of the above maturity models 0 presents that only OIM deals with organizational interoperability barriers and concerns, though without proposing a specific approach to solve interoperability problems at the organizational level. Although the aforementioned models describe the stages, levels and layers, they don't identify any assessment constructs for measuring and benchmarking organizational interoperability.

Maheshwari 0 highlights that none of these models which were developed and implemented by different researchers, national and international organizations discusses specific measures to assess the organizational aspects of interoperability.

European Commission, having identified on the one hand the lack of interoperability as a major obstacle for a successful digital transformation while on the other, the gaps in the aforementioned assessment models, has introduced a new model, the Interoperability Maturity Model (IMM) 0. IMM was developed within ISA^2 program in order to help public administrations to measure how well they interact with external entities and organize the efficient provisioning of their public services to other public administrations, businesses and/or citizens. It is based on the vision laid out in the European Interoperability Strategy (EIS) and it is fully aligned with the latest version of European Interoperability Framework (EIF) 0.

Assessment Tools

Through the previously mentioned maturity models and frameworks, assessment tools were developed in order to identify the level of interoperability maturity and to suggest specific improvements, such as:

- Government Interoperability Maturity Matrix (GIMM) 0
- Measurement instrument 0
- Interoperability Maturity Model and Tool (IMM Full & Lite) 0
- Interoperability Maturity Assessment of a Public Service (IMAPS) tool 0

GIMM (Government Interoperability Maturity Matrix) is presented by Sarantis 0 and has five levels of maturity that are identified and closely aligned with the descriptions of LISI model. Each level of maturity corresponds to a different interoperability level for a set of Interoperability Attributes (IA) providing public administrations, an easy and comprehensive way to evaluate their current status and identify the areas that need further elaboration and improvement on e-Government issues. Although a more effective approach considering assessment of technical, semantic and organizational interoperability readiness is described, specific measures to assess organizational interoperability are not proposed. Furthermore, the LISI model that was used as a referential model for the matrix is not aligned with EIF's latest version.

A measurement instrument for assessing organizational interoperability in practice 0 introduces a set of constructs that correspond to six sublayers of organizational interoperability, providing in this way a practical approach to assess and benchmark the organizational aspects of interoperability. Although this approach is more complete, taking into account even socio-technical aspects as well as interoperability-related governance aspects, it is not related with levels of maturity.

The Interoperability Maturity Model and Tool (IMM Full & Lite) is the evolution of IMM (Interoperability Maturity Model). It can be used by public administrations to assess interoperability (technical, semantic and organizational) of a public service at all government levels (international, national, regional and local). Interoperability Maturity Assessment of a Public Service (IMAPS) tool is an improvement of IMM tool which provides insight into the current interoperability maturity of a digital public service based on a set of defined interoperability attributes and maturity stages assessment and furthermore it provides guidelines on how the digital public service can improve interoperability maturity in all four dimensions (legal, organizational, semantic and technical).

Despite all these characteristics, IMAPS does not include all the necessary attributes for a complete assessment of organizational interoperability. Exploitation of the results of interoperability assessment of

digital services with the IMAPS tool during 16 training courses (370 participants/55 trainers)0, which took place at the National Centre for Public Administration and Local Government (EKDDA) in Athens, has shown that neither sociotechnical attributes nor interoperability-related governance ones are included in the aforementioned assessment tool. Moreover, recent legislation issues such as GDPR regulation and other policy issues such as Once Only Principle are not taken into account.

This paper presents the development of an efficient and reliable model/tool for the assessment of organizational interoperability maturity level of a digital public service in practice. The new assessment model/tool is based on a recent maturity model in accordance with measurable attributes that cover all current barriers and concerns in the area of organizational interoperability. It is expected to provide a more effective approach for public administrations to identify their gaps and weaknesses in the area of organizational interoperability. It can be used as an independent assessment model/tool in the area of organizational interoperability while it could also extend the IMAPS tool.

METHODOLOGY APPROACH

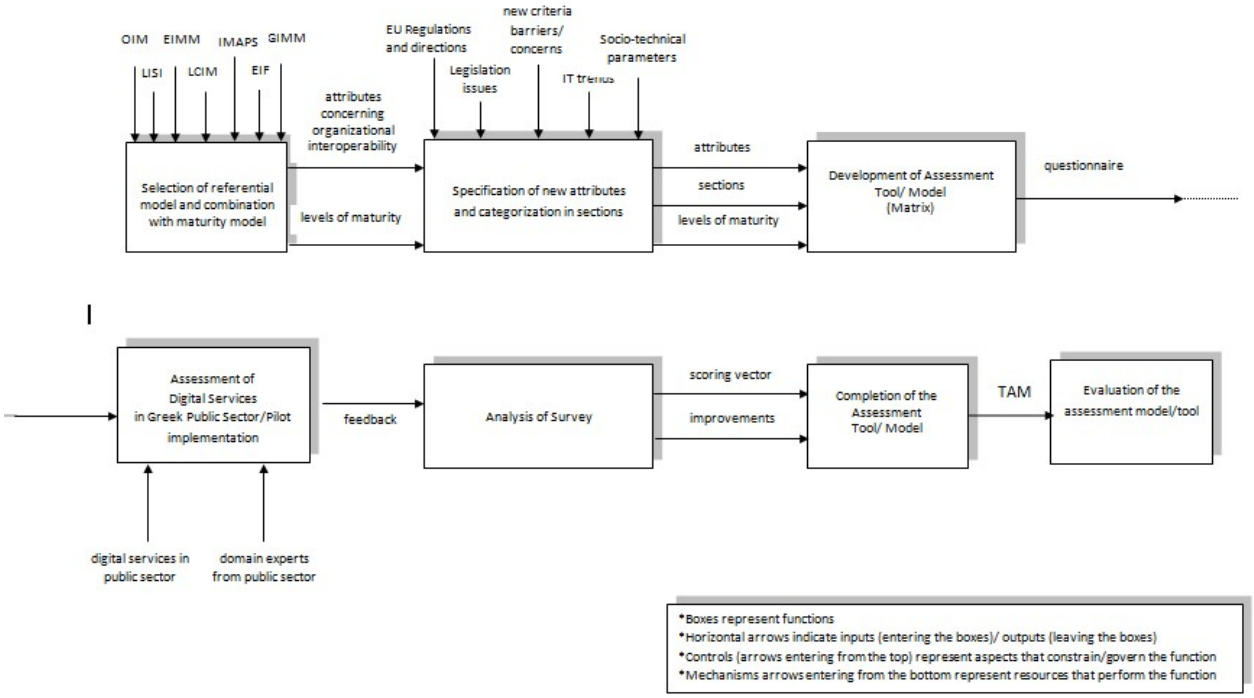
Basic Steps of Development

The development of the new model/ tool for the assessment of a digital service concerning the level of organizational interoperability maturity includes the following steps:

- Selection of an existing assessment model of literature as a reference model, combined with an existing maturity model
- Identification of all attributes concerning organizational interoperability.
- Specification of new attributes in order to accomplish a more complete approach of organizational interoperability. During this step new criteria are taken into consideration according to literature review on barriers and concerns, EU regulations and guidelines, legislation issues, socio-technical parameters and IT trends.
- Categorization of all attributes in sections
- Development of a new matrix with interoperability attributes defined in lines and corresponding levels of maturity defined in columns.
- Structure of a questionnaire, where each question concerns a specific attribute and each available answer corresponds to the fulfilment of the interoperability attribute according to levels of the maturity model.
- Assessment of the maturity level of organizational interoperability of Digital Services in the Greek Public Sector with the aid of the structured questionnaire. Forwarding of the structured questionnaire to authorities/domain experts of the Greek Public Sector of various administrative levels (local, municipal, national) and from various policy areas.
- Pilot implementation of the assessment model/tool during a training course at the National Centre for Public Administration and Local Government in Athens.
- Feedback with improvements and generation of a scoring vector.
- Completion of the new assessment model/tool with the integration of the scoring vector and the incorporation of improvements.
- Final evaluation of the new model/tool according to TAM (Technology acceptance methodology) guidelines as far as it concerns its perceived usefulness and its perceived ease of use.

All the above steps/stages of the development process of the model/ tool are presented in the following methodology diagram:

FIGURE 1
METHODOLOGY DIAGRAM



Application Scenario

Selection of Referential Model and Maturity Model

GIMM matrix was selected as the referential model because it provides an easy and comprehensive way to evaluate the current status of an organization on e-Government interoperability issues and it is furthermore constructed in such a way that it can be applied to quantify the organization e-Gov interoperability transformation. Furthermore, it is very much focused on achieving governmental interoperability.

The part concerning assessment of organizational dimension of interoperability was utilized and was further enriched with new attributes, so as to achieve a more analytical structure of the initial matrix.

The levels of maturity in GIMM were substituted by the ones of Interoperability Maturity Model (IMM) because it is considered to be the most suitable maturity model due to its fully alignment with the latest released version of European Interoperability Framework (EIF)0.

Identification of Organizational Attributes

All the attributes that relate to organizational interoperability and are available in the assessment tool of IMM (IMAPS), were identified to enrich the referential model. All these are depicted in the following table (see Table 1):

TABLE 1
IDENTIFIED ORGANIZATIONAL ATTRIBUTES

Interoperability Attributes
Procurement criteria
Specification Process
Certification
Business Process Modelling
Procedural transparency
User Feedback
Service level Agreements
Service Consumption
Reuse and sharing
Cross border service delivery

Addition of New Organizational Attributes

Addition of new attributes according to literature review about barriers and concerns for the accomplishment of organizational interoperability was the next step of the methodological approach. More specifically, measurement constructs such as the socio-technical ones that Marijn Janssen 0 suggests for a more complete approach of organizational interoperability, were added. In addition, attributes to satisfy concerns such as GDPR, Once Only Principle were also taken into account.

The following table (see Table 2) presents the new attributes added. Furthemore, justification is provided to specify their added value in the process of development of the new assessment model/tool.

TABLE 2
NEW ORGANIZATIONAL ATTRIBUTES

Attributes	Justification
Design Methodology	Design methodology (good practices, design patterns and design principles) is an important factor for a successful design process where an heterogeneous organization is transformed to an interoperable system **(Rauffet et al., 2009)**. Structural transformation of an organization for the alignment of structures requires a design methodology
Collaboration	Inter-and intra-organizational interactive and willing working relationship is essential to recognize shared goals roles and responsibilities **(Maheshwari et al., 2012)**. Furthermore, institutional arrangements which is a prerequisite for inter-organizational governance requires collaboration between organizations. **(Ostadzadeh et al., 2015) (Yang et al., 2015)** Consequently collaboration is a determinative factor for the assessment of maturity level of organizational interoperability
Compatibility with legislation issues	The compatibility with legislation issues that concern governmental processes is an important metric for the assessment of organizational interoperability of a digital service
Compatibility with EIF	The maturity level of organizational interoperability of a digital service is determined by the level of compatibility with EIF guidelines
Compatibility with GDPR	According to GDPR, privacy by design must be fulfilled upon development of a digital service thus compatibility with GDPR is a criterion for the

Attributes	Justification
	assessment of the maturity level of organizational interoperability of a digital service
Once-only Principle	Once – Only Principle is an important metric of organizational interoperability either at national or at international level because its fulfilment, confirms that all businesses processes are successfully aligned and data are provided only once by the citizen (European Digital Single Market Strategy)
Staff restructuring	The organizational interoperability requires effective Change Management in order to assign the right job to the right person **(Rauffet et al.,2009)**
Training	Training is an important factor for a successful Change Management since employees become more effective in the management of the digital service

Categorization of Interoperability Attributes

The next step was the categorization of all organizational attributes into sections for better assessment results. The following table (see Table 3) presents the selected interoperability attributes aggregated in sections.

TABLE 3
INTEROPERABILITY ATTRIBUTES (IA) PER SECTION

Attributes	Sections
(A1) Procurement criteria	Design Process (A)
(A2) Specification Process	
(A3) Design methodology	
(A4) Collaboration	
(B1) Compatibility with intergovernmental legislation issues	Government Process Alignment (B)
(B2) Certification	
(B3) Business Process Modelling	
(C1) Compatibility with EIF	Compatibility with European policies and regulations (EIF, GDPR) (C)
(C2) Compatibility with GDPR	
(D1) Procedural transparency	Interaction with users (D)
(D2) User Feedback	
(D3) Service level Agreements	
(E1) Service Consumption	Service Consumption (E)
(F1) Reuse and sharing	Reusability of service (F)
(G1) Once-Only Principle	Interoperability at national-international level (G)
(G2) Cross border service delivery	
(H1) Staff restructuring	Change Management (H)
(H2) Training	

Development of a Matrix of Interoperability Attributes With the Corresponding Levels of Maturity

A new matrix was developed with interoperability attributes (IA), categorized in sections, defined in lines and the five (5) levels of the maturity model (IMM) defined in columns. The idea of development of such a matrix is based on the GIMM matrix that was introduced in 0. The grade of fulfillment of an IA in a digital service corresponds to a specific level of maturity in the organizational interoperability dimension. In order to assess this grade of fulfillment, a questionnaire was structured where each question concerns a specific attribute and each answer corresponds to a specific maturity level.

The Contribution of the Questionnaire

The questionnaire was structured in such a way that a reliable and accurate assessment of the attributes related to organizational interoperability of a digital service is achieved. It was, afterwards, converted into a Google form (Questionnaire) for a more effective use providing easier distribution to domain experts and giving the ability to have automatically an Excel database of the results as well as the ability to export statistics.

The questionnaire was utilized for the evaluation of all the interoperability attributes per section according to the importance given by the domain experts. The evaluation results contributed to the definition of the weights of attributes and sections in order to generate a scoring vector for the new assessment model/tool.

TABLE 4
ORGANIZATIONAL INTEROPERABILITY MATURITY MATRIX

IA \ IMM levels	**Ad hoc (1)**	**Opportunistic (2)**	**Essential (3)**	**Sustainable (4)**	**Seamless (5)**
Design Process (A)					
(A1) Procurement criteria	No standards in procurement		Partially, standards - based procurement		Fully, standards -based procurement
(A2) Design methodology	No, design processes haven't been used at all		Partially, best practice based designed processes		Fully, design approaches-based process transformation
(A3) Specification Process	Closed specification process		Stakeholders have been invited once	Stakeholders have been invited periodically (frequently)	Open specification process
(A4) Collaboration	No, working groups was not established				Yes, working groups with members from all stakeholders were established

Government Process Alignment (B)					
(B1) Compatibility with intergovernmental legislation issues	No		Partly		Yes
(B2) Certification	No, there is no certification procedure available				Yes, there is a certification procedure available
(B3) Business Process Modeling	No BMP		Ad hoc BMP	Standards-based BPM	Standards-based and collaborative BPM
Compatibility with European policies and regulations (EIF,GDPR) (C)					
(C1) Compatibility with EIF	No		Partly		Yes
(C2) Compatibility with GDPR	No		Partly		Yes
Interaction with users (D)					
(D1) Procedural transparency	No procedural transparency		Partly procedural transparency		Full procedural transparency
(D2) User Feedback	No User Feedback channel		Physical Feedback channel	Digital Feedback channel	Digital Feedback channel and insight into others' feedback
(D3) Service level Agreements	No		SLAs without monitoring		Monitored SLAs and corrective action
Service Consumption (E)					
(E1) Service Consumption					
Reuse and sharing (F)					
(F1) Reuse and sharing	None	One answer chosen	Two answers chosen	Three answers chosen	All answers chosen

Interoperability at national-international level (G)					
(G1) Once-only Principle	No				Yes, provision of diverse data only once in contact with public administrations
(G2) Cross border service delivery	Restrictions towards foreigners				Restrictions towards foreigners
Change Management (H)					
(H1) Staff restructuring	No		Yes, there was partly staff restructuring		Yes, there was fully staff restructuring
(H2) Training	No				Yes, all employees involved were trained

Selection of Authorities /Domain Experts

Public authorities that were selected represent Directorates of Information Systems of Hellenic Ministries and Municipalities while domain experts are IT employees in relative departments. The following table (see Table 5) presents the participation of authorities and experts.

TABLE 5
PUBLIC AUTHORITIES AND DOMAIN EXPERTS

Public Authority	Number of Domain Experts
Ministry of Infrastructure and Transport Directorate of Information Systems	4
Ministry of Education Directorate of e-Government	2
Ministry of Administrative Reconstruction Directorate of e-Government	3
Ministry of Finance Secretary General of Information Systems and Administrative Support Department of Interoperability	1
Ministry of Rural Development and Food Directorate of e-Government	1
Ministry of Economy and Development General Secretariat of Trade	2
Ministry of Migration Policy Directorate of Information Systems	1
OAED	1
EFKA	1

Public Authority	Number of Domain Experts
Municipality of Vari -Vouliagmeni	1
The Greek Ombudsman	1
Ministry of Internal Affairs	1
Hellenic Statistic Authority	1
Ministry of National Defence	1
Municipality of Glyfada	1
Ministry of Finance	1
Municipality of Glyfada	1
Municipality of Trikala	1

Results

Feedback From Participated Authorities

Almost 30 digital services from various policy areas at local, municipal and national level of public administration in Greece were assessed utilizing the new model/tool under development

The following table (see Table 6) depicts the Greek Public Authorities in accordance with the digital services that were assessed by their domain experts with the aid of the structured questionnaire:

TABLE 6
PUBLIC AUTHORITIES AND DIGITAL SERVICES

Public Authority	Digital Service
Ministry of Infrastructure and Transport Directorate of Information Systems	Web service for vehicle registration data
Ministry of Infrastructure and Transport Directorate of Information Systems	Register of Members of Committees for public procurement procedures, studies, technical and other related scientific services (MIMED)
Ministry of Infrastructure and Transport Directorate of Information Systems	RESPER Web service for driving license data
Ministry of Infrastructure and Transport Directorate of Information Security	Information system for direct public procurement works contracts and studies
Ministry of Education ASPETE Directorate of e-Government	Student Registration service
Ministry of Administrative Reconstruction Directorate of e-Government	eiD in Greece
Ministry of Administrative Reconstruction Directorate of e-Government	Inventory for public servants (Apografi)
Ministry of Administrative Reconstruction Directorate of e-Government	Birth Certificate
Ministry of Finance	Information system for e-protocol
Ministry of Agricultural Development and Food Directorate of e-Government	e-service
Ministry of Economy and Development General Secretariat of Trade	Central Electronic Public Procurement Register – KIMDIS

Public Authority	Digital Service
Ministry of Economy and Development General Secretariat of Trade	National Electronic Public Procurement System (ESIDIS)
Ministry of Migration Policy Asylum Service	Databases interconnection of Asylum Service and Hellenic Police
Municipality of Glyfada	Fix my city
The Greek Ombudsman	e-government services-web complaint-G2B and G2G and G2C services
Municipality of Vari Voula	Weighing a waste bin
OAED	Issue of unemployment card
Hellenic Statistical Authority	Intrastat (Electronic system of Intrastat declarations on Intra EU trade transactions of Goods)
Ministry of National Defense	Share Docs
EFKA	Detailed periodic statement
AADE	Disclosure of natural and legal persons in the taxpayer's register
Ministry of Internal Affairs	Register for citizens
General Secretariat of Information Systems	E-paravolo
Municipality of Trikala	Citizen Complaints Registration

Feedback From Pilot Implementation of the Assessment Tool

A pilot implementation of the new assessment tool, took place during a training course on interoperability assessment with IMAPS at the National Centre for Public Administration and Local Government in Athens. About 20 participants divided in 6 groups assessed digital services with the aid of the new tool according to the following table (see Table 7):

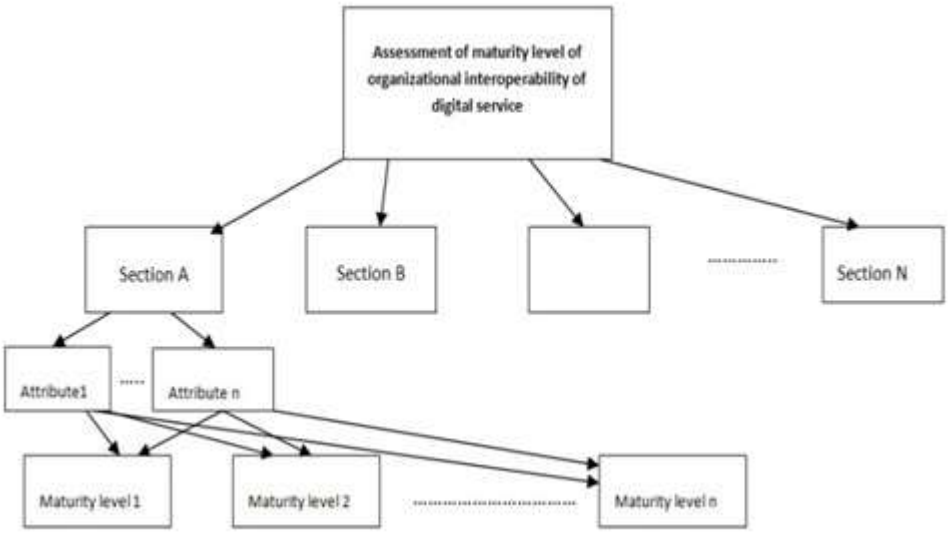
TABLE 7
PUBLIC AUTHORITIES AND DIGITAL SERVICES

Authority	Digital Service	Number of participants
Ministry of Health	Publicity of hospital shifts	3
Municipality of Athens	Issue of Birth Certificate	3
Ministry of Health	Citizens' registration to a Family Doctor	3
General Secretary against corruption	Apply citizen complaint	3
Ministry of Health	Financial Compensation after health treatment at a public hospital	4
Ministry of Labour, Social Insurance and Social Solidarity	Provision of financial data between public organizations due to a public servant's retirement	3

Analysis of the Survey

The analysis of the survey was based on Analytic Hierarchy Process (AHP) method 0 0. The following figure (see Figure 2) shows the AHP structure modeled as a decision tree in which the goal, in this case, is the assessment of maturity level of organizational interoperability. The second level of the decision tree includes the Sections of interoperability assessment, each of which corresponds to a number of Interoperability Attributes (IA) of the next level. The fulfillment level of each IA corresponds to specific levels of maturity.

FIGURE 2
DECISION HIERARCHY DIAGRAM



Calculation of Weighted Average of Attributes/Sections and Generation of Scoring Vector

The first step for the generation of the scoring vector for the assessment of the digital service was the calculation of the weights for attributes and sections.

The following tables (see Table 8, Table 9 and Table 10) depict the way that weighted average of sections and attributes was generated. The whole procedure was based on AHP method

TABLE 8
CALCULATION OF WEIGHTED AVERAGES

Domain Experts j **Attributes i**	**Grade of domain experts for each attribute per section**	**Sum of grades per attribute**	**Weighted average of each attribute per section**
	aij	Xi = ∑ aij ∀i	Wai = (xi /∑ xi)
Domain experts j Section i	**Grade of domain experts for each section**	**Sum of grades per section**	**Weighted average of each section**
	Sij	Zi = ∑ Sij ∀i	Wsi = (zi /∑ zi)

Taking into consideration the above equations concerning the calculation of weighted average for each attribute and section of our model, the scoring vector is generated as follows:

Scoring vector =$\sum(score\ \ of\ \ section\mathrm{i} * Wsi\ )$ (1)

Score of section = $\sum score\ of\ attributei$ (2)
Score of attribute = (*Score of answer*$_j$) * Wa_i

where j=1…5 $\forall$ *level of maturity* (3)

Scoring vector = $\sum\ \sum[(score\ \ of\ \mathrm{answerj} * Wai\ )\ * Wsi]$ (1) & (2) & (3)

The calculated weights for all attributes and sections of our model are presented in the following tables (see Table 9 and Table 10). The calculation was based on the above equations, according to the evaluation ranking made by domain experts.

TABLE 9
WEIGHTED AVERAGES PER INTEROPERABILITY ATTRIBUTE

Interoperability Attribute (IA)	Weighted average of each attribute per section	Percentage of weight
A1	0.21994884	22%
A2	0.25831202	26%
A3	0.25063938	25%
A4	0.27109974	27%
B1	0.39130435	39%
B2	0.32608695	32%
B3	0.28260869	28%
C1	0.52577319	53%
C2	0.47422680	47%
D1	0.29015544	29%
D2	0.34196891	34%
D3	0.36787564	37%
F1	1.00	100%
G1	0.486486	48%
G2	0.520000	52%
H1	0.46846468	47%
H2	0.53153153	53%

TABLE 10
WEIGHTED AVERAGES PER SECTION

Section	Weighted average of each section	Percentage of weight
A	0.134417344	13%
B	0.126829268	13%
C	0.138211382	14%
D	0.125661247	13%
E	0.121409214	12%
F	0.122493225	12%
G	0.118157182	12%
H	0.113821138	11%

The final assessment of Digital service is provided as follows:

Final Score = Score(A) *W(A) + Score(B) *W(B) + Score(C) *W(C) + Score(D) *W(D) + Score(F) *W(F) +Score(G) *W(G) + Score(H) *W(H)

where

Score (A) = Score (A1) *W (A1) + Score(A2) * W(A2) +Score(A3) *W(A3) + Score(A4) *W(A4)

and

Score (B), Score(C), Score (D), Score (F), Score (G) and Score (H) are calculated accordingly

Having calculated the weights for the attributes and sections of the model and incorporating the scoring vector in the model, the assessment of the maturity level of organizational interoperability of a digital service can be achieved in a measurable way.

Improvements

During the pilot implementation and the process of analysis new attributes were proposed by domain experts in order to improve the initial assessment model/tool. These attributes and the corresponding justification for the development of the new model are shown in the following table (see Table 11):

TABLE 11
PROPOSED INTEROPERABILITY ATTRIBUTES

Attributes	Justification
Best practices	Similar already cross border implemented digital services should be taken into account during the process of the development to accomplish high level of organizational interoperability. Example: e-Procurement methodology important for ESIDIS
Cataloguing	The potentiality of searching, drawing and integrating of services during the process of development is an indicator of high level of organizational interoperability
Multilingualism	The potentiality of providing a specific service in multiple languages should be taken into account in the evaluation of organizational interoperability
Coordination	The strategic approach of implementing the digital service is essential parameter for the achievement of organizational interoperability
Interaction with NIFO Greece	The potentiality of providing feedback to a national observatory for interoperability is a crucial index for assessing the maturity of organizational interoperability
Accessibility to the European Interoperability Knowledge Base	The potentiality of the public authority to have access to the European Interoperability Knowledge Base (Learning organizations, ISA^2, NIFO, social media) in order to follow up all necessary updates for the digital service is a crucial parameter for assessing interoperability maturity
Dissemination	The providence of a dissemination system for the notification of the new digital service to other authorities is an important parameter for assessing the maturity of organizational interoperability.
Exploitation of dedicated to interoperability financial resources	The awareness and exploitation of all relative to interoperability financial resources for the development and the implementation of the digital service is an index for measuring the level of maturity of organizational interoperability.

Evaluation of the New Model With Tam

An evaluation of the new model and tool, which was thoroughly presented in the first version of the paper (Margariti, 2020), based on TAM methodology, was considered to be beneficial because the results of such a procedure could provide valuable feedback for further enhancement.

The evaluation was accomplished with the aid of a questionnaire (see Table 12) which was converted into a Google form (Questionnaire -2) and was distributed to domain experts from various policy areas in order to provide a first level evaluation for the new model/tool. The domain experts after assessing the maturity of organizational interoperability of the digital services (see Table 13) with the aid of the new model/tool, they evaluated its perceived usefulness and its perceived ease of use with TAM questionnaire.

TABLE 12
TAM QUESTIONNAIRE

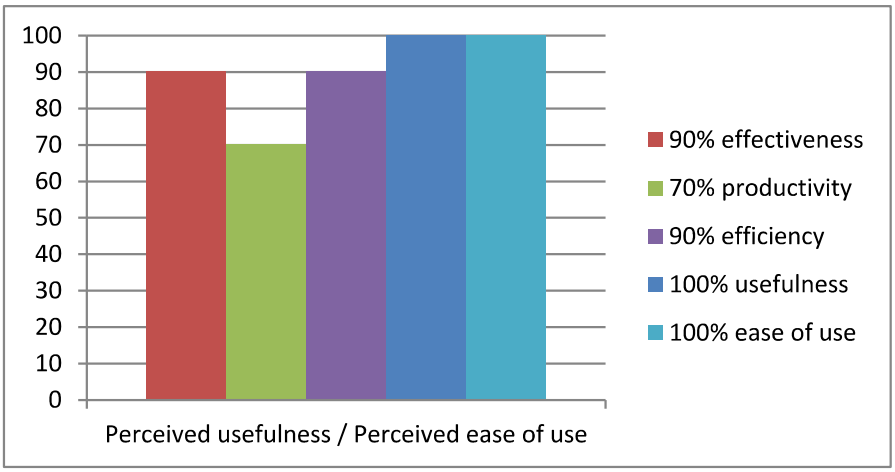
Perceived Usefulness (PU)
I consider this new model/tool useful for the assessment of the maturity level of the organizational interoperability of a digital service
The use of this new model/tool increased my effectiveness in the area of interoperability
The use of this new model/tool increased my productivity
The use of this new model/tool improved my efficiency
Perceived Ease of Use (PEOU)
The interaction with the new model/tool was clear and comprehensible
It was easy to gain the skill to use the new model/tool
I consider the new assessment model/tool easy to use
It was easy for me to learn to use the new assessment model/tool for the organizational interoperability of a digital service

TABLE 13
PUBLIC AUTHORITIES AND DIGITAL SERVICES

Public Authority	**Digital Service**
Ministry of Infrastructure and Transport Directorate of Information Systems	Payroll application producing Salary Slips for the employees via the Ministry Website
Ministry of Education and Religion Affairs	Remote enrolment of kids in primary schools
Ministry of Health - National Centre for Emergency Care	Certificate for medical care and transport using ambulance service
Ministry of Employment – Manpower Employment Organization	Renewal of Unemployed Person's Card
Ministry of Education ASPETE Directorate of e-Government	Student registration
Ministry of Infrastructure and Transport Directorate of Information Systems	Register of Members of Committees for public procurement procedures, studies, technical and other related scientific services (MIMED)
Ministry of Digital Governance	National Electronic Public Procurement System (ESIDIS)
Ministry of Infrastructure and Transport Directorate of Information Systems	Digital Tachograph Card Issuing Public Service
Municipality of Glyfada	Fix my city (digital certificates for citizens and business)

According to the results of the evaluation, the new model and tool is useful and easy to use for all domain experts while the majority of them became more effective, efficient and productive after the exploitation of it (see Figure3)

FIGURE 3
TAM DIAGRAM



Completion of the New Model/Tool

The new assessment model/tool will be completed with the integration of the generated scoring vector and the incorporation of improvements. Results of the first level evaluation with TAM will also be taken into account. In this way a reliable, automated and measurable assessment of the maturity level of organizational interoperability of a digital service can be achieved.

Final Evaluation of the New Model/Tool

After the completion of the new model and tool, a technical acceptance procedure will take place. TAM methodology applied in an extensive questionnaire will be utilized for the final evaluation stage and feedback from European and national domain experts from various policy areas will be provided.

CONCLUSIONS

Organizational interoperability is an efficient factor for accomplishing efficient, integrated and transparent intergovernmental services and is believed to be strongly related to IT governance. Moreover, the public sector considers it a key prerequisite to applying open data policies and therefore providing open data services.

There are several maturity models and assessment tools that are presented in the literature, which help administrations identify the level of organizational interoperability. According to surveys and comparisons none of them provides a complete and measurable approach of all the current concerns and barriers of organizational interoperability.

The new model/tool for the assessment of the maturity level of organizational interoperability of a digital public service provides a more complete and reliable method to diagnose the current situation and plan for future improvements in organizational interoperability. Its development is based on a referential model combined with an existing maturity model and it is further enhanced with attributes that either emerge from literature or satisfy current needs and new guidelines. The accurate assessment is achieved with the aid of a scoring vector which is generated through an evaluation procedure .

The new assessment model/tool will be afterwards completed with the incorporation of the generated scoring vector. All the proposed improvements by domain experts will also be taken into account to provide

an updated version of the model/tool. TAM methodology will be used to evaluate the perceived usefulness and the perceived ease of use of the model/tool.

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