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Ontology Model for Public Services in Morocco Based on 5W1H Approach : PSOM-eGovMa

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Abstract

Morocco has launched several e-government programs to develop efficient public e-services which meet the needs of users. However, while digitizing public services processes for Moroccan administrations, the designers of information systems record the entered data in databases, without being too interested in the meaning of the entries made by citizens nor on the benefit of exchanged information between public administrations. This causes inconsistency and lack of interoperability between public administration systems. Moreover, the systems require information collection and shared knowledge based on a common vocabulary of public services in Morocco. For this purpose, this paper presents an ontology model based on the 5w1h Method for defining the public services domain. This PSOM ontology is based on the referential defined by the Moroccan Ministry of Administration Reform and Public service. Indeed, we have collected the different concepts related to this field and all possible relationships between them in order to ensure interoperability between all government entities.

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1. Introduction

E-governments initiatives varies from countries, they depend on the diversity of culture, multinational administrative structures and various process management methods [1]. Considered as a developing country, Morocco is seeking to implement e-government programs and give priority to the services offered by the public sector. In this context, the Moroccan National Plan for the Reform of the Administration 2018-2021 aims to develop an efficient, transparent and competent public services that meet expectations of users [2]. The plan attempts to enhance the maturity level of public e-services in the country, simplify and digitize administrative procedures. Indeed, according to the study conducted by the Moroccan Ministry of Administration and Public service reform to assess the e-readiness of electronic public services, two main categories have been identified based on their interactions: Dependent and independent public e-services. Dependent e-services are divided into three sub-categories: Internally dependent, externally dependent and both internally and externally. As a matter of fact, the e-readiness index of dependent e-services remains low: 70% are still at the first maturity level and only 5% are at the top level [3]. This, means that dependent e-services which require interaction with other administrations (external or internal) are seriously affected toward their e-readiness process. Thus, to improve the e-readiness index and quality of government e-services, public administrations have to share knowledge. It can be done by ensuring interoperability between their information systems.

The interoperability is known as the aptitude of different systems to interact. There are several levels of interoperability, at least four levels: Organizational interoperability, Data interoperability, Technical interoperability and Semantic interoperability [4]. To ensure semantic interoperability, adopting ontologies is the suitable way to identify semantic properties of a specific domain and shared knowledge. The ontologies are developed to assist interoperability and interconnectivity from different government information systems [5]. Indeed, conceptualizing the domain of government using ontology is an emerging area of the management support system. Even, retrieving information is complex due to the multiplicity of public service stakeholders and the diversity of public processes.

The establishment of the Moroccan e-government framework to identify public services helps to frame terminologies in the country [6], but it is not enough to define the domain of public services in Morocco. This prompts us to think of an effective solution requiring the use of a common vocabulary to present all components which is a domain ontology, so that all data relating to a public service is semantically annotated with the same concepts. To analyse concepts, relations, and proprieties related to the public service domain, it is relevant to pose questions. This work provides a model of a domain ontology representing a knowledge based on the 5W1H questions. Collected information introduce a controlled vocabulary for describing definitions and sharing a common knowledge of public services in Morocco. Protégé is the tool we used to model and implement our ontology by defining the different concepts and possible relationships. Of course, the language used is owl respecting the RDF / XML syntax.

The remainder of the paper is organized as follows: The next section presents related works. The third section gives an overview of our proposed approach. It describes e-government public services based on the 5W1H method, then presents our PSOM domain ontology by providing definitions of its taxonomy and properties. In section 4, we explain how we can establish semantic interoperability between all public services in Morocco. The paper ends with conclusion and some future works.

2. Related Works

The interest of developing ontology in many areas have attracted Moroccan researchers: Big Data [7], model-driven engineering [8,9] and E- government field where different approaches were presented using Semantic Web technology to develop e-government services [10]. However, exchanging data and implementing collaborative environment between Moroccan public administrations is still limited. Sharing information in public sector requires serious review, likewise, modelling a domain ontology of "public services" is a tedious task as the structure in the public sector is complex. Several researchers agreed that the ontologies must be included in all systems that have an impact on modeling administrative processes [11]. The 5W1H helps to obtain and examine concepts within domain ontology[12]. Therefore, we have resorted to this approach in order to analyse the concepts and relations related to the public service domain in Morocco. While comparing these existing works with our approach, we notice that they have

defined semantic descriptions of the domain of government without drawing on a referential. In our approach, we have presented a domain ontology based on the referential defined by the Ministry of Administration Reform and Public service, it can be applicable in real projects. The aim is to incite wide coordination between different public agencies and departments and share common information to all public service end users in the country.

3. PSOM-GovMA Framework

3.1 5W1H-BASED MODELING METHOD FOR MOROCCAN PUBLIC SERVICES DOMAIN ONTOLOGY

Morocco is among the leading countries in Africa to initiate e-Government programs. Since the year 2001, Morocco has adopted persistent efforts toward ensuring efficient implementation of e-Government. This initiative to exploit Information and Communication technology (ICT) tools helps to classify public services in the country and enhance their efficiency. To this end, the ministry of Administration and Public service Reform sets a new framework based on 5W1H approach to identify then classify public services. The 5W1H method deals with six universal questions: What? Why? Who? Where? When? and How? Hence, the new framework presents six main components as the key elements in the public service concept: The PS interactions (What), the PS value (Why), the PS user (Who), the PS time (When), the PS infrastructure (Where) and the PS access (How) (see figure 1).

Public administrations and ministerial departments were required to review their “public services”, to be conform to the proposed framework that allow the unification of concepts and definitions.

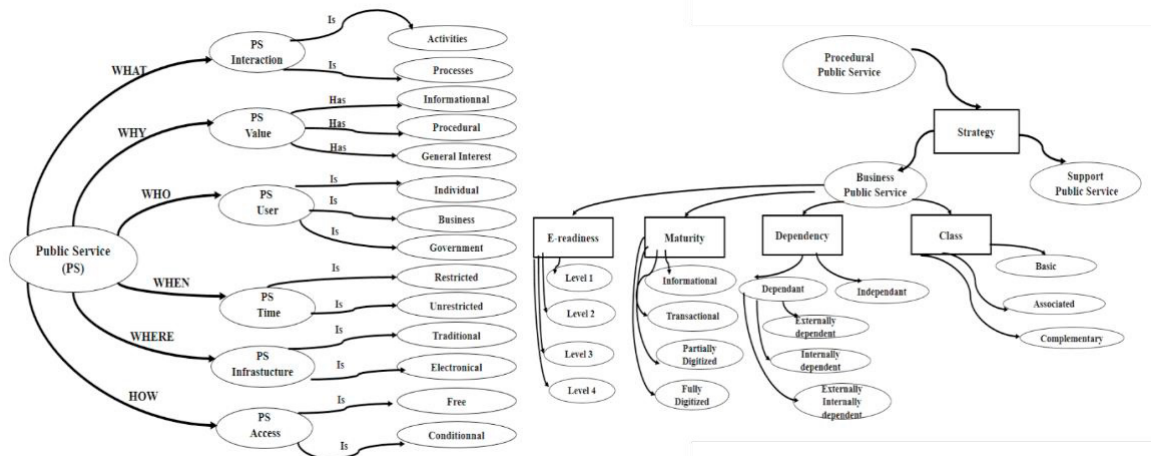


Fig 1: Defining Public Service Concept using 5W1H Method

3.2 PSOM ontology

This work proposes a model of a domain ontology representing a knowledge base for all public services components. Protégé is the tool we used to model our ontology by defining the different concepts and possible relationships. This ontology has been implemented respecting a certain order of steps.

3.2.1 Taxonomy of PSOM classes

The first step in our ontology construction process, is collecting and representing the most relevant concepts of public services of e-government in Morocco. Then, we have established axioms between them representing generalization/specialization.

As a starting point, we assume that the nature of the administrative service can be classified according to the public value delivered to users. In this sense, we distinguish the following natures:

- *Informational services*: Provided by an administration to users, allowing them to obtain useful information.

- *Procedural services*: Triggered by a request from the user providing administrative documents or a change in the administration's registers.
 - *General interest services*: Provided to all users, allowing them to benefit from all public goods and assets.
- Then, we have defined three main classes of public services users, namely Individual (G2I), Business (G2B) and Government (G2G) entities.

Otherwise, our ontology highlights the levels of maturity of public services in Morocco defined by the ministry of Administration and Public service Reform. In order to measure the electronic maturity of services, the e-readiness indicator is used based on an evaluation grid containing several criteria. The index is calculated on the basis of a scoring model which assesses the availability of the criteria assessed at the level of the studied service. Moreover, the ministry has proposed four maturity levels: Informational level, procedural level, partially digitized level and fully digitized one. All these levels have been defined in our PSOM ontology as seen in figure 2.

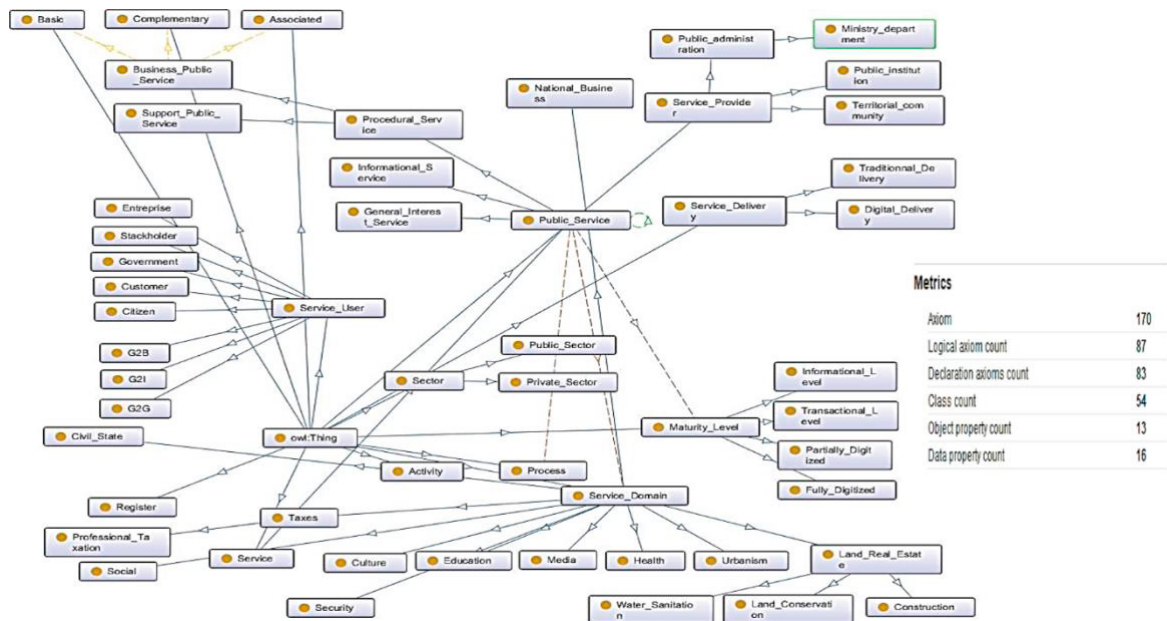


Fig 2: PSOM Ontology Designed by Protégé

3.2.2 Properties of PSOM for Moroccan government

Object and data properties represent the relationships between PSOM domain elements. ObjectProperty represents the relationship between two individuals belonging to two classes. For modeling the dependency that specifies the interaction between public services, we have declared “dependency” as ObjectProperty having two sub-properties; which represent independent and dependent properties. As for dependent Object property, it is divided into three sub-properties: Internally_dependent, externally_dependent,externally_internally_dependent.

On the other hand, data properties will add information and characteristics to the concepts and classes defined for the field of e-public services. Starting with the most important class in this domain which is Public_Service, we have defined several properties characterizing it, citing the type, the code, the name,etc. In addition, we have identified an element allowing to know e-readiness of each public services. To do so, we have defined the axiom subPropertyOf to the e-readiness dataProperty and the four subProperty expressions: level1, level2, level3, level4. Also, we have added an element allowing to know the time restrictions to the services. For that, we have attached The axiom subPropertyOf to the “time_limitation” dataProperty and the two subProperty expressions (subPropertyOf Axiom “time_limitation” as dataProperty and “restricted”, “unrestricted” as subProperties). If the public services have no limitation in time which means, they provide vital needs for citizens without any

interruption like informational one that are broadcasting news continuously, we associate them with “unrestricted” property. On another side, the majority of public services that provide administrative document are amended by *restricted access time* of opening hours, the users cannot access the service outside working hours.

TABLE 1 : OVERVIEW OF DATA PROPERTIES OF PSOM

Public Services Concept	Data Properties	Description
Service_Delivery	hasType	This property provides the type of service delivery, if it is traditional or electronic.
Public administration, Public institution, Territorial community, etc.	hasName	The name of entity providing a public service
	hasAdress	The adress of entity providing a public service
	title_Service	The significant name of the service offered to the various users.
	time_limitation	Property determining time restrictions. ie is it free (permanent) or not.
Public Service	e-readiness	Property determining the e-readiness index. Ie is it in level 1, 2, 3 or level4
	hasURL	The Website of the portal providing the service.
Service_Customer	isMoral	Enterprise which is a potential user of a service.
	isPhysical	Citizen representing a user of a service.

4. Semantic Interoperability

To reach a desired degree of semantic interoperability between government e-services, we have used PSOM ontology. The proposed solution based on this centralized ontology achieves better collaboration and coordination between heterogeneous public administrations and agencies through interoperable public e-services. In fact, the Moroccan ministry has classified public services according to various criteria: Strategy, class of services, E-readiness, maturity level and dependency (See figure1). As mentioned in the introduction, dependency affects significantly the E-readiness index of public e-services. The ministry focuses on dependant public services (DPS) that requires communication and cooperation with other public administrations to provide value for end-users. Unlike independent public services (IPS), they don't need any type of interaction: All necessary procedures to get the value from the service are performed at the concerned administration.

In this sense, the ministry identifies three type of dependent public services described as follow:

- Externally dependent public services (EDPS): The PS requires interactions with one or more external administrations that are not concerned directly by the service.
- Internally dependent public services (IDPS): The PS requires interaction with other departments in the same entity
- Externally and Internally dependent services (EIDPS): The PS requires interactions with both of external administrations and internal departments.

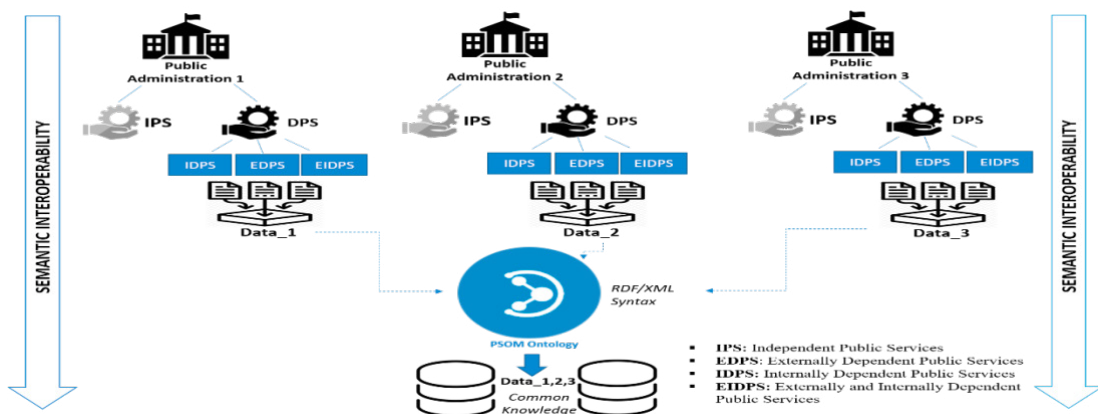


Fig 3: Interoperability between Dependent Public Services using PSOM Ontology

As presented in figure 3, IDPS services simply means that the public entity providing the service, ensures interoperability between its departments. Whereas EDPS services involve several service providers, that ensure interoperability between other external public entities. As for the EIDPS category, interoperability must be established between external and internal public institutions. In this scenario, data will circulate between all types of dependent public services (IDPS, EDPS and EIDPS) keeping a meaningful information. Furthermore, public services users (Individual, Business and Government) can have access to a structured repository, where public data are stored including RDF/XML descriptors. Hence, with this approach, Moroccan government can enhance the maturity level, the E-readiness index of dependant public services by exploiting the common knowledge and exploring shared data in an effective way.

By doing so, our ontology ensures consistency between information provided by Moroccan public administrations, guarantees a common understanding of information and common data definitions used by all government entities.

Thus, semantic interoperability will be ensured between dependent public services.

5. Conclusion

In this paper, we have presented a domain ontology based on the referential defined by the Moroccan Ministry of Administration Reform and Public service. We have emphasized the importance of using ontologies in government information systems to incite wide coordination between different public agencies and departments. Our centralized solution ensures veracity, confidentiality, and data accuracy for government services. Furthermore, it will guarantee semantic interoperability between public administrations. The proposed approach highlights the use of PSOM ontology to ensure semantic interoperability, which can be extended to cover other levels of interoperability like organizational, Data or technical interoperability. With that said, as a future work, we will try to integrate technical interoperability by establishing a physical architecture for ensuring communication between government entities.

References

- [1] E. Benany, M. Mahmoud, E. Beqqali. (2015) "SOA Based E-Government Interoperability." In the 12th International Conference of Computer Systems and Applications (AICCSA). Marrakech, Morocco
- [2] Ministère de la Réforme de l'Administration et de la Fonction Publique. (2018) "Plan National de la Réforme de l'Administration 2018 – 2021." https://www.mmsp.gov.ma/uploads/documents/PNRA2018-2021%20_Fr.pdf.
- [3] H. Benaddi, Y. Hannad, E. El Kettani, mohammed Askour. (2021) "E-Readiness Assessment for Public e-Services in Morocco." *Electronic Government, an International Journal*. Accepted 27 Jun 2021.
- [4] B. Oumkaltoum, E.B. Mohamed Mahmoud, E.B. Omar. (2019) "Toward A Business Intelligence Model for challenges of interoperability in egov system: Transparency, Scalability and Genericity." In the International Conference on Wireless Technologies, Embedded and Intelligent Systems (WITS), IEEE, Fez, Morocco.
- [5] E. Tzagkarakis, H. Kondylakis, G. Vardakis, N. Papadakis. (2021) "Ontology Based Governance for Employee Services." *Algorithms* **14** (4): 1-21.
- [6] Ministère de l'Economie, des Finances et de la Réforme de l'Administration - Département de la Réforme de l'Administration. (2020) "Recueil de services électroniques et l'évaluation de leur maturité électroniques." <http://ereadiness.service-public.ma/referentiel>.
- [7] N. Laaz, S. Mbarki. (2018) "An MDA approach based on UML and ODM standards to support big data analytics regarding ontology development." In The Proceedings of the Third International Conference on Smart City Applications. *Springer, Cham*: 211–225.
- [8] N. Laaz, S. Mbarki. (2019) "OntoIFML: Automatic Generation of Annotated Web Pages from IFML and Ontologies using the MDA Approach: A Case Study of an EMR Management Application" In the Proceedings of the 7th International Conference on Model-Driven Engineering and Software Development. 353–361
- [9] N. Laaz, N. Kharmoum, S. Mbarki. (2020) "Combining Domain Ontologies and BPMN Models at the CIM Level to generate IFML Models" *Procedia Computer Science*. **170**: 851–856.
- [10] H. Lamharhar, L. Benhlila, D. Chiadmi. (2015) "OWLSGOV: An Owl-S Based Framework for E-Government Services." *Intelligent Distributed Computing*. Springer International Publishing: 225–238.
- [11] F. Fallucchi, E. Alfonsi, A. Ligi, M. Tarquini. (2014) "Ontology-Driven Public Administration Web Hosting Monitoring System" In the conference OTM Confederated International Conferences" On the Move to Meaningful Internet Systems: 618–625.
- [12] L. Yang, Z.G. Hu, J. Long, T. Guo. (2011) "Conceptual Modelling for Domain Ontology Using a 5W1H Six-Layer Framework" *Advanced Materials Research* **282-283** : 68–73.