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Developing an XML Schema for the Standard System Data Dictionary

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□ ABSTRACT □

A number of metadata standards have emerged and represented using either the XML Schema or the RDF Schema with the involvement of the namespace term, to globally define their metadata elements. These standards have been registered in metadata registries that provide mapping information from one standard into another. Business and IT systems have the flexibility, ability, and suitability to represent their data objects and describing their semantic units using metadata elements, leading to a proper data objects transition among these systems across the Web, and an increased interoperability among these systems. A standard system data dictionary that has been developped encompasses of a set of metasystem elements to document system metadata type of metadata regarding the undertaken development process of the business and IT system.

To make this standard globally applicable through the Web and to increase its interoperability, we have developed for it an XML Schema and this paper consequently discusses this developed schema and presents its main structure, then outlines it.

Key Words: metasystem element, XML namespace, metadata registry, XML Schema, data dictionary.

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تطوير مخطط XML لمعجم بيانات النظام القياسي

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□ ملخّص □

لقد ظهرت العديد من معايير البيانات الوصفية وتم تمثيلها باستخدام مخطط XML أو مخطط RDF حيث تم استخدام مصطلح فضاء الاسم (n..s) لتعريف عناصر البيانات الوصفية الخاصة بهم على الصعيد العالمي، حيث تم تسجيل هذه المعايير في مسجلات البيانات الوصفية التي توفر معلومات للتحويل من معيار لمعيار أخر. تتمتع أنظمة الأعمال وتكنولوجيا المعلومات بالمرونة والقدرة والملاءمة لتمثيل كائنات البيانات الخاصة بها ووصف وحداتها الدلالية باستخدام عناصر البيانات الوصفية، مما يؤدي الى انتقال مناسب لكائنات البيانات بين هذه الأنظمة عبر الويب، وزيادة التوافقية بين هذه الأنظمة. تم سابقا تطوير معجم بيانات النظام القياسي والذي يشتمل على مجموعة من عناصر بيانات النظام الوصفية لتوثيق بيانات النظام الوصفية والتي تعتبر نوع من أنواع البيانات الوصفية والخاصة بتوثيق عملية تطوير نظام الأعمال وتكنولوجيا المعلومات. لجعل هذا المعيار قابلا للتطبيق عالميا من خلال الويب ولزيادة توافقيته، قمنا بتطوير مخطط XML لهذا المعيار، وستقوم هذه الورقة بمناقشة هذا المخطط المطور وعرض بنيته الاساسية ومن ثم عرضه بشكل كامل.

الكلمات المفتاحية: عنصر بيانات النظام الوصفية، فضاء اسم XML، مسجل بيانات وصفية، مخطط XML، معجم البيانات

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1- Introduction

A standard system data dictionary has been modeled and designed to record system metadata type of metadata, then a relational database schema representation and a chart representation for the intended system data dictionary standard have been developed, this paper outlines present work to increase the operability and the applicability of this standard by making it available for use on the World Wide Web by designing an XML schema for it, so that systems and users can use it by utilizing either its entire XML schema to represent their systems instances, or some of its globally defined metasystem elements to describe their corresponding systems and sharing system information with other systems via the internet.

XML is a W3C recommendation standard, it is designed to store and transport data while HTML is designed to display data, moreover XML is a complement to HTML since HTML has a predefined set of tags while XML does not have a predefined tags. XML language is a self-describing data interchange language since it contains both the data and the information about the structure and the nature of the data. From these advantages and other advantages, XML files are almost used in all the applications that tend to make their data available in the World Wide Web [1], [2], [3], [4].

Initially the structure and the data of the XML files or documents were validated against a validation technique using DTD (Document Type Definition) documents to insure that XML data was in the correct structure in their documents [5].

Recently XML files are validated against a stronger validation technique using XML Schemas, which are written using the same XML language and stored as XSD (XML Schema Definition) documents, the main advantage behind using the XML Schema concept is that, the XML schema supports the W3C namespace recommendation.

XML namespace is a W3C standard for providing uniquely named elements and attributes in an XML instance, it has been defined as an abstract entity; it's nothing more than a group of names being with each other conceptually, it is concerned with a vocabulary, not a document type, its name is used as a name, not as a location [6].

XML namespaces provide a method to avoid element name conflicts, prefix names are often used to denote to the namespaces, and to remove the conflict that the prefix name may be used by more than one person, unique prefix names are often used such as using the internet domain names by using the URI, any unique name can also be used for the namespace such as the personal emails [7], [8], [9].

Detailed descriptions about both the XML and XML Schemas are available in many web sites and books. [10], [11], [12].

1-1 The Benefits of the XML Schema over the DTD

The XML Schema was approved as a W3C Recommendation and it provides the following benefits over the DTD:

- XML Schemas are created using the same XML language, while DTDs uses a separate syntax.
- XML Schemas support the W3C namespace recommendation.
- Validation of XML document text element is done against built-in and user-defined data types so XML Schemas provide rich data typing capabilities.
- XML Schemas enable you to easily create and reuse complex models.

- XML Schemas utilize Object Oriented Design principles into its specifications.
- The XML Schema specification plays an important role in the design and implementation of Web Services.
- XML Schemas are extensible to future additions [13], [7], [14], [15].

1-2 XML Schema Utilizations and Practicalities

As it is known, the XML Schema describes and gives the precise structure of the XML document. The vast majority of web applications make use of the XML Schema to give their XML documents a unified structure definition for their elements and content models to ensure that the XML data is appropriately structured and valid.

XML Schemas have an enough potential for use in the inoperability of variant models and the accessibility of information stored in database systems [1].

An XML Schema Recommendation has significant value for XML-based publishing applications, XML Schemas are used to improve books and documents publishing [16], [17].

Biographical information gathering and storage applications make use of the XML Schema for gathering together the information in a standard format that would facilitate their re-use in a variety of contexts [18], [19].

1-3 The Need for a Standard System Dictionary

Systems evolve in a dramatic way, because of the evolution in business requirements, in addition to that, the software engineering field has encountered an emergence of new technologies that depend on many evaluation, measurement, estimation, assessment, and quality methods and models, which utilize a set of emerging high quality COTS, metrics, and ICASE tools.

These changes have increased the project member's responsibilities to produce more accurate and high quality systems depending on their experience and selection of the proper development tools and approaches from a sea of software engineering tools and methods [20], [21], [22].

A lot of studies have concentrated on developing a set of structured and reusable attributes for classifying and evaluating system products such as, the COTS products, software evaluation, quality, and assessment methods, for helping the users in selecting the proper set of products, tools, and methods for developing their systems to meet the business requirements and quality [20], [23], [24].

Nowadays Software products are more complex, and more interrelated to each other to fulfill the wide variety of emerging requirements of the business domain, the complexity and the increased number of utilized engineering approaches have led to an increased size of required documentations to document all system development activities, and the system components descriptions.

The role of the system developers, the analysts, and the project managers who are responsible to engineer, or reengineer the software system has also been complicated, since they have to revise and see all available system information from the available organizations' assets of system documentations, which assist them in developing high quality and reliable systems.

To reduce the time and the effort spent by the various project members and system analysts in revising the detailed system information that are located in a variety of resources, and in order to facilitate and enhance their work, a system documentation standard which can be viewed as a high conceptual system dictionary that has to store the metasystem information in a high granularity and in a reduced size of documentation has been designed. It provides project members and stakeholders with summarized, statistical,

and key information regarding the system undertaken development approaches, assessments, evaluation and system main measured and evaluated features and factors.

The dictionary also provides references to more detailed information that are located in other documentation resources such as the original system documentations and measurement repositories, which may have documented more details regarding each specific metasystem element; so the dictionary also plays the role of an index of the original system documentations [25].

2- Research Objectives And Methods

The work that has been done previously in [25] can be described as to define the framework and structure of the standard system data dictionary, then developing its data model to illustrate its metasystem entities and elements, then describing the semantic units for each metasystem element. the current standard system dictionary consists of a set of 171 metasystem element.

A variety of Metadata standards and dictionaries have designed metadata schemas like RDF and XML to benefit from Metadata schemas advantages like increased accessibility, retention of context, Multi-versioning, preservation, and to uniquely locate, describe and define the semantic unities of their corresponding metadata elements, [26], and they have built metadata repositories and registries to provide the interested users with the appropriate descriptions, vocabularies, and identifications to their standards elements and mappings from one standard elements to another standard elements, so that they can use the standards schemas efficiently.

some examples of such dictionary standards are; the data dictionary for documenting metadata for phonograph records [27], the XML Schema repository system for public construction information sharing [28]**,** the Dublin core data dictionary [29], the public broadcasting metadata dictionary [30], preservation metadata standards for digital resources [31], data dictionary- technical metadata for digital still images [32]**,** metadata for intangible cultural heritage [33], metadata in the digital health technologies [34], and a lot of other variety of applications and systems [35], [36], [37].

In view of above ,the present work is going to develop metasystem (system metadata) Schemas, XML and RDF schemas for our standard system dictionary to define the overall structure of the dictionary metasystem elements and their corresponding content models, then any information system or users can make use of these schemas.

This paper outlines one of the methods used to create metadata schemas which is the XML schema for the system standard, this schema will help system users and developers to create XML instance documents to describe their corresponding developed systems, and moreover, to deal with the XML documents that correspond to a variety of other documented systems via the internet, if these XML documents are instances of the same XML Schema of the system dictionary. Then, all these documents will be validated against the same schema leading to an increased interoperability among these systems and leading to a higher level of abstraction, standardization and utilization of the dictionary, an email address has been used to represent the default XML namespace to globally declare the schema elements, to let the interested users make use of them in their applications schemas.

3- Research Methodology

3-1 An Enhanced System Dictionary Data Model

We have previously developed the data model of the standard system dictionary, based on the main metasystem components (entities), that have been considered, and the hierarchy relationships among their enclosed metasystem elements. We have currently modified that data model to let it represent more occurrences of system developments as shown in figure (1). The new model consists of a root entity called the systems entity, and it, in turn, consists of system entity, which consists of one major entity the metasystem entity that encompasses of a set of entities, each entity of them encompasses of a number of sub entities and the sub entities will in turn encompasses of a set of raw and basic metasystem elements, as we have stated earlier in our previous research the relationships among these entities are of causal dependencies type [38], these relationships are represented as a direct lines, each direct line has a name that indicates the name of the dependency relationship [25].

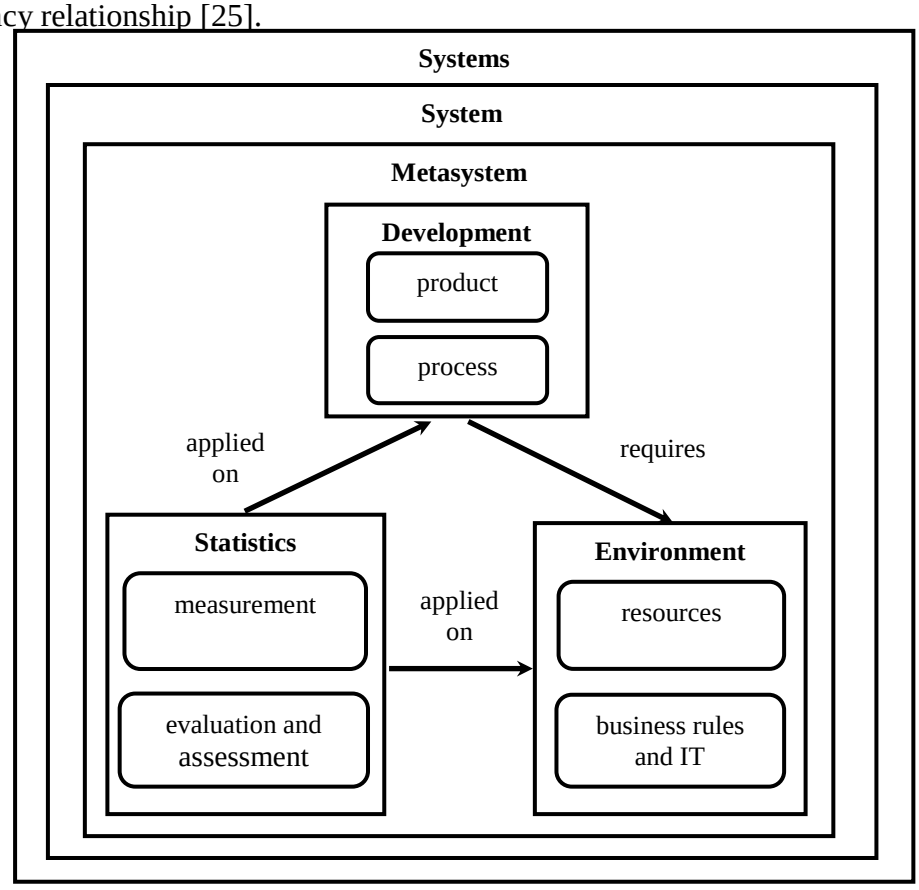

Figure (1) the system data dictionary data model

3-2 System Dictionary Metasystem Entities

From the above modified and derived data model, we can notice that it contains a number of main metasystem entities:

1. The systems entity: it is designed to be the highest root entity that represents the whole dictionary structure.
2. The system entity: an organization may have more than one information system, so for each system there will be one system instance.

3. The metasystem entity: it is designed to be the enclosing entity that covers all other entities, the development entity, the environment entity, and the statistics entity; each system development instance will have a unique metasystem entity instance.

4. The development entity: it contains two sub entities; the product metasystem sub entity and the process metasystem sub entity, each of these sub entities is encompassing of a set of interrelated metasystem elements, as an example the process sub entity is encompassing of a set of process metasystem elements that document information about the development process that has been used to develop the system.

5. The environment entity: it contains two sub entities; the resources metasystem sub entity that contains a set of metasystem elements for documenting information about the consumed resources, and the business rules and IT metasystem sub entity for providing information regarding the business and IT domain.

6. The statistics entity: it contains two sub entities; the measurement metasystem sub entity, and the evaluation and assessment metasystem sub entity; both of them contain metasystem elements for documenting information about assessment, quality, maturity, capability, improvement models, applied evaluation approaches, and etc.

4- Research results and Discussion

XML Metasystem Schema Representation for Dictionary

This section outlines the resulting XML Schema graph of the main entities using Microsoft visual studio software as illustrated in figure (2). It should be noted that these main entities were shown in the data model above.

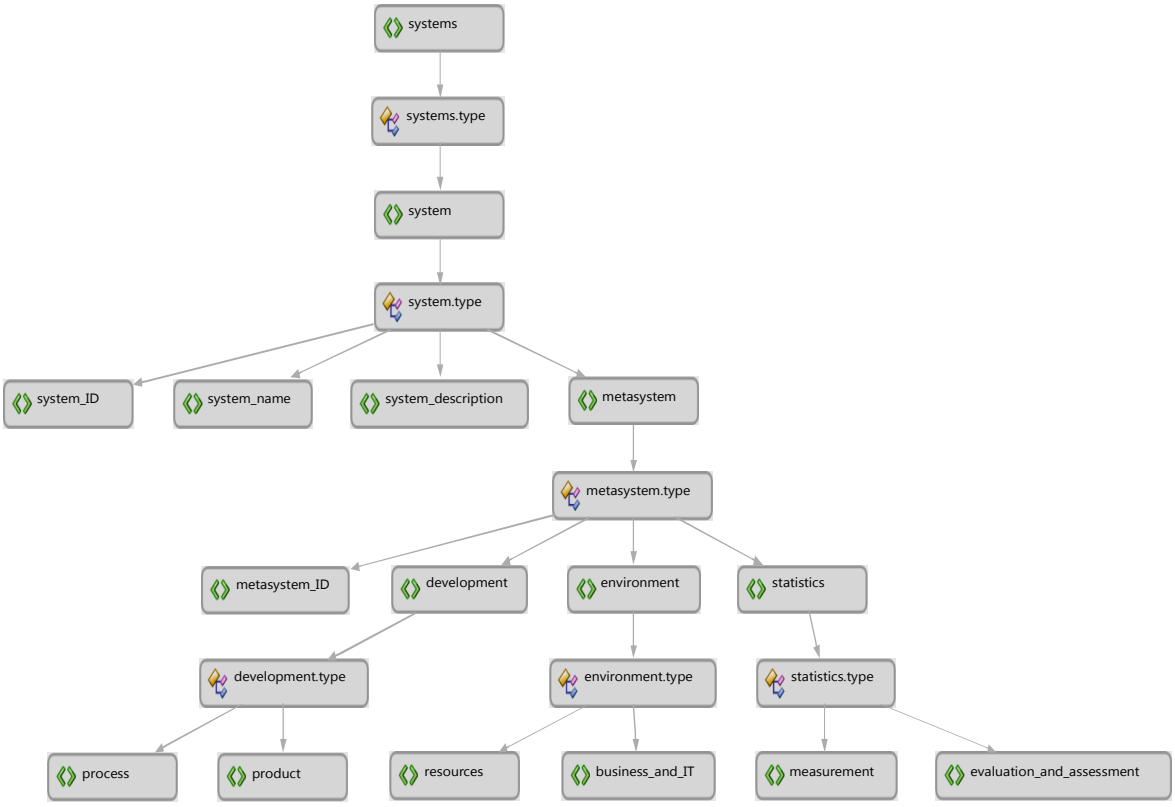

Figure (2) the main structure elements of the XML Schema

figure (2) shows only the main resulting xml schema elements as a graph, it does not show all the mapped xml schema elements of the system standard, which its metasystem elements have previously been defined and declared in [25].

It should be noted that, the Microsoft visual studio software shows only the correct and valid XML schema, this means that, this schema is correct and valid. Since this schema is the first developed schema for the standard system data dictionary, so it cannot be compared with other schemas.

We have drawn the graph for each main metasystem entity of this schema using the Microsoft visual studio software, but we did not list them here, since we don't want to increase the size of the research.

The figure (3) lists the full resulting xml schema with all xml schema elements for the standard system data dictionary.

```
<?xml version="1.0" ?>
- <xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
targetNamespace="maherib1978@yahoo.com" xmlns="maherib1978@yahoo.com"
elementFormDefault="qualified">
  <xsd:element name="systems" type="systems.type" />
- <xsd:complexType name="systems.type">
- <xsd:sequence>
  <xsd:element ref="system" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="system" type="system.type" />
- <xsd:complexType name="system.type">
- <xsd:sequence>
  <xsd:element ref="system_ID" />
  <xsd:element ref="system_name" />
  <xsd:element ref="system_description" />
  <xsd:element ref="metasystem" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="system_ID" type="xsd:integer" />
  <xsd:element name="system_name" type="xsd:string" />
  <xsd:element name="system_description" type="xsd:string" />
  <xsd:element name="metasystem" type="metasystem.type" />
- <xsd:complexType name="metasystem.type">
- <xsd:sequence>
  <xsd:element ref="metasystem_ID" />
  <xsd:element ref="development" />
  <xsd:element ref="environment" />
  <xsd:element ref="statistics" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="metasystem_ID" type="xsd:integer" />
  <xsd:element name="development" type="development.type" />
  <xsd:element name="environment" type="environment.type" />
```

```
<xsd:element name="statistics" type="statistics.type" />
- <xsd:complexType name="development.type">
- <xsd:sequence>
<xsd:element ref="process" />
<xsd:element ref="product" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="process" type="process.type" />
<xsd:element name="product" type="product.type" />
- <xsd:complexType name="process.type">
- <xsd:sequence>
<xsd:element ref="process_ID" />
<xsd:element ref="process_name" />
<xsd:element ref="starting_date" />
<xsd:element ref="finishing_date" />
<xsd:element ref="activity_quality_scale" />
<xsd:element ref="p_development" />
<xsd:element ref="life_cycle" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="process_ID" type="xsd:integer" />
<xsd:element name="process_name" type="xsd:string" />
<xsd:element name="starting_date" type="xsd:date" />
<xsd:element name="finishing_date" type="xsd:date" />
<xsd:element name="activity_quality_scale" type="xsd:string" />
<xsd:element name="p_development" type="p_development.type" />
<xsd:element name="life_cycle" type="life_cycle.type" />
- <xsd:complexType name="p_development.type">
- <xsd:sequence>
<xsd:element ref="dev_type" />
<xsd:element ref="dev_method" />
<xsd:element ref="management" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="dev_type" type="xsd:integer" />
<xsd:element name="dev_method" type="dev_method.type" />
<xsd:element name="management" type="management.type" />
- <xsd:complexType name="dev_method.type">
- <xsd:sequence>
<xsd:element ref="method_name" />
<xsd:element ref="method_type" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="method_name" type="xsd:string" />
<xsd:element name="method_type" type="xsd:string" />
- <xsd:complexType name="management.type">
- <xsd:sequence>
<xsd:element ref="management_kind" />
```

```
  <xsd:element ref="management_comment" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="management_kind" type="xsd:string" />
  <xsd:element name="management_comment" type="xsd:string" />
- <xsd:complexType name="life_cycle.type">
- <xsd:sequence>
  <xsd:element ref="increment" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="increment" type="increment.type" />
- <xsd:complexType name="increment.type">
- <xsd:sequence>
  <xsd:element ref="increment_no" />
  <xsd:element ref="activity" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="increment_no" type="xsd:integer" />
  <xsd:element name="activity" type="activity.type" />
- <xsd:complexType name="activity.type">
- <xsd:sequence>
  <xsd:element ref="activity_name" />
  <xsd:element ref="estimated_effort" />
  <xsd:element ref="actual_effort" />
  <xsd:element ref="effort_accuracy" />
  <xsd:element ref="estimated_cost" />
  <xsd:element ref="actual_cost" />
  <xsd:element ref="cost_accuracy" />
  <xsd:element ref="activity_quality_level" />
  <xsd:element ref="work_products" maxOccurs="unbounded" />
  <xsd:element ref="activity_comment" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="activity_name" type="xsd:string" />
  <xsd:element name="estimated_effort" type="xsd:decimal" />
  <xsd:element name="actual_effort" type="xsd:decimal" />
  <xsd:element name="effort_accuracy" type="xsd:decimal" />
  <xsd:element name="estimated_cost" type="xsd:decimal" />
  <xsd:element name="actual_cost" type="xsd:decimal" />
  <xsd:element name="cost_accuracy" type="xsd:decimal" />
  <xsd:element name="activity_quality_level" type="xsd:decimal" />
  <xsd:element name="work_products" type="xsd:string" />
  <xsd:element name="activity_comment" type="xsd:string" />
- <xsd:complexType name="product.type">
- <xsd:sequence>
  <xsd:element ref="product_ID" />
  <xsd:element ref="product_type" />
  <xsd:element ref="architecture" />
```

```
<xsd:element ref="product_points" maxOccurs="unbounded" />
<xsd:element ref="programming_languages" maxOccurs="unbounded" />
<xsd:element ref="database" maxOccurs="unbounded" />
<xsd:element ref="programs" />
<xsd:element ref="documentation" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="product_ID" type="xsd:integer" />
<xsd:element name="product_type" type="xsd:string" />
<xsd:element name="architecture" type="xsd:string" />
<xsd:element name="product_points" type="product_points.type" />
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<xsd:element name="database" type="database.type" />
<xsd:element name="programs" type="programs.type" />
<xsd:element name="documentation" type="documentation.type" />
- <xsd:complexType name="product_points.type">
- <xsd:sequence>
<xsd:element ref="points_type" />
<xsd:element ref="no_of_points" />
<xsd:element ref="calculating_approach" />
<xsd:element ref="value_adjustment_factor" />
<xsd:element ref="unadjusted_points" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="points_type" type="xsd:string" />
<xsd:element name="no_of_points" type="xsd:integer" />
<xsd:element name="calculating_approach" type="xsd:string" />
<xsd:element name="value_adjustment_factor" type="xsd:integer" />
<xsd:element name="unadjusted_points" type="xsd:integer" />
- <xsd:complexType name="programming_languages.type">
- <xsd:sequence>
<xsd:element ref="language_name" />
<xsd:element ref="language_kind" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="language_name" type="xsd:string" />
<xsd:element name="language_kind" type="xsd:string" />
- <xsd:complexType name="database.type">
- <xsd:sequence>
<xsd:element ref="database_ID" />
<xsd:element ref="DBMS_type" />
<xsd:element ref="DBMS_name" />
<xsd:element ref="DBMS_version" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="database_ID" type="xsd:integer" />
<xsd:element name="DBMS_type" type="xsd:string" />
```

```
  <xsd:element name="DBMS_name" type="xsd:string" />
  <xsd:element name="DBMS_version" type="xsd:string" />
- <xsd:complexType name="programs.type">
- <xsd:sequence>
  <xsd:element ref="lines_of_code" />
  <xsd:element ref="program_details" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="lines_of_code" type="xsd:integer" />
  <xsd:element name="program_details" type="program_details.type" />
- <xsd:complexType name="program_details.type">
- <xsd:sequence>
  <xsd:element ref="program_type" />
  <xsd:element ref="no_of_programs" />
  <xsd:element ref="type_loc" />
  <xsd:element ref="written_code_percentage" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="program_type" type="xsd:string" />
  <xsd:element name="no_of_programs" type="xsd:integer" />
  <xsd:element name="type_loc" type="xsd:integer" />
  <xsd:element name="written_code_percentage" type="xsd:decimal" />
- <xsd:complexType name="documentation.type">
- <xsd:sequence>
  <xsd:element ref="documentation_type" />
  <xsd:element ref="documentation_name" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="documentation_type" type="xsd:string" />
   <xsd:element  name="documentation_name"  type="documentation_name.type"
/>
- <xsd:complexType name="documentation_name.type" mixed="true">
- <xsd:sequence>
  <xsd:element ref="information_area" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="information_area" type="information_area.type" />
- <xsd:complexType name="information_area.type" mixed="true">
- <xsd:sequence>
  <xsd:element ref="component_name" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="component_name" type="component_name.type" />
- <xsd:complexType name="component_name.type" mixed="true">
- <xsd:sequence>
  <xsd:element ref="reference" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
```

```
<xsd:element name="reference" type="xsd:string" />
- <xsd:complexType name="environment.type">
- <xsd:sequence>
<xsd:element ref="resources" />
<xsd:element ref="business_and_IT" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="resources" type="resources.type" />
<xsd:element name="business_and_IT" type="business_and_IT.type" />
- <xsd:complexType name="resources.type">
- <xsd:sequence>
<xsd:element ref="resources_ID" />
<xsd:element ref="software_resources" />
<xsd:element ref="hardware_resources" maxOccurs="unbounded" />
<xsd:element ref="personal_resources" />
<xsd:element ref="information_resources" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="resources_ID" type="xsd:integer" />
<xsd:element name="software_resources" type="software_resources.type" />
<xsd:element name="hardware_resources" type="hardware_resources.type" />
<xsd:element name="personal_resources" type="personal_resources.type" />
<xsd:element name="information_resources" type="information_resources.type" />
- <xsd:complexType name="software_resources.type">
- <xsd:sequence>
<xsd:element ref="COTS" maxOccurs="unbounded" />
<xsd:element ref="ICASE" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="COTS" type="COTS.type" />
<xsd:element name="ICASE" type="ICASE.type" />
- <xsd:complexType name="COTS.type">
- <xsd:sequence>
<xsd:element ref="COTS_type" />
<xsd:element ref="COTS_no" />
<xsd:element ref="COTS_size" />
<xsd:element ref="COTS_name" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="COTS_type" type="xsd:string" />
<xsd:element name="COTS_no" type="xsd:integer" />
<xsd:element name="COTS_size" type="xsd:integer" />
<xsd:element name="COTS_name" type="xsd:string" />
- <xsd:complexType name="ICASE.type">
```

```
- <xsd:sequence>
  <xsd:element ref="ICASE_type" />
  <xsd:element ref="ICASE_no" />
  <xsd:element ref="ICASE_name" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="ICASE_type" type="xsd:string" />
  <xsd:element name="ICASE_no" type="xsd:integer" />
  <xsd:element name="ICASE_name" type="xsd:string" />
- <xsd:complexType name="hardware_resources.type">
- <xsd:sequence>
  <xsd:element ref="hardware_type" />
  <xsd:element ref="no_of_devices" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="hardware_type" type="xsd:string" />
  <xsd:element name="no_of_devices" type="xsd:integer" />
- <xsd:complexType name="personal_resources.type">
- <xsd:sequence>
  <xsd:element ref="experience_criteria" />
  <xsd:element ref="satisfaction_criteria" />
  <xsd:element ref="specialization" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="experience_criteria" type="xsd:string" />
  <xsd:element name="satisfaction_criteria" type="xsd:string" />
  <xsd:element name="specialization" type="specialization.type" />
- <xsd:complexType name="specialization.type">
- <xsd:sequence>
  <xsd:element ref="specialization_type" />
  <xsd:element ref="no_of_personnels" />
  <xsd:element ref="average_experience_level" />
  <xsd:element ref="average_satisfaction_level" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="specialization_type" type="xsd:string" />
  <xsd:element name="no_of_personnels" type="xsd:integer" />
  <xsd:element name="average_experience_level" type="xsd:string" />
  <xsd:element name="average_satisfaction_level" type="xsd:string" />
- <xsd:complexType name="information_resources.type">
- <xsd:sequence>
  <xsd:element ref="information_kind" />
  <xsd:element ref="information_titles" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="information_kind" type="xsd:string" />
  <xsd:element name="information_titles" type="xsd:string" />
- <xsd:complexType name="business_and_IT.type">
```

```
- <xsd:sequence>
  <xsd:element ref="business_IT_ID" />
  <xsd:element ref="business" />
  <xsd:element ref="IT" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="business_IT_ID" type="xsd:integer" />
  <xsd:element name="business" type="business.type" />
  <xsd:element name="IT" type="IT.type" />
- <xsd:complexType name="business.type">
- <xsd:sequence>
  <xsd:element ref="business_domain" />
  <xsd:element ref="planned_functions" maxOccurs="unbounded" />
  <xsd:element ref="achieved_functions" maxOccurs="unbounded" />
  <xsd:element ref="computerized_functions" maxOccurs="unbounded" />
  <xsd:element ref="manual_functions" maxOccurs="unbounded" />
  <xsd:element ref="computerization_rate" />
  <xsd:element ref="market_share" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="business_domain" type="xsd:string" />
  <xsd:element name="planned_functions" type="xsd:string" />
  <xsd:element name="achieved_functions" type="xsd:string" />
  <xsd:element name="computerized_functions" type="xsd:string" />
  <xsd:element name="manual_functions" type="xsd:string" />
  <xsd:element name="computerization_rate" type="xsd:integer" />
  <xsd:element name="market_share" type="xsd:integer" />
- <xsd:complexType name="IT.type">
- <xsd:sequence>
  <xsd:element ref="team_kind" />
  <xsd:element ref="team_size" />
  <xsd:element ref="organizations" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="team_kind" type="xsd:string" />
  <xsd:element name="team_size" type="xsd:integer" />
  <xsd:element name="organizations" type="organizations.type" />
- <xsd:complexType name="organizations.type">
- <xsd:sequence>
  <xsd:element ref="organization_name" />
  <xsd:element ref="organization_quality_description" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="organization_name" type="xsd:string" />
   <xsd:element  name="organization_quality_description"  type="xsd:string"
/>
- <xsd:complexType name="statistics.type">
- <xsd:sequence>
```

```
<xsd:element ref="measurement" />
<xsd:element ref="evaluation_and_assessment" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="measurement" type="measurement.type" />
<xsd:element name="evaluation_and_assessment" type="evaluation_and_assessment.type" />
- <xsd:complexType name="measurement.type">
- <xsd:sequence>
<xsd:element ref="measurement_ID" />
<xsd:element ref="cost" />
<xsd:element ref="effort" />
<xsd:element ref="defects" maxOccurs="unbounded" />
<xsd:element ref="metrics" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="measurement_ID" type="xsd:integer" />
<xsd:element name="cost" type="cost.type" />
<xsd:element name="effort" type="effort.type" />
<xsd:element name="defects" type="defects.type" />
<xsd:element name="metrics" type="metrics.type" />
- <xsd:complexType name="cost.type">
- <xsd:sequence>
<xsd:element ref="sys_total_cost" />
<xsd:element ref="sys_actual_cost" />
<xsd:element ref="sys_wasted_cost" />
<xsd:element ref="sys_estimated_cost" />
<xsd:element ref="cost_activity_rate" />
<xsd:element ref="cost_estimation_method" />
<xsd:element ref="cost_details" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="sys_total_cost" type="xsd:integer" />
<xsd:element name="sys_actual_cost" type="xsd:integer" />
<xsd:element name="sys_wasted_cost" type="xsd:integer" />
<xsd:element name="sys_estimated_cost" type="xsd:integer" />
<xsd:element name="cost_activity_rate" type="xsd:integer" />
<xsd:element name="cost_estimation_method" type="xsd:string" />
<xsd:element name="cost_details" type="cost_details.type" />
- <xsd:complexType name="cost_details.type">
- <xsd:sequence>
<xsd:element ref="cost_category" />
<xsd:element ref="amount" />
<xsd:element ref="cost_calculating_approach" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="cost_category" type="xsd:string" />
<xsd:element name="amount" type="xsd:integer" />
```

```
  <xsd:element name="cost_calculating_approach" type="xsd:string" />
- <xsd:complexType name="effort.type">
- <xsd:sequence>
  <xsd:element ref="sys_total_effort" />
  <xsd:element ref="sys_actual_effort" />
  <xsd:element ref="sys_wasted_effort" />
  <xsd:element ref="sys_estimated_effort" />
  <xsd:element ref="effort_activity_rate" />
  <xsd:element ref="effort_estimation_method" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="sys_total_effort" type="xsd:integer" />
  <xsd:element name="sys_actual_effort" type="xsd:integer" />
  <xsd:element name="sys_wasted_effort" type="xsd:integer" />
  <xsd:element name="sys_estimated_effort" type="xsd:integer" />
  <xsd:element name="effort_activity_rate" type="xsd:integer" />
  <xsd:element name="effort_estimation_method" type="xsd:string" />
- <xsd:complexType name="defects.type">
- <xsd:sequence>
  <xsd:element ref="defects_kind" />
  <xsd:element ref="main_causes" maxOccurs="unbounded" />
  <xsd:element ref="no_of_defects" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="defects_kind" type="xsd:string" />
  <xsd:element name="main_causes" type="xsd:integer" />
  <xsd:element name="no_of_defects" type="xsd:integer" />
- <xsd:complexType name="metrics.type">
- <xsd:sequence>
  <xsd:element ref="metric_name" />
  <xsd:element ref="metric_nature" />
  <xsd:element ref="target_usage" />
  <xsd:element ref="phase" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
  <xsd:element name="metric_name" type="xsd:string" />
  <xsd:element name="metric_nature" type="xsd:string" />
  <xsd:element name="target_usage" type="xsd:string" />
  <xsd:element name="phase" type="xsd:string" />
- <xsd:complexType name="evaluation_and_assessment.type">
- <xsd:sequence>
  <xsd:element ref="evaluation_ID" />
  <xsd:element ref="pre-evaluation" maxOccurs="unbounded" />
  <xsd:element ref="post-evaluation" maxOccurs="unbounded" />
  <xsd:element ref="applied_quality_models" maxOccurs="unbounded" />
  <xsd:element ref="product_quality" maxOccurs="unbounded" />
  </xsd:sequence>
  </xsd:complexType>
```

```
<xsd:element name="evaluation_ID" type="xsd:integer" />
<xsd:element name="pre-evaluation" type="pre-evaluation.type" />
<xsd:element name="post-evaluation" type="post-evaluation.type" />
<xsd:element name="applied_quality_models" type="applied_quality_models.type" />
<xsd:element name="product_quality" type="product_quality.type" />
- <xsd:complexType name="pre-evaluation.type">
- <xsd:sequence>
<xsd:element ref="pre-evaluation_method" />
<xsd:element ref="pre-evaluation_type" />
<xsd:element ref="applied_methodology" />
<xsd:element ref="considered_factors" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="pre-evaluation_method" type="xsd:string" />
<xsd:element name="pre-evaluation_type" type="xsd:string" />
<xsd:element name="applied_methodology" type="xsd:string" />
<xsd:element name="considered_factors" type="xsd:string" />
- <xsd:complexType name="post-evaluation.type">
- <xsd:sequence>
<xsd:element ref="model_kind" />
<xsd:element ref="model_name" />
<xsd:element ref="model_description" />
<xsd:element ref="post-evaluation_scale" />
<xsd:element ref="post-evaluation_details" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="model_kind" type="xsd:string" />
<xsd:element name="model_name" type="xsd:string" />
<xsd:element name="model_description" type="xsd:string" />
<xsd:element name="post-evaluation_scale" type="xsd:string" />
<xsd:element name="post-evaluation_details" type="post-evaluation_details.type" />
- <xsd:complexType name="post-evaluation_details.type">
- <xsd:sequence>
<xsd:element ref="target_component" />
<xsd:element ref="post-evaluation_level" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="target_component" type="xsd:string" />
<xsd:element name="post-evaluation_level" type="xsd:string" />
- <xsd:complexType name="applied_quality_models.type">
- <xsd:sequence>
<xsd:element ref="quality_model_name" />
<xsd:element ref="quality_model_description" />
<xsd:element ref="quality_scale" />
<xsd:element ref="quality_details" maxOccurs="unbounded" />
</xsd:sequence>
```

```
</xsd:complexType>
<xsd:element name="quality_model_name" type="xsd:string" />
<xsd:element name="quality_model_description" type="xsd:string" />
<xsd:element name="quality_scale" type="xsd:string" />
<xsd:element name="quality_details" type="quality_details.type" />
- <xsd:complexType name="quality_details.type">
- <xsd:sequence>
<xsd:element ref="applied_on" />
<xsd:element ref="quality_level" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="applied_on" type="xsd:string" />
<xsd:element name="quality_level" type="xsd:string" />
- <xsd:complexType name="product_quality.type">
- <xsd:sequence>
<xsd:element ref="product_quality_model_name" />
<xsd:element ref="quality_criteria" />
<xsd:element ref="quality_factor" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="product_quality_model_name" type="xsd:string" />
<xsd:element name="quality_criteria" type="xsd:string" />
<xsd:element name="quality_factor" type="quality_factor.type" />
- <xsd:complexType name="quality_factor.type" mixed="true">
- <xsd:sequence>
<xsd:element ref="factor_attribute" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="factor_attribute" type="factor_attribute.type" />
- <xsd:complexType name="factor_attribute.type" mixed="true">
- <xsd:sequence>
<xsd:element ref="attribute_sub_attribute" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="attribute_sub_attribute"
type="attribute_sub_attribute.type" />
- <xsd:complexType name="attribute_sub_attribute.type">
- <xsd:sequence>
<xsd:element ref="attribute_weight" />
<xsd:element ref="evaluation_scope" />
<xsd:element ref="quality_rating" />
<xsd:element ref="metrics_used" maxOccurs="unbounded" />
</xsd:sequence>
</xsd:complexType>
<xsd:element name="attribute_weight" type="xsd:integer" />
<xsd:element name="evaluation_scope" type="xsd:string" />
<xsd:element name="quality_rating" type="xsd:string" />
<xsd:element name="metrics_used" type="xsd:string" />
```

```
</xsd:schema>
```

Figure (3) The XML Schema Representation of the Standard System Dictionary

5- Conclusion and Future Study

Throughout this paper, an XML Schema has been developed for the dictionary for giving the system dictionary standard a wider representation and a higher level of abstraction, availability and usability for aiding system analysts and the other variety forms of users in their precious work and saving a lot of their efforts and time in developing and enhancing their current systems and exploring the metasystem of other developed systems that use the same XML Schema to document their systems.

6- References

[1] Good J. "The Benefits and Practicalities of Using Extensible Markup Language (XML) for the Interfacing And Control of Object-Oriented Simulations", *International Congress on Modelling and Simulation – MODSIM 05, Melbourne, Australia*, December 12-15-2005.

[2] Tim Bray, Jean Paoli, C. M. Sperberg-McQueen, Eve Maler, Extensible Markup Language (XML) 1.0 (Fifth Edition) - *W3C Recommendation* 26 November 2008.

[3] XML Tutorial, Introduction to XML, http://www.w3schools.com/XML/xml_whatis.asp.

[4] Petrova-Antonova D., Kuncheva K. and Ilieva S, "Automatic Generation of Test Data for XML Schema-based Testing of Web Services". *In Proceedings of the 10th International Conference on Software Engineering and Applications (ICSOFT-EA-2015)*, pages 277-284, France 2015.

[5] DTD Tutorial, Introduction to DTD, http://www.w3schools.com/dtd/dtd_intro.asp

[6] What is XML Namespace? Code Beach What is XML Namespace.MHTML, http://blog.codebeach.com/2008/02/what-is-xml-namespace.html , 2008.

[7] David Hunter, Jeff Rafter, Joe Fawcett, Eric van der Vlist, Danny Ayers, Jon Duckett, Andrew Watt, and Linda McKinnon, "Beginning XML 4th Edition", *Published by Wrox*, 2007.

[8] "XML Namespaces", http://www.w3schools.com/XML/xml_namespaces.asp

[9] Tim Bray, "XML Namespaces by Example", *O'Reilly Media*, http://www.xml.com/pub/a/1999/01/namespaces.html, 2008.

[10] Norman Walsh, "Understanding XML Schemas", *O'Reilly Media*, http://www.xml.com/pub/a/1999/07/schemas/index.html, 2008.

[11] P.G. Daly, "XML Basics and Benefits", *intranet journal*, http://www.intranetjournal.com/articles/200312/pij_12_08_03a.html, 2003.

[12] "Benefits of XML", *mulberry technologies*, http://www.mulberrytech.com/papers/HowAndWhyXML/slide009.html

[13] Schema Tutorial, "Introduction to XML Schema", http://www.w3schools.com/schema/schema_intro.asp

[14] David C. Fallside, Priscilla Walmsley, "XML Schema Part 0: Primer Second Edition" - *W3C Recommendation*, 28 October 2004.

[15] Trace Galloway, " Principles of XML Schema design " *proceedings by deepX* 2002.

[16] Kay Ethier, Alan Houser, "XML Weekend Crash Course", *Wiley, The Springer International Series in Engineering and Computer Science*, 2001.

[17] Arved C. Hübler, Klaus Kreulich, "Improving Individual Book Bublishing Concepts with XML Schema", 4th ICCC/IFIP conference on electronic publishing, Russia, 2000.

[18] Neil Thomson, "Report on the Development of BiogML: an XML Schema for Biographical Information as a Synthesys", *NA-D Activity*, 2005.

[19] Rogerio Campos-Rebelo et al, "Annotation Rules for XML Schemas with Grouped Semantic Annotations", *Proceedings of the 45th Annual Conference of the IEEE Industrial Electronics Society (IECON 2019)*, Lisbon, Portugal, 2019.

[20] Farbey, B. & Finkelstein, A. "Evaluation in Software Engineering: ROI, but more than ROI". *3rd International Workshop on Economics-Driven Software Engineering Research (EDSER-3)*, 2001.

[21] Köhler, G., Rust, H., & Simon, F. "An Assessment of Large Object Oriented Software Systems", *Proceedings of Object-Oriented Product Metrics for Software Quality Assessment at 12th European Conference on Object-Oriented Programming*, 1998.

[22] Nicole Clark, Pamela Davies, Rebecca Skeers, "Self and peer assessment in software engineering projects". *ACM International Conference Proceeding Series*; Vol. 106, Australia, 2005.

[23] Torchiano, M. & Jaccheri, L. "Assessment of Reusable COTS Attributes". *2nd International Conference on COTS-Based Software Systems*, Ottawa, Canada, 219-228, 2003.

[24] Kececi, N. & Abran, A. "Analyzing, Measuring, and Assessing Software Quality within a Logic-Based Graphical Framework", *4th International Conference on Quality and Dependability-QUALITA 2001*, Annecy, France, 2001.

[25] M. Maher Ibrahim & Dr. S.A.M Rizvi, "A framework for building standard system data dictionary", *proceedings of the first international conference on emerging technologies and applications in engineering, technology and sciences*, volume 3, paper number 3, india, 2008.

[26] Nagendra Panini Challa, Dr.R.Vasanth Kumar Mehta, "Metadata Schemas for Long Term Preservation of Digital Documents - A Survey", *International Research Journal of Computer Science* (IRJCS) ISSN: 2393-9842, Issue 12, Volume 3, December 2016.

[27] Catherine Lai, Ichiro Fujinaga, "Data Dictionary: Metadata for Phonograph Records", ISMIR0633_Paper.PDF, *joint conference on Digital libraries*, Chapel Hill, NC, USA, 2006.

[28] Choung-Houng Wu, Shang-Hsien Hsieh, I-Chen Wu, and Hui-Ping Tserng, "Development of an XML Schema Repository System for Public Construction Information Sharing", 2002.

[29] "Dublin Core Metadata Initiative making it easier to find information", Dublin Core Metadata Initiative (DCMI).MHTML http://dublincore.org/

[30] "PBCore XML Schema", PBCore XML Schema.MHTML, http://www.pbcore.org/PBCore/PBCoreXMLSchema.html, 2009.

[31] Sally H.McCallum, "Preservation Metadata Standards for Digital Resources (PREMS)", premis-final.PDF, http://www.oclc.org/research/projects/pmwg/premis-final.pdf May 2005.

[32] Ballot Period, "Data Dictionary – Technical Metadata for Digital Still Images", NISO Standard, Z39-87- 2006.pdf, 2006.

[33] Giannoulakis S., Tsapatsoulis N. and Grammalidis N. "Metadata for Intangible Cultural Heritage - The Case of Folk Dances". *In Proceedings of the 13th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISAPP 2018)*, pages 634-645, 2018.

[34] Badawy et al, "Metadata for Advancing the Use of Digital Health Technologies inClinical Research", *Published by S. Karger AG*, Basel, Digit Biomark;3:116–132, 2019.

[35] "XML Schemas for Resource Metadata: a Tutorial Version 1.0", http://www.ivoa.net/Documents/Note/XML-RM/XML-RM-20031125.html, 2003.

[36] S.M. Rashid, J.P. McCusker, P. Pinheiro, M.P. Bax, H. Santos, J.A. Stingone, A.K. Das & D.L. McGuinness. "The semantic data dictionary – an approach for describing and annotating data". *Data Intelligence*, 443–486. doi: 10.1162/dint_a_00058, 2020.

[37] Jean Brodeur et al, "Geographic Information Metadata—An Outlook from the International Standardization Perspective", ISPRS Int. J. Geo-Inf, 8, 280; doi:10.3390/ijgi8060280, 2019.

[38] R. Dumke, M. Blazey, D. Reitz, & Karsten, "Causalities in software process measurement and improvement", *Proceedings of the International Conference on Software Process and Product Management*, p No 42-52, 2006.