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Added value in the context of research information systems

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Abstract

Purpose – The purpose of this paper is to discuss added value in the context of current research information systems (CRISs) based on metadata enrichment.

Design/methodology/approach – This discussion paper uses literature review as well as analysis of CRISs specifications to discuss added value possibilities.

Findings – Added value of the CRISs is in their integration and interoperability with the same and similar information systems. Since metadata plays key roles in interoperability of information systems, therefore focussing on metadata-related issue can add considerable values to CRISs. Two types of metadata can be distinguished in every CRISs including macro- and micro-metadata. In terms of macro-metadata common European research information format (CERIF) by itself is an added value for CRIS because it draws a complete view of the research landscape including entities and their relations. CERIF metadata structure is designed in such a way that supports micro- and macro-metadata.

Originality/value – There is a lack of literature on adding value to research information systems especially CRIS and particularly how value can be added in CRISs still is an unanswered question. CRIS developers can use this paper as a road map to choose the most valuable strategy for adding value to their systems.

Keywords Added value, CERIF, CRIS, Data model, Macro-metadata, Micro-metadata

Paper type General review

1. Introduction

Every research information system is composed of data about research landscape components such as projects, research organizations, researchers and research outputs (e.g. publications or patents). Research information is usually available on the web and could be found on organization websites, researcher's personal webpage and information systems. Most of the existing structures are proprietary or not well-known. This research information can be useful for all of science and technology stakeholders for discovering, evaluating and planning research activities at organizational or national levels. The main stakeholders of research information are: researchers, research managers, science and technology policy makers, research councils, organizations responsible for technology transmission, media and the public. Ideally, research information should be available in a consistent, updated and open access manner, but the reality is different. Research data are distributed among organizational, personal, social and commercial websites and these data have various structures (Blümel *et al.*, 2014). In other words, these data are just like islands owned by various persons and organizations and each of them have their own structure. Therefore, integration of these data and making an integrated and comprehensive information system containing a single structure of research data, is necessary

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(Beucke *et al.*, 2014). This necessity made research administrators think about information systems for managing their research information. The most well-known keyword for describing this kind of information systems is current research information system (CRIS).

From 1960s CRISs have been used especially for research management (Jeffery and Asserson, 2009). From about 1970s efforts have been made for standardization of research information systems and in 1994 EuroCRIS was formed as a foundation for standardization of CRIS. Common European research information format (CERIF) as a standard data model for CRISs was formed and maintained by EuroCRIS (Rabow, 2009). According to the definition presented on the EuroCRIS (2010) website, CRISs are tools for providing access to research information and disseminating them. Therefore, every CRIS consists of a data model for description of objects included in research and development and tools or collection of tools for data management. The goal of every CRIS is helping its users in discovering, registering, reporting and decision making in research-related processes.

According to Pinto *et al.* (2014) and Beucke *et al.* (2014) there are some kinds of research information systems that can be mistakenly regarded as CRISs. These systems include:

- Research social networking tools that provide an interactive environment for researchers to communicate and broadcast their research results such as ResearchGate, Academia.edu.
- Information retrieval systems that are designed for resource discovery purposes. Online databases and repositories are examples of this kind of systems.
- Research profiling information systems. This systems use the concept of open linked data for integration and exchange of data available on the web. VIVO is an example of such systems.

CRISs are different from these information systems in terms of goals, users and data. Therefore the notion of added value concept in the context of the CRIS will be different from such information systems.

Unlike other kinds of research information systems, CRISs are regarded as research management information systems (RMIS) at organizational or national levels since it provides a tool for supporting research decision makers to successfully do tasks such as national science and technology road mapping; defining national research priorities; supporting and automating the process of assigning public budget for research institutes; evaluating and ranking research institutes based on defined criteria (Khoshroo and Fatemi, 2010). Along with these main goals, objectives such as providing fast, easy and reliable access to scientific information for researchers; improving quality of research, providing an area for industry to announce their needs and for researchers to propose their solutions, are followed in CRISs (Khoshroo and Fatemi, 2010). In management information systems metadata play a key role and metadata about data, its source, its format, its assumptions and constraints, and other facts about the data are stored in data warehouse's metadata database and the reporting system uses the metadata to prepare and deliver reports to the appropriate users (Kroenke *et al.*, 2014, p. 270). In other words reports generated for every user include different metadata elements.

As a RMIS, CRIS includes metadata relevant to the research landscape in organizational or national level. Therefore, CRIS can be regarded as a pool of metadata and this differentiates CRIS from well-known scientific full text or bibliographic

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information systems. Studying literature on adding value in information systems shows that this issue is addressed in scientific literature databases generally (Taylor, 1982; Eisenberg and Dirks, 2008; Scholl *et al.*, 2011) or bibliographic database (Notess, 1998; Kottai, 1993; Jatkevicius and Sebold, 2000; De Groote, 2000; Tenopir and Hover, 1993; Anagnostelis and Cooke, 1997). It should be noted that some of this literature has not directly mentioned "added value" or "value added" terms. Since the purpose of comparing the various versions of same database is identifying their strength and weakness, therefore these documents are regarded as a relevant body of literature. There is a lack of literature on adding value to research information systems especially CRIS and particularly how value can be created in CRISs still is an unanswered question. Therefore, the main goal of this paper is addressing added value in the context of CRISs. In what follows, after discussing added value in information systems generally, this concept will be addressed in the context of CRISs based on the metadata enrichment approach. Finally, CERIF will be criticized in terms of its value added structure and value added metadata elements.

2. Research method

This paper is a discussion paper and existing literature on added value in information system is used to discuss about the issue of adding value to CRISs. At first step existing literatures on adding value in information systems generally and in the context of CRIS are reviewed to identify different points of view about added value in CRISs. Then according to the definition presented for CRIS by EuroCRIS, as a formal and reference definition, two approaches for adding value in the context of CRISs are proposed: adding value through developing new tools and software for data analysis, and adding value through content, i.e. metadata enrichment. Because of the importance and the centrality of metadata in CRISs, added value is discussed specially in terms of metadata enrichment. In this regards metadata structure of CERIF data model as a standard data model proposed for CRISs by EuroCRIS has been reviewed. Metadata categorization which includes macro- and micro-metadata are borrowed from register-based statistics literature is used to analyze the metadata structure of CERIF.

3. Literature review

Added value in information system

The existing well-known value added model in information systems, i.e. Taylor value added model, is based on a continuum which begins with data and ends with action. This journey from data to action has four phases and in every phase values are added to data. These phases are: organizing process, synthesizing process, judgmental process and decision process (Taylor, 1982). Based on this continuum Taylor's (1986) value added model and TEDS framework are formed. Taylor value added model is consisted of a table with three columns. The first column includes criteria that make users choose an information system. These criteria are ease of use, noise reduction, quality, adaptability, time saving and cost saving. Based on each of these criteria values are offered in column two. For example, to meet quality-related criteria accuracy, comprehensiveness, currency, reliability and validity of information should be regarded in information systems. Finally in the third column strategies that can put the second column values in action, are considered (Eisenberg and Dirks, 2008). Updating Taylor's model in terms of keeping pace with changes in the information technology landscape, Scholl *et al.* (2011) introduced a TEDS framework. This framework is the

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same as the Taylor model, but some elements are replaced with new ones. For example, under user criteria time saving and cost saving relatively are replaced with performance and affection. Accordingly some new elements are also added to added value (column two). Generally, the value added model, and consequent TEDS framework, provides a vocabulary grounded for analyzing and evaluating knowledge organization (KO) practices. They are designed in such a way that can act as a tool to evaluate value so that transcends the particularities of any technology platform or use environment (Pimentel, 2009).

Cisco and Strong (1999) have proposed value chain-based model for adding value to information management process in organizational context. This model is based on Michael Porter's value chain concept and information management process is regarded as a production line and every activity in these processes adds some value to records, knowledge and document management processes. In this model, value chain activities, i.e. records management, knowledge management, and document management form a matrix and its structure is similar to Taylor value added model. But, in contrast to the Taylor model which was user oriented, this model is process oriented.

In addition to added value models in information systems, there are scientific literatures related to the evaluation of the structure and content of online databases. These studies can also be regarded as part of the knowledge about added value in information systems since they are seeking for the ways to increase database popularity among users and according to Picoli (2007, p. 201) value is in the eye of the customer. Jacsó (2001, pp. 136-148) in his book, *Content Evaluation of Textual CD-ROM and Web Databases*, has addressed value added data elements in databases. He believes that the following can add value to databases:

- number of fields;
- subject classification and allocation of subject terms to documents;
- providing abstracts and summaries along with full-text versions of documents;
- availability of full texts; and
- linking among various databases such as linking references of a paper to databases containing their full text.

Existing literatures on value adding to information systems cannot be applied fully for CRISs because of the following reasons:

- Added value models are general and they consider value based on users needs and wants without considering system specifications. They consist of some predefined criteria for value added systems and according to Pimentel (2009) value added model is a vocabulary for analysis and evaluation of KO practice in information systems. CRIS consist of data (in terms of metadata) and tools for managing that metadata. In the existing models there are no specific guidelines or clues for added value through metadata or data management tools.
- Other studies on added value consider one specific database or information system as case for value addition and they have considered many aspects of a bibliographic or full-text databases. Since their objects are mainly publication oriented databases and CRIS includes many other entities in addition to publication, therefore this literature support only a small part of discussion on added value in CRIS.

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Therefore, added value in CRISs requires comprehensive knowledge about this kind of systems including their missions, components and then different user groups whom these systems serve and their needs and wants.

Adding value to CRIS

There are studies which discuss added value in the context of CRISs. Many of these works have addressed this issue briefly. Following are some of the points of view on added value in the context of CRISs derived from literature.

According to the European Science Foundation (2008) report on integrated research information systems added value in CRISs are those functions that can be achieved using integrating research information systems. In other words, authors of this report consider integration as valuable and what leads to these values is integration of research information systems. Some of these functions are:

(1) making information on national research accessible for international audiences and therefore making national research performance visible;
(2) acquiring information on national-level research activity and/or other countries and then:
    - comparison of budgeting performance in national or organizational levels;
    - identifying and comparing research profiles of researchers, organizations, and even nations in special subject domains;
    - identifying hot and popular subject domains; and
    - identifying gaps in research in terms of lacking research on some subjects or in some regions.
(3) helping to manage research budgets and activities;
(4) expanding of scientific and research collaboration in international and interdisciplinary levels;
(5) using research data for evaluation purposes;
(6) integrated search capability in different organizational and/or national research information systems;
(7) offering one single point for entering to information world on research projects;
(8) possibility of finding researchers with similar research interests or experienced organizations in terms of research on special subject domains in addition to conventional methods such as scientific conferences or analyzing publications; and
(9) possibility of finding professional researchers and reviewers for research agencies.

Hornbostel (2006) argued that future CRISs value is not just their information, but it will be dependent on their capability in information evaluation and relating information from different sources. This means that these systems should be designed in such a way that can be interoperable with other information systems and there should be monitoring processes to guarantee reliability of their information.

Schirrwagen and Jahn (2013) suggest that added value of CRISs is in their capability to connect with open access information systems such as OpenAIRE and according to them; this capability can enrich information available in two systems using information harvesting.

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Chudlarský and Dvořák (2012) argued that since in CRISs research outputs are visible and centered in one research information system, added value is perceivable in terms of researchers capability of intra-national scientific collaboration.

Houssos *et al.* (2012) believed that added value services based on heterogeneous data are a product of the representation and management of metadata. They discuss that this matter is specially a challenging issue in the field of making data infrastructure for public information sector.

Zimmerman (2002) argued that the added value in CRISs is in their interoperability with same information systems and making an international research information system.

Schöpfel (2013) believes that since CRISs are centralized information systems containing metadata from different information systems and repositories, therefore it is necessary that these information systems allow CRIS to access their information and using this as a way of adding value to their content. It seems that he looks at CRIS as an added value platform for information systems/repositories that can integrate their information and insists on using common data exchange standards such as CERIF and reliable and rich metadata.

Summarizing researcher's points of view on added value in CRISs, it can be said that the majority of them directly or indirectly believe that interoperability of CRISs with each other and existing information systems and harvesting of metadata on research entities in a single information system (i.e. integration) can add value to CRIS. This belief can arise from this fact that CRISs are primarily developed in organizational contexts and integrating them is an added value that allows managing research and technology status at a higher level. Such integration or interoperability allows added value processes to be both meaningful and useful.

There are some countries such as Iran where CRIS has been implemented in their national level (known as SEMAT) and organizations upload their research data directly or indirectly to it. Therefore the structure of adding value will be different in these cases and should have new approaches. In this situation the major added value is an integrated CRIS. In the absence of multiple CRISs, the concept of interoperability has no meaning. In this situation it is necessary to think about appropriate and standard data/metadata model that meets users' needs and compatible with national research context. On the other hand future trends toward interoperability of CRISs in international levels should be considered and compatibility of national CRIS with each another should be guaranteed.

4. Approaches for adding value to CRIS

There can be two approaches for adding value to CRIS regarding their main components: data model (with integration and interoperability aspects) and processing. The second component which is beyond this paper's domain, is developing efficient tools for managing data including analysis, reporting, disseminating of data. Research Data that are translated to the structure of a data model and its metadata elements are at the heart of every CRIS and without an efficient data model and metadata elements on every entity CRISs will have no or little value for its target users. The data model is also a metadata model (Simons, 2014). The reason is related to the type of use. If the data model is used as a mean to acquire information on the research landscape, therefore it is metadata (data about research landscape). For considering value addition using metadata, it is better to have a framework to categorize metadata since there are different types of metadata in CRIS. There is categorization of metadata in context of register systems that is compatible with CRIS metadata specification and it should be worth noting that CRIS itself is a register system for the research landscape. According to Wallgren and Wallgren (2007)

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metadata can be considered in two categories: macro-metadata and micro-metadata. Micro-metadata are data about individual units or objects such as a book or a researcher and Macro-metadata are data which are about aggregated data for groups of objects. Table I presents macro- and micro-metadata in the context of CRIS.

The level of analysis is an important aspect which can be influential on borders of micro- and macro-metadata. For instance at the level of a university, the number of citations for an article is micro-metadata for article entity in research evaluation systems and the total number of citations for articles published by authors affiliated to a university is a macro-metadata element for that university.

Macro-metadata

Macro-metadata are data about collections of information objects at the highest appropriate or relevant level of analysis. Actually macro-metadata elements are generated using further analysis of micro-metadata elements. Macro-metadata can be considered in two forms in CRIS: a data model determining entities and their relationships and metadata elements that can be generated using mathematical operations on metadata at micro-levels. The latter type of macro-metadata can be generated from various queries, such as count, average, total, in structural query language.

Various standards have been used for representing the research landscape at macro-level. According to Pinto *et al.* (2014) from ten national CRISs, four CRISs were compliant with a standard data model and other had proprietary data models. In this situation interoperability of CRISs, as a main added value considered in literature, will be a difficult work. Therefore, countries should choose a standard and comprehensive data model to be fully representative of their national research landscape and interoperable with other CRISs. There is already a comprehensive data model which is specifically designed for CRISs. This data model which is updated regularly from 1991 to be comprehensive and interoperable enough is CERIF maintained by EuroCRIS.

CERIF as a standard data model for CRISs by itself is a macro-metadata. It fully represents research landscape using various entities and relationship among them. CERIF will be discussed below under CERIF metadata structure.

Using CERIF can add value to every CRIS that is fully representation of research landscape by making them interoperable and with other similar systems. For those national CRISs that are not compatible with CERIF, Pinto *et al.* (2014) have proposed using the Dublin Core (DC) metadata schema to make their CRIS interoperable because CERIF supports (as in interconvertible subset) the DC metadata schema. Although using DC makes their CRIS interoperable, due to its flat nature (Jeffery *et al.*, 2014) it cannot represent relations and semantics of the research landscape and thus these types of CRIS will lose significant potential added value with this adoption.

Metadata type	Definition	Purpose	Users
Macro-metadata	Data about whole body of data entities, their relations, accumulated data and so on	Statistics, comprehension of an existing landscape	Users engaged with policy making and reporting such as decision makers and media
Micro-metadata	Data about every individual item inside body of data like a book in library	Resource discovery	Researchers

Table I.
Metadata categories in context of CRIS

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Regarding research information systems, there are lower-level entities where aggregation of their metadata elements (micro-metadata) can be regarded as a metadata for upper-level entity (macro-metadata). For example, at national level, the total number of articles published by researcher X is a micro-metadata element for researcher X, and every research organization has several researchers. Therefore, the total number of articles published by researchers affiliated to organization Y is a macro-metadata element for that organization. Every country has several research organizations that the total number of articles published by organizations is a macro-metadata for country research output in terms of number of articles published during a period of time. It is better to say, macro-metadata are indicators that a policy maker needs in order to gain information on the current status of a research system. This kind of metadata provides an infrastructure for better policy making in different levels of research. There are various indicators which can be considered as an evidence for policy making. Some of these indicators for measuring science and technology are internationally accepted (UNESCO, 2014) while others can be contextual and based on information needs of policy makers. Therefore identifying information needs of science and technology policy makers and translating them to the form of macro-metadata is a value creation for policy makers in every national CRIS.

Micro-metadata

Micro-metadata are the building blocks for identifying an entity in information systems. Micro-metadata generally are used for introducing an information object, therefore they are used for discovery purposes. There are metadata schemas such as DC and MARC which are composed of fixed sets of micro-metadata elements for identifying information objects basically in the library context. This type of metadata is defined in the micro-level of entities in information systems and considers individual object types. Interoperability of research information systems are met using micro-metadata. Interoperability was one of the most cited added values for CRISs and interoperability with institutional repositories and with the other CRISs have been considered by authors. As an example, Jeffery and Asserson (2009) have described a framework for interoperability of CRISs with each other and open access repositories. Researchers are main users of metadata at micro-level. They prefer to search and retrieve their desired information through simple and more integrated search systems (Maughan, 1999). Besides providing integrated search over distributed science and technology databases, there should be sufficient metadata elements for meeting the needs of researchers. As an example, according to a review on existing literature by Tenopir *et al.* (2003), 77 percent of scholars begin their search at multi-journal websites with links to full texts, therefore a metadata element containing a link to full text of publications can add considerable value to CRIS.

Micro-metadata have many standard schema such as DC, METS and so on and every schema has fixed set of metadata elements. Generally micro-metadata have been categorized in literature in different forms. Jeffery *et al.* (2002) have drawn a map for micro-metadata in the context of research information which is presented in Table II. This categorization can inform CRIS designers about adding value in CRIS. According to this research micro-metadata are associative metadata that "provide additional information for application assistance. The assistance may improve performance, accuracy or precision of the system and/or provide assistance to end-user through a domain aware supportive user interface."

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It should be noted that the authors have categorized micro-metadata elements based on their use. Descriptive metadata are used for identifying; restrictive metadata elements are used for copyright, security, and privacy issues and supportive metadata elements are metadata elements with standard and consistent value across information systems like subject or geographical places in affiliation field. In what follows, CERIF as a value adding option is introduced in terms of macro- and micro-metadata.

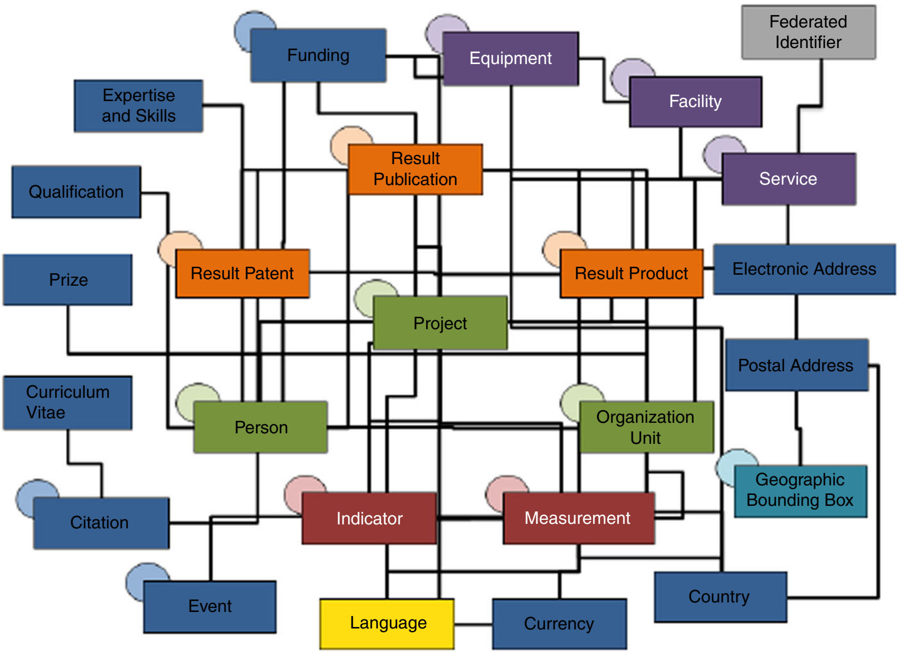
Macro- and micro-metadata in CERIF

CERIF is a conceptual (meta) data model which allows interoperation among research information systems and systems for management of information about researchers, research projects, publication and so on. The first version of this data model was released in 1991 (Jorg *et al.*, 2012). The first data model in 1991 mainly focussed on research projects (Pinto *et al.*, 2014) and since then this data model has been evolved so that the version of this data model since 2000 supports time-stamped semantic relationships between entities (Dvorak, 2013). Figure 1 shows abstract model of this data model.

Table II. Metadata categorization

Metadata categories	Examples
Descriptive metadata: catalogue record	Dublin Core
Restrictive: content rating	PICS or security, privacy (cryptography, digital signature)
Supportive: dictionaries, thesauri, hyper glossaries, domain ontologies	Mesh thesaurus

Source: Jeffery *et al.* (2002)



Source: Jeffery *et al.* (2014)

Figure 1. Abstract model of CERIF data model

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CERIF completely represents a research system and its entities and relations among them. This data model is consisted of different entities which are (Jorg, 2010):

- Base/core entities: these entities are representing the research landscape actors by their contribution to research execution. These entities form a first layer of CERIF database that is a pre requisite for CRISs to act as dynamic research register system.
- Result entities: these entities are representing output of research which can be in the form of publications, product (such as software) and patent. For instance a dissertation while is running is regarded as projects and when is done its status change to publication. This layer can be regarded as library layer.
- Second-level entities: these entities represent research infrastructures such as facilities, equipment, funds, awards and so on. Information communicated using this layer can inform policies about research infrastructure status. This layer can be regarded as research infrastructure.
- Link entities: these entities are used to connect core, result and second-level entities with each other, themselves and classes of semantic layer. This type of entities is considered as one of the main strengths of this data model so that every link has its own metadata elements including role, start date, end date. A closer look at the metadata embedded in CERIF data model for representing every entity makes it evident that there are three main metadata elements in CERIF which are presented in Table III.

What is important about the CERIF metadata structure is that the value for metadata elements that cover different aspects of entities, such as type, broad subject category, topics of a publication, is extracted from a classification schema in the semantic layer. The main reason for that is establishing consistency within the information system and this structure is required for guaranteeing interoperability of CRISs.

Returning to the main discussion of the article on macro- and micro-metadata it can be said that CERIF provides both macro- and micro-metadata elements. CERIF as a whole can be regarded as macro-metadata since it reveals research structure in organizational and/or national level and it can be said that CERIF by itself is an added value inside CRISs. This data model completely covers the research landscape and it is flexible enough to embrace new entities. For instance the

Meta data elements	Purpose	Example
Common metadata	Common metadata elements are use for identifying and following up an entity and they are mandatory for every entities in CERIF	ID, acronym, URI, start date, end date
Multi-lingual metadata in the form of multi-lingual weak entities	These metadata elements describe an entity in various languages and make it possible to have data exchange among various research-related information systems and multi-lingual search	Title, abstract, keywords
Link metadata in the form of link entities	These metadata elements are created based on relations among entities in CERIF and are set up by relational entities	Project_person (author, manager of project and so on)

Table III.
Metadata structure in CERIF

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MICE (measuring impact under CERIF) project results added two second-level entities, i.e. indicator and measure to CERIF (Gartner *et al.*, 2013). Excessive comprehensiveness of CERIF is an obstacle for its use. Pinto *et al.* (2014) argue that the domain and details of this data model is very expansive so that its full understanding is a difficult task and they propose using DC as a complementary solution for increasing interoperability among CRISs. Mapping CERIF entities and attributes to DC is provided (Jeffery *et al.*, 2002). On the other hand a difficulty of CERIF that is a result of focussing on machine understandability of research landscape (Jeffery *et al.*, 2002) and this can be solved by customization of CERIF based on contextual needs as some national CRISs have done it (Pinto *et al.*, 2014). An example of misunderstanding of CERIF is a paper published by Nonthakarn and Wuwongse (2015). The main goal of the paper is "designing an application profile that will enable interoperability among research management systems, support research collaboration, and facilitate the management of research information." The authors have criticized CERIF in some parts of the paper. The followings are points by authors which are wrong:

- According to the authors "although CERIF covers the research information […]. […] it is a conceptual model based on the entity-relationship model which does not directly support information sharing." This assertion is not true and when CERIF is implemented in a distributed information environment, it is capable of information sharing (Pacheco *et al.*, 2006). Furthermore EuroCRIS has defined the CERIF-XML interchange standard especially for information sharing among web services (EuroCRIS, 2013).
- According to the EuroCRIS (2010) it has neutral architecture and can be implemented in relational or object-oriented structures. In this paper it is claimed that "CERIF uses an entity relationship-based conceptual model" which is not true.
- It is claimed that CERIF "provides fewer properties in each entity. All entities have the same property structure and some properties are not clearly defined." According to Table III, CERIF has supported three kinds of metadata elements. This claim maybe is the result of assuming CERIF as a flat metadata structure. In this regard it should be said that many of the CERIF metadata elements are defined based on relationship of entities and represented by link entities.
- In this paper it is claimed under CERIF the starting point or the center of the data model: "project entities are the starting point and aim is to support is exchange of information on research projects between EU member states." Studying history of CERIF proves the fallacy of this claim. Project was at the center of CERIF 91, i.e. the earliest version of CERIF and in latter versions of CERIF focus is on research organizations, and persons in addition to projects as main or core elements of research systems.

CERIF as a contextual data/metadata model (macro-metadata), as shown in Figure 2, is designed in such a way that also supports micro-metadata including: discovery, flat metadata schema and domain metadata, "detailed metadata standards for data sets of particular types or domains such as CSMD for scientific data sets, SDMX for statistical data, INSPIRE for geospatial data and DDI for data documentation initiative" (Jeffery *et al.*, 2014).

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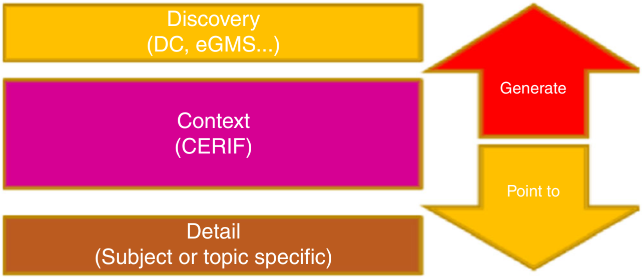

Figure 2.
CERIF metadata layer

Source: Jeffery *et al.* (2014)

5. Conclusion

Adding value in information systems is a process that increases information systems' popularity and use among user groups. According to information system elements, different approaches can be adopted for added value for users. What is important in added value processes is considering user's needs and wants. The focus of main added value models for information systems including Taylor's value added model, is the criteria set based on users and general, mainly content based, value adding options with no sign of information system's specifications. In the context of CRISs whose main components are data/metadata model and tools for processing and analyzing data, two ways can be considered for adding value: enriching metadata; and working on different tools for analyzing existing data. This paper considered only the former. Metadata are at the heart of CRIS, i.e. CRISs are a pool of metadata, and the other component, i.e. analyzing tools, is shaped based on metadata specification. Therefore, metadata enrichment plays a key role in adding value processes in CRISs. Most of value added mechanisms and perceptions in literature can be satisfied using considerations on metadata-related issues including setting standards, metadata elements enrichment, metadata harvesting protocol and so on. Elaborating on metadata in CRISs, it can be revealed that there are two kinds of metadata elements inside CRISs: macro-metadata; and micro-metadata. Macro-metadata are indicators which are formed by combination of individual micro-metadata elements and a comprehensive data model that can fully represent the context of a research system. The main users of this kind of metadata are especially research policy makers and media. Micro-metadata are metadata at the level of every individual entity that exists in CRIS and their main mission is identifying an individual item. The main users of this type of metadata are researchers. CERIF has met both the macro- and micro-metadata requirement and using this data model can add value to CRISs. It has been suggested that given the level of comprehensiveness of CERIF and variety of information needs in different contexts, CRIS developers should customize CERIF based on their needs. However, such customization may preclude the added value aspects of integration (providing a consistent information base) and interoperability. Further researches are needed to study CRISs user's information needs and customize CERIF based on the results, followed by testing for added value aspects of integration and interoperability. It is expected that such research will discover that the "excessive comprehensiveness" of CERIF is in fact necessary for these added value aspects to be realized.

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