Mapping scheme from RIS to CERIF

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***Abstract*—This paper describes basics of the Research Information System (RIS) format and Current Research Information Systems (CRIS) and their data models. The result of this research is the mapping scheme of data from RIS format to the Common European Research Information Format (CERIF) standard.**

I. INTRODUCTION

Today we are witnesses of rapid development of science and hence data from research need to be easy accessible. These data are usually stored in various systems such as digital libraries, institutional repositories (IR), research information systems, etc. All of these systems are constrained in access to the information that they contain mainly caused by their specialization for specific data types from the scientific research domain, like digital scientific journals libraries focusing on published scientific papers, institutional repositories typically containing internal reports and educational materials, and research information systems containing information on research institutions, research projects, etc. Standardization of data used in these systems is necessary to enable scientists and researchers to find the desired data in various scientific research information systems and to enable exchange of data among those systems. Also, if importing of data from one system to another can be done, then that data can additionally be useful to stakeholders and managers at research institutions, because it will provide them with an insight of how research is done, to see if goals and aims of research are reached, to find who is producing more and who is producing less than expected, etc. Moreover, the exchange of stored research data is necessary to stimulate the research and innovation and to provide a faster and broader technology transfer to industry and society. Initially, information about research was kept in digital libraries, so it was available in according to library standards such as Dublin Core, UNIMARC, MARC 21, ATOM, MODS [1] etc. Fortunately, in the last decade new modern comprehensive standards, by which almost all data from scientific research domain can be supported, were developed. One of these formats is the Research Information System (RIS) format [2] which is widely used in well-known systems such as IEEE Xplore, Scopus, ACM Portal, ScienceDirect, etc. Apart from RIS, it is highly important to mention Common European Research Information Format (CERIF) standard [3], which is the basis of Current Research Information Systems (CRIS) [4]. A non-profit organization euroCRIS has been responsible for the development of the CERIF since 2002 [5]. The European Union encourages the development of national research management systems in accordance with CERIF standard because the European Union wants to achieve maximum competitiveness of Europe at all levels of research activity. For the purpose of the evaluations of scientific research, European Science Foundation organization clearly stresses the importance of data in CERIF based information systems [6]. Those evaluations are the basis for the policy makers and research managers to make their decision in research funding [7].

Summarizing all above, one goal of this research was create some mechanisms which would enable CERIF based information system to include data from various sources/formats, where RIS is an example of those formats.

In this paper, the scheme for mapping data from the RIS to the CERIF format is proposed. Outcome of this research (mapping scheme) can be used as a guideline, supporting the exchange between the RIS based repositories and the CRIS systems.

CRIS UNS is an example of the CRIS system, which is widely used for storing research information data on the University of Novi Sad [8]. This system is fully in accordance with the CERIF, but yet it does not have support for the the RIS data format. Thus, as authors are part of the CRIS UNS developer team, one of the author's motives for this mapping was to lay out a basis in making the CRIS UNS compatible with the RIS data. Moreover, this mapping could be efficiently used in other CERIF like systems in order to make support for the RIS format.

Motivation for this work was also to extend and improve research from [9], [10], [11] and [12].

II. RIS FORMAT

The RIS format [13] is a standardized tag format made by the company which full name is "Research Information Systems, Incorporated". This format has become one of the most common "tool" for presenting and exchanging research information records. In [14] is stated that the RIS is one of the most flexible format on the market for exchanging references.

Data in the RIS format is stored within a file which extension is ".ris". The RIS is actually a plain text file that can contain multiple records. Every record is a combination of the multiple tags with contents, which are called fields. Every field is defined in a single line of a file, where line must end with the ASCII carriage return and/or line feed characters depending on the used operating system. It is important to mention that Unix like operating systems will use line feed only as a end of line mark. The RIS standard does not impose any restriction on a number of lines (fields) in a particular record or in a

file. Every tag is consisted of the six characters where the first and second are reserved for defining the tag name. First character has to be an uppercase alphabetic letter and the second one must be an uppercase alphabetic or a numeric character. The third and fourth are space (ANSI 32) characters. At the end dash (ANSI 45) and space (ANSI 32) are following the previous characters. After these 6 characters the actual data content of the tag follows. The RIS format has the strict structure that does not allow comments, or any other information rather than tag entities. Every record must have predefined tag's order where the first tag must be "TY - " and the last one has to be the "ER - " tag. All other tag between *TY* and *ER* can be in an arbitrary order. *TY* tag defines type of a record and ER indicates the end of a record and they can appear only once in a particular record. In the same .ris file user can define multiple records by separating them with "ER- " tag at the end of the record definition. All other tags between TY and ER are not mandatory and can be given in any order. Some tags may be placed more than once in a record like tags representing authors and keywords. Therefore, each record can include an unlimited number of authors and keywords. In the RIS format there are 55 valid types of data that can be used [13]. If a type is not specified in a record a default value "*GEN*" is used. This value is label for Generic type in the RIS format. Value in tag "*TY*" is important for processing the record since it will determine how all other fields should be interpreted. Not all tags are allowed in every type of data in the RIS format. For example, SP tag (start page) can be used in type journal (*JOUR*) but it is not allowed to be used in the type patent (*PAT*). An example or record in RIS format is given on Figure 1.

III. CERIF MODEL

CERIF is a standard that describes data model which can be used as a basis for an exchange of data from scientific-research domain. CERIF Standard describes the physical data model [15] and the exchange of XML messages between the CRIS systems [16]. The best feature of the CERIF is that it can be expanded and adapted to different needs. In practice, CERIF is often mapped to other standards that also represent the data of scientific-research domain, for example CERIF/MARC21 mapping described in [17]. Authors of [18] recommend an extension of CERIF that incorporates a set of metadata required for storing theses and dissertations. Another example is [19] where authors argue how CERIF can be used as a basis for storage of bibliometric indicators.

Hereinafter we will present main entities of the CERIF data model version 1.5. Figure 2 shows some of Base, Result, Link and Multiple Language Entities which are relevant for the mapping proposed in this paper.

- Base Entities - represent the core (basic) model entities. There are only three basic entities *cfPerson*, *cfOrganizationUnit* and *cfProject*.
- Result entities - A group of entities which includes results from scientific research such as publications, products and patents. Representatives of this group are: *cfResultPublication*, *cfResultProduct* and *cfResultPatent*.
- Infrastructure Entities - represent a set of infrastructure entities that are relevant for scientific research. The entities which belong to this group are: *cfFacility*, *cfEquipment* and *cfService*.

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TY  - JOUR
TI  - A CERIF compatible CRIS-UNS model extension for assessment of conference papers
T2  - Acta Polytechnica Hungarica
J2  - Acta Polytech. Hung.
VL  - 12
IS  - 7
SP  - 129
EP  - 148
PY  - 2015
SN  - 1785-8860
A1  - Nikolić, S.
AU  - Penca, V.
AU  - Ivanović, D.
AU  - Konjović, Z.
AU  - Surla, D.
AD  - University of Novi Sad, Trg Dositeja Obradovića 6, Novi Sad, Serbia
AD  - University of Novi Sad, Trg Dositeja Obradovića 3, Novi Sad, Serbia
AB  - This paper proposes an extension to CERIF compatible CRIS, enabling automated ev
KW  - Automated evaluation
KW  - CERIF
KW  - Conferences
KW  - Jess
KW  - Model extension
PB  - Budapest Tech Polytechnical Institution
LA  - English
UR  - https://www.scopus.com/inward/record.uri?eid=2-s2.0-84948781741&partnerID=40&md5
ER  -
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Figure 1 – Example of RIS record for journal article

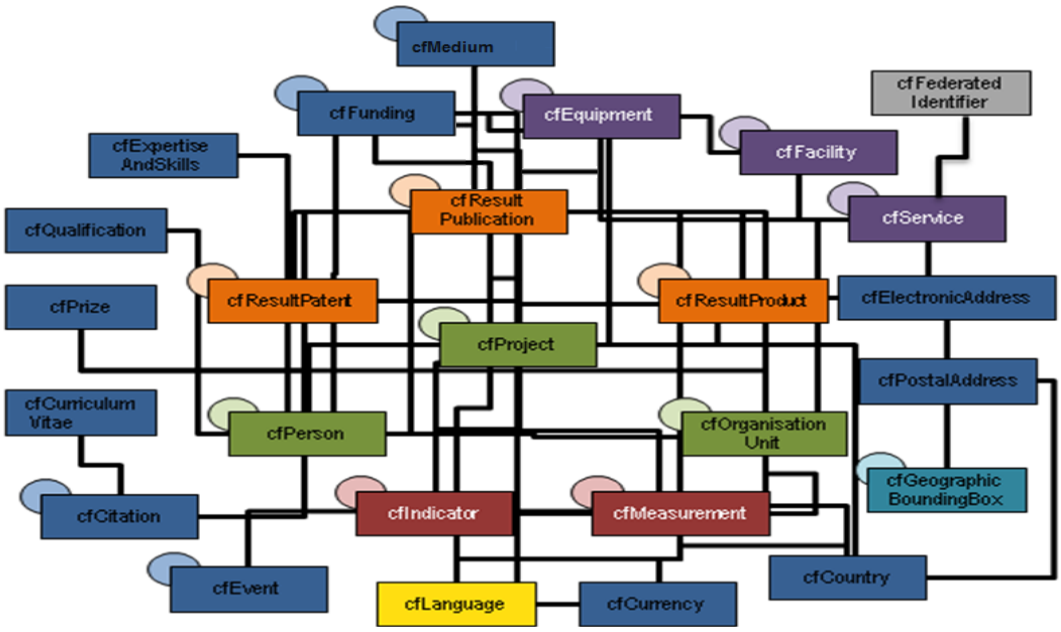

Figure 2 – CERIF model

- 2nd Level Entities - Entities that describe the Base Entities and Result Entities. For instance, *cfMedium* can be physical representation of some Result Entity.
- Link Entities - are used to link entities from different groups. Typical entities from this group are: *cfOrganizationUnit_OrganizationUnit*, *cfOrganizationUnit_ResultPublication* and *cfResultPublication_DublinCore*. Link Entities provide mechanism to define meaning for a generic classification, indicating the role for each entity instance in a relationship. Every Link entity is described with a role (*cfClass*, *cfClassScheme*), timeframe of relation (*cfStartDate*, *cfEndDate*), value (*cfFraction*) and identifiers of elements creating relation (e.g. *cfOrgUnit*, *cfResPublId*). The 'role' in link entities is not stored directly as attribute value, but as reference to Semantic layer.
- Multiple Language Entities - These entities provide multilingualism in the CERIF for some entities.
- Semantic Layer Entities - Provide different kinds of semantics in the CERIF model. Members of this group are *cfClassificationScheme* and *cfClassification*. These entities are used to describe classes and classification schemes for link and other entities. CERIF prescribes a controlled vocabulary to describe some of the classifications.
- Additional Entities - Currently in this group are classified entities that represent DC record.

IV. RIS MAPPING TO CERIF

The RIS format is widely used for different purposes all around the world. Papers [20] and [21] support previous statement, where their authors relied on the RIS format to retrieve and import research data in order to perform complex statistical analysis of publications. In mentioned research, the RIS format is selected because it has a human readable structure for presenting complex scientific research data. Also, RIS is used in some learning management systems in the UK to represent their data [22]. Popularity of the RIS format is seen through the dozens of projects on the Github that are actually small tools that can be useful for handle RIS data. Some of the most popular are definitely [23], [24] and [25].

Firstly, similar mapping from the RIS to the CERIF is done to some extent in commercial CRIS system Pure [26]. The mentioned system provides only importing of research publications from the RIS format to the CERIF. Also, the mapping that supports this importing process is not available to public and it is not clear which fields from the RIS format could be imported to the CERIF. Secondly, famous institutional repository DSpace [27] supports ingestion of bibliographic records in the RIS format but only for journals data and journal's articles. Last but not least, Islandora [28] and EPrints [29] repositories to some extent have a possibility to import publications in RIS format in their local databases.

Author's intentions were to map all types of data from the RIS format to adequate CERIF 1.5 version entities and to make the mapping available to everyone.

In general, the authors preformed assessment of the the RIS format in order to find out its potential for storing various types of data from scientific research domain. At the beginning, in depth analysis of the RIS format specification has been done. Focus of this analysis was to identify structure and possibility of the RIS format to describe different types of research data. Afterwards, authors used popular systems such as Scopus and ScienceDirect to export their data in the RIS format to realize how real data look like in practice.

Last step was to use conclusion from the previous phases to define adequate mapping of data from the RIS format to the CERIF standard.

TABLE I.
MAPPING OF RIS RECORD TYPES TO THE CERIF ENTITIES

RIS		CERIF		
Record with TY - tag content	Record type description	Entity	Classification Scheme	Classification
ABST	Abstract	cfResPubl	Output Types	Journal Article Abstract
BOOK	Whole book	cfResPubl	Output Types	Book
CHAP	Book chapter	cfResPubl	Output Types	Chapter in Book
COMP	Computer program	cfResProd	Output Types	Software
CONF	Conference proceeding	cfResPubl	Output Types	Conference Proceedings
CPAPER	Conference paper	cfResPubl	Output Types	Conference Proceedings Article
DATA	Data file	cfResProd	Output Types	Research data sets and databases
EDBOOK	Edited Book	cfResPubl	Output Types	Edited Book
EJOUR	Electronic Article	cfResPubl	Output Types	Journal Article
ELEC	Web Page	cfResPubl cfResProd	Output Types	Online Resource Website content
GRANT	Grant	cfProj	Activity Subtypes	Programme Grant
JFULL	Journal (full)	cfResPubl	Output Types	Journal
JOUR	Journal	cfResPubl	Output Types	Journal Article
LEGAL	Legal Rule or Regulation	cfResPubl	Output Types	Standard and Policy
PAT	Patent	cfResPat	CERIF Entities	Patent
PCOMM	Personal communication	cfResPubl	Output Types	Letter
SER	Serial publication	cfResPubl	Output Types	Journal
SLIDE	Slide	cfResPubl	Output Types	Presentation
UNPB	Unpublished work	cfResPubl	Publication Statuses	Unpublished
VIDEO	Video recording	cfResPubl	Output Types	Video Recording

Table 1 presents a part of a proposal for mapping specific RIS record types to the adequate CERIF 1.5 version entities. The first two columns represent content of tag "TY - " and its description that relates to the RIS record type. The third column is reserved to present correspondent CERIF entities. The fourth and the fifth columns are used to provide the different kinds of semantics in the CERIF model for the entities in the third column by using powerful semantic layer of the CERIF model. The CERIF predefined classifications and classifications schemes from CERIF vocabulary are used for this purpose [30].

In the following, mapping example of RIS journal article record to the CERIF standard is explained in detail. Mapping of RIS journal article record from Figure 1 is shown in the Table 2.

First line from the RIS file [Figure 1] indicates the type of this record which is *JOUR*. This type will be presented within CERIF with entity *cfResPubl*. Additionally, the entity will be classified by CERIF semantic layer with the class *Journal Article*. To begin with, tag *TI* which is a title of the journal article is mapped to the CERIF entity *cfResPublTitle*, precisely in its attribute *cfTitle*. Title of the journal in which is article published is kept in the tag *T2* of the RIS record and can be mapped to a new instance of *cfResPubl* and *cfResPublTitle* entities. For journal record, it is necessary to provide the CERIF classification *Journal* which is a part of *Output Types* schema. Relation between article and its journal is established via CERIF link entity *cfResPubl_ResPubl* where the classification *Part* and schema *Inter-Publication Relations* specify the link between these entities. The *J2* tag is an alphanumeric field of up to 255 characters and contains abbreviation of the

TABLE II.
MAPPING OF RIS RECORD TYPES TO THE CERIF ENTITIES

RIS field	CERIF Entities	Multiple	Cerif Link Enitity	Used classification
TI	cfResPublTitle (cfTtitle)			
T2	cfResPubl;cfResPublTitle (cfTtitle)		cfResPubl_ResPubl	sheme:Output Types, class:Journal; sheme:Inter-Publication Relations, class:Part
J2	cfResPubl;cfResPublNameAbbrev (cfNameAbbrev)		cfResPubl_ResPubl	sheme:Output Types, class:Journal; sheme:Inter-Publication Relations, class:Part
SN	cfResPubl (cfISSN)			
AU	cfPers; cfPersName (cfFirstName/cfLastName/cfOtherName)	X	cfPers_ResPubl; cfPersName_Pers	scheme: Person Output Contributions, class: Author scheme: Person Names, class: Presented Name or class:Initials
AD	cfPers; cfPAddr (cfAddrline1,..,cfAddrline5)	X	cfPers_PAddr	scheme: Person Contact Details, class: Person Professional Postal Address
VL	cfResPubl (cfVol)			
IS	cfResPubl (cfIssue)			
SP	cfResPubl (cfStartPage)			
EP	cfResPubl (cfEndPage)			
AB	cfResPublAbstr (cfAbstr)			
KW	cfResPublKeyw (cfKeyw)	X		
PB	cfOrgUnit; cfOrgUnitName(cfName)		cfOrgUnit_ResPubl	scheme: Organisation Output Roles, class: Publisher
PY	cfResPubl(cfResPublDate)			
LA	cfResPublTitle (cfLangCode)			
UR	cfFedId(cfFedIdId,cfInstId,cfClassSchemeId, cfClassId)	X		scheme: Identifier Types, class: URL;

periodical in which the article is published. This tag should be mapped similarly as the *T2* where the only difference is using entity *cfResPublNameAbbrev* instead of the *cfResPublTitle*.

The value of journal's serial number (*SN*), volume (*VL*), issue (*IS*), start page (*SP*) and end page (*EP*) may be stored in following attributes of the *cfResPubl* which are *cfISSN*, *cfVol*, *cfIssue*, *cfStrartPage* and *cfEndPage*. In the RIS *UR* tag (URI) multiple addresses can be entered on one line using a semi-colon as a separator. To be precise, those values can be stored as separate instances of *cfFedId* CERIF entity where value is stored in attribute *cfFedIdId*. Connection of entity *cfResPubl* with *cfFedId* is achieved by entering id of *cfResPubl* in attribute *cfInstId* of *cfFedId* entity.

Author's personal data from the RIS tag *AU* can be specified with new instances of *cfPers*, *cfPersName* and *cfPersName_Pers* entities. Entity *cfPersName* will be used for storing the actual value of the RIS *AU* tag, while *cfPersName_Pers* has a role to link *cfPersName* with an entity *cfPers* that represents the person in the CERIF. The *AU* field value can have maximum 255 characters. This limitation does not have an effect on mapping. The author name in the mentioned field must be in the following syntax: *Lastname*, *Firstname*, *Suffix*. For *Firstname*, it can be used full name, initial, or both. The format for the author's first name is as follows: Phillips,A.J., Phillips,Albert John, Phillips,Albert. In the syntax Lastname, Firstname, Full Name could be any string of letters, spaces, and hyphens and Initials could have a value of any single letter followed by a period. When it comes to Suffix there could be some values like Jr/Sr/II/III/MD etc, use of the suffix is optional. *Lastname* value from the RIS *AU* tag is stored in attribute *cfFamilyNames* of *cfPersName*, whereas the *Firstname* value from the RIS *AU* tag is stored in attribute *cfFirstNames* of *cfPersName* entity. *Sufiix* is stored in field *OtherName* of the *cfPersName*. If there are initials in authors' name, the entity *cfPersName_Pers* should be classified with class *Initials* and scheme *Person Names*. In other variants of name the used classification should be with class *Presented Name* from the same scheme *Person Names*.

Relation between journal article and its authors is established via CERIF link entity *cfPers_ResPubl* where the classification *Author* and schema *Person Output Contribution* define the link between entities.

It is important to mention that this author's data could be found more than once in a record. The specific situation is when there is *A1* tag in RIS file since this indicates that the first (primary) author is present. Mapping of the first author is similar to mapping of standard author with a small difference of using classification *First Author* instead of the *Author* for the same schema *Person Output Contribution* to define the link between article and author entities.

Addresses of author (*AD*) from the RIS are stored in the CERIF entity *cfPAddr* which is linked with author via *cfPers_Paddr*. Classification scheme *Person Contact Details* and class *Person Professional Postal Address* are used to classify this relation.

The CERIF entity *cfResPublAbstract* should be used to represent the RIS *AB* tag content. Keywords from the RIS article (*KW*) should be put into the CERIF entity *cfResPublKeyw*.

The publisher data from tag *PB* can be mapped to the CERIF entity *cfOrgUnit*. Publisher name can be kept in the *cfOrgUnitName* enitity where the concrete value can be stored in entity's attribute *cfName*. The *cfOrgUnit* is linked to the *cfResultPubl* via entity *cfOrgUnit_ResPubl*. The *cfOrgUnit_ResPubl* need to be classified with CERIF semantic layer by using scheme *Organisation Output Roles* and classification *Publisher*.

RIS *LA* tag, the language of the publication, cannot be simply mapped to CERIF because *cfResPubl* entity does not have the attribute for that purpose. Actually, the only way to store the language of the publication in CERIF is to repurpose the attribute *cfLangCode* from entity *cfResPublTitle* that is used in the title mapping. Entity *cfResPublTitle* is selected since journal article RIS record is seamless without the title data because the tag TI is almost always present in the RIS article record. The *PY* tag is the publication year and it must be four numeric characters and it maps to field *cfResPublDate* of entity *cfResPubl*.

It is important to stress that this paper describes only segment of data mapping for only 1 of 55 RIS record data types, while the complete mapping for all RIS record data types is presented here [31]. In complete mappings some part are annotated with string N/A which means that the authors did not map those RIS fields because there was no straightforward solution. Authors wanted to achieve the mapping using only original entities, fields and classifications from the CERIF model. Every RIS tag could be mapped to CERIF by adding custom classifications. For example, the RIS Y2 tag *Access Date* can be stored in the attribute *cfStartDate* of entity *cfResPub_Class* and the *cfResPub_Class* should be classified by crating the new scheme *Date* and its class *Access Date*.

V. CONCLUSION

The importance for interoperability is enormous especially among various systems that store scientific research data. Making data accessible among these systems is an ultimate goal. Therefore, this paper presents a mapping scheme for the RIS format to the CERIF model where all (not only publications) the RIS data types are represented in the current 1.5 CERIF format. The proposed mapping scheme enables unambiguous mapping from the RIS format to the CERIF format without any extensions of the RIS or the CERIF model.

This mapping could be used as a starting point to make the CERIF based systems interoperable with the RIS repositories.

Our future goal is to implement a fully functional software tool for mapping data from the RIS to the CERIF and vice versa. This application will implement all the mapping futures presented in this paper.

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