Using DynaRules to Integrate Context Information in Semantic Correlation Rules for Intelligent Content Delivery

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Abstract. In the past, information deliveries in technical communication were often considered as a normative duty, but has now grown into a knowledge-bearing and knowledge-transmitting medium by more modern approaches of dynamic content delivery. As described in a previous publication [1] implementing and working with semantic correlation rules and knowledge graphs enhances, for example, the contextual understanding of information and the technology of content delivery. The use of various established media technologies, which are explained in detail in this paper, prevents risks such as unclear information management and a lack of transparency. Companies must ensure that necessary information is provided in a simple and targeted manner where it is needed. Therefore, using an efficient system which provides detailed information about products, processes or services, a company is able to create, manage and deliver a high amount of information in a professional way. In an era where efficiency, innovation and speed set the tone, technologies have been developed on the market for creating and delivering content. In this paper we will moreover describe the possible interplay of recent IT architectures, non-linear DynaRules of semantic models and AI extensions to enable metadata-linked content effectively with reduced fuzziness according to the regarded context of intelligent content delivery and information services.

1 INTRODUCTION

In addressing the complexities of today's technical communication and the integration into its industrial context, we investigate the interaction between the methodologies of semantic modeling and AI extensions. The goal of the industrial-driven use-cases was to overcome the limitations of traditional information management approaches by using semantic correlation rules defined in earlier research [2]. By this, it is possible to connect metadata domains of different information systems to provide previously implicit knowledge explicitly to the user. However, inaccurate metadata and an incomplete ontology modeling can make it difficult to link information correctly to the desired preciseness. It can happen, that resulting fuzziness occurs. This means that some information within the ontology is inexactly linked after processing the semantic correlations. In other words, the information is correctly processed, but the resulting linking is wrong due to inexact metadata modeling in the corresponding domains. We will therefore use DynaRules being developed in the SCR framework. DynaRules can be used in our case context to link to the exact metadata context, enabling correct, intelligent linking of information and metadata even in incomplete ontologies with unprecise metadata. The aim of this research is to develop and investigate a technical implementation of SCR 1.2 as an extension to SCR framework. By this, we want to show how fuzziness of an already existing SCR implementation [2] can be overcome.

2 THEORETICAL BACKGROUND

Previous papers already explained the systematics behind SCR implementations and the required software [3]. This research included the two industrial information systems, Content Delivery Portal (CDP) and a Spare Parts Catalogue (SPC), as components. The CDP delivers information previously managed and edited in a CCMS (Component Content Management System) to users. The SPC contains relevant data for identifying and ordering spare parts. Since this research acts as a continuation of a previous research the following text requires knowledge about SCR implementation or the standard 1.1 (SCR standard 1.1). This contains knowledge about conceptional constructs of ontologies just as the concept of Inrules and Outrules and their systematic connections to each other and metadata from different systems.

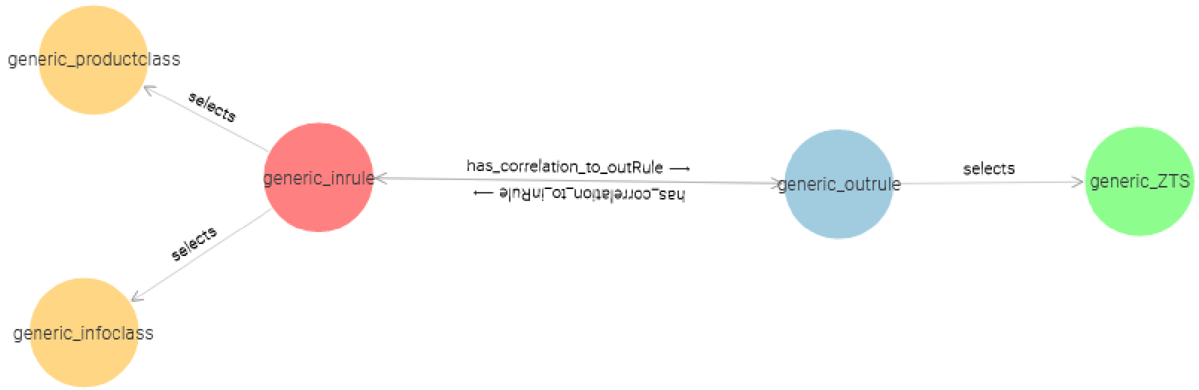

FIGURE 1. Visualization of basic SCR modeling by generic classes of an industrial implementation.

In this specific research case, we worked with an ontology that combines the two unique metadata models of the CDP and SPC systems. As shown in Fig. 1 the metadata from the CDP was created using the PI classification [4]. Those are represented by the yellow dots. The Inrule requires both types of metadata. Through the connection to the Outrule, suitable metadata can now be found in the SCP taxonomy in the form of the so-called ZTS class. The ZTS-Class is a metadata type for the industry partner used for enriching article labels in a type of component classification within the engineering process. This classification is therefore used in the SPC for the identification of spare parts.

3 INITIAL SITUATION

For our project we were provided with a fully modeled semantic knowledge graph and a working API environment. Furthermore, we worked with an user interface for displaying yet existing SCR in a test scenario of CDP and SPC. Those are achievements from previous research and are used as a starting point for our project [1]. The type of cooperation with software providers and the resulting framework also have already been explored in previous papers [3]. The implementation of SCR is visualized in practice in the User Interface of the CDP and SPC as links to the related content. The user-driven starting point of the joint research with the industry partner was available as a collection of use cases with a need for more precise linking between the content domains.

4 INSIGHTS AND FINDINGS

In the context of this project, fuzziness is a phenomenon which describes the appearance of more information than a use case requires. Fuzziness occurs because of imprecise metadata and/or incomplete ontology modeling. As a result, end user will be confused or misled in choosing the right information from the displayed links in CDP or SPC. The user can not recognize the difference between the right and the wrong link. This could lead to further mistakes for users in the handling of products. Figure 2 shows all SCR-processed links being not all relevant in the given context.

Details of this will be explained in the research work [5].

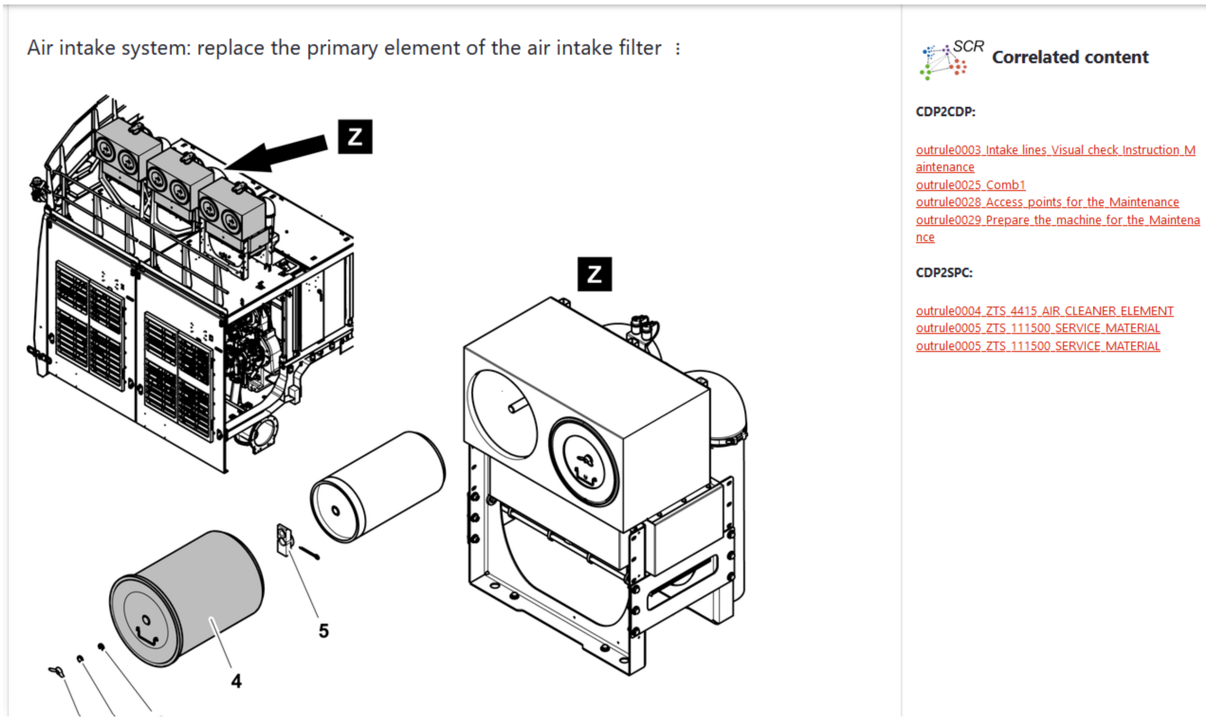

FIGURE 2. Screenshot of a topic in CDP with active links generated with SCR

5 APPROACH AND MODELLING OF DYNARULES

The approach for solving this fuzziness is the adding more precise context rules. This context is assigned as an addition to the component class (ZTS) when an Outrule is processed. The combination of metadata and the explicit context is modeled via a generic function. They can be understood as a kind of symbolic programming and are connected to the Outrule via a scr:calls relations. The underlying functions are characterized by Dynarule instances. In our case, the required functions select (scr:selects) likewise the ZTS class as the newly added context. The created instance dynarule is used additionally to the yet existing instances Inrule and Outrule. The concept of dynarules and context information works as a supplement to SCR 1.1 [2] and concludes in the standard SCR 1.2. As context, it is suitable to use predefined main components given by the industry partner. A main component is a parent of the item or article desired in the use case. Hence the main component is located at a higher level in the metadata taxonomy than the requested article. From this originates the term "main component context" (MCC) in Fig. 3.

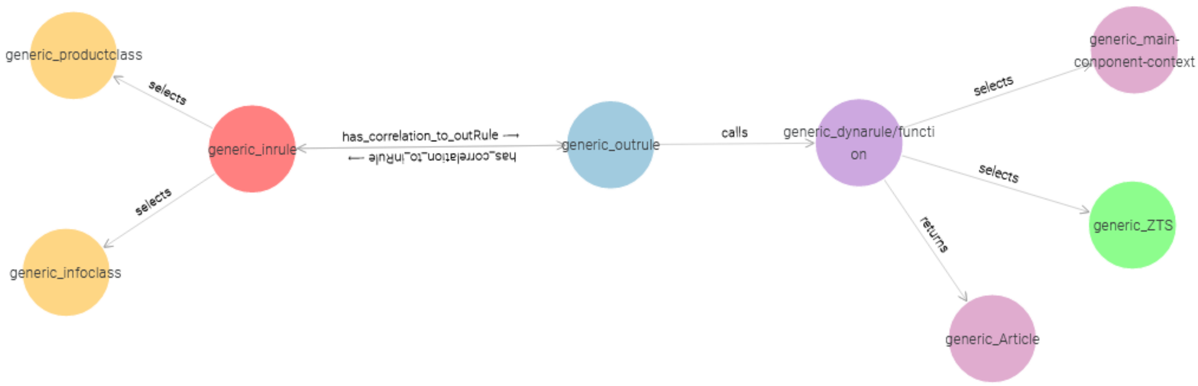

FIGURE 3. generic graph of standard SCR 1.2

By selecting these 2 variables (ZTS class and MCC) functions can process the specific information to the API by SPARQL queries (Fig. 4). Predefining the context of information the correct content and linking can be precisely selected.

```
SELECT DISTINCT  ?Articlenumber ?ArticleLabel WHERE {

    ?Article SIMPoC:as-articlecode ?Articlenumber.
     OPTIONAL    {
         ?Article rdfs:label ?ArticleLabel
     }
     ?Article SIMPoC:hasParent* ?Context.
     ?Article SIMPoC:has-ZTSClass ?ZTSClass
}
```

FIGURE 4. generic SPARQL query

The SPARQL query shown in Fig. 4 is the parameterized version before the variables are dynamically filled in by the API. It queries all articles via their article number that fit the ZTS and MCC. To be found the queried article must have a direct relationship “has-ZTSClass” with the ZTS and an indirect relationship “hasParent” with the MCC. Note, that in this implementation, there are slight differences in the naming of SCR relations compared to the standard SCR framework.

Utilizing main component context or general context information can trigger side effects. Due to the nature of the MCC being a parent to the article that was intended to be found it is very likely that they have the same ZTS-Class (Fig. 5).

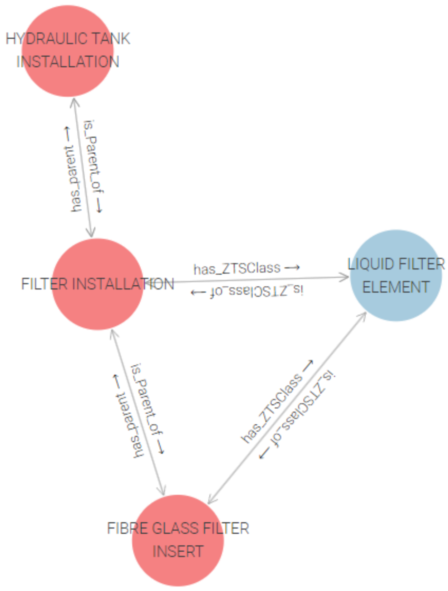

FIGURE 5. example data

When one intends for example to query the article “Fibre glass filter insert” in the example shown (Fig. 5) and the MCC is “Hydraulic tank installation” and the ZTS-Class is “Liquid filter element” the result unintentionally includes “Filter installation” (Fig. 6). These imprecise results occur when a MCC is used which is too high up in the parent-child-hierarchy of the ontology. This can be prevented by using a MCC from a lower position in the hierarchy. In the encountered use case, this type of overcomplete response was accepted and preferred, even though scripting extensions could even eliminate this small ambiguity.

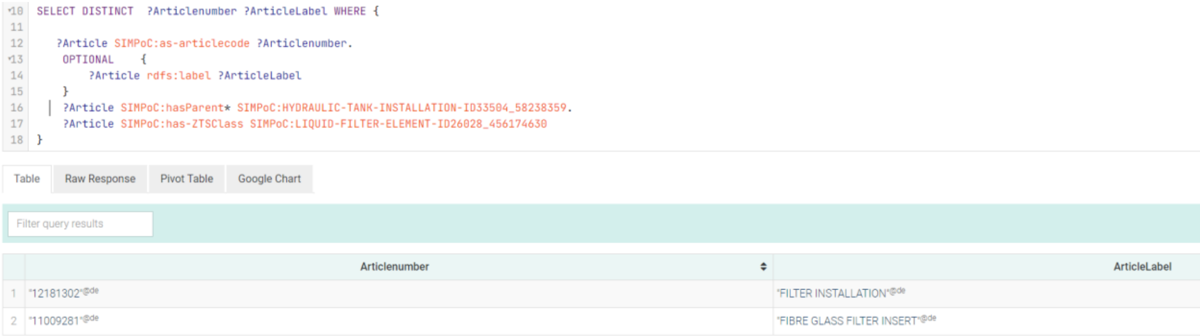

FIGURE 6. manual example query for verification of Fig. 5

The described type of function, including a more precise contextual information is not the only way, dynarules and corresponding server-side functions call can be utilized. Another approach to solve fuzziness is to use AI to compare data paths as shown in [5]. A function to call a query which generates the mentioned path can be implemented as it is shown in Fig. 7. This shows the SPARQL query that generates the paths for every article that has a certain ZTS-Class.

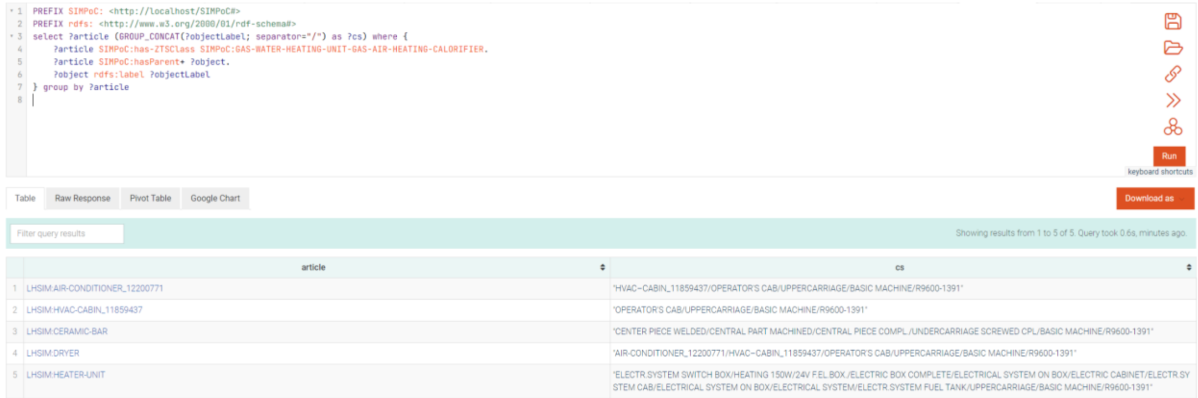

FIGURE 7. path generation via SPARQL (Example)

Figure 8 shows an early version of the resulting links in the UI of the CDP. It depicts generated links from the approach described in this paper and different AI-driven dynarules. The latter also yields preciseness factors as a probability for the correctness of links given by the AI algorithms.

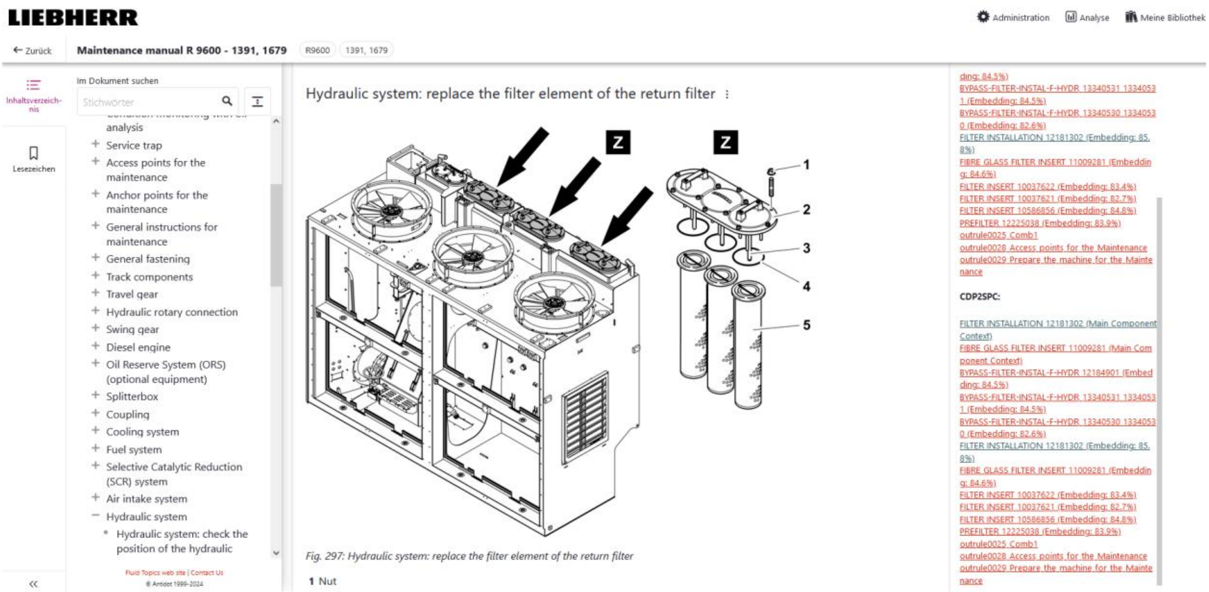

FIGURE 8. CDP UI with resulting links

6 CONCLUSION

The research has shown how to resolve the fuzziness of SCR-extracted links. The approach of implementing and adding context to the original metadata (outrules) leads to a significantly reduced fuzziness. This means that there is still some fuzziness, but this is due to the given ontology. With a more consistent classification of metadata and an corresponding appropriate ontology, DynaRules are able to completely eliminate the fuzziness. Therefore it is recommended to choose the MCC explicitly and with consideration. If there is some reduced fuzziness it will be a question of tolerance to keep it that way or not. Moreover the implementation of Dynarules is time-consuming. Since the original fuzziness occurs because of incomplete ontologies it is important to know where metadata is missing and incomplete. Only then it is possible to edit the ontology and add the missing parts, resp. context information. Dynarules are a relatively easy way to provide relevant information more precisely. In conclusion, it can be said that, in this researched industrial use case, the integration of DynaRules as context rules made it possible to overcome the previously detected inpreciseness of the SCR-induced linking between information domains.

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