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Towards an Ontology Based-Approach for Human Resource Management

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Abstract

Human Resources (HRs) as one of the most valuable asset of any organizations play a crucial role in their success. Within the context of project management, HR Management (HRM) is perceived as an entire knowledge area with defined processes, Tools and Techniques (T&T) in PMBOK 5th Guide. Although this guide shows a strong focus on HRM, it does not illustrate, in a clear way, how to perform each process with the required competencies and the related T&T. Hence, by using only PMBOK processes, the project manager cannot be assisted to select the suitable team according to their skills, also the project team members are not able to interchange their competencies. To address these issues, we propose to use an ontological approach in order to build a common shared representation in the HRM domain. This approach fosters the interoperability among HRs as well as their efficient use of T&T; further it can provide whom using PMBOK a better understanding and guidance for managing HRs with evidence.

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1. Introduction

Over the last few years, there is a growing attention toward HRs as one of the most valuable assets of any project and organization; and managing successfully this asset is crucial in project management [1, 2]. HR Management (HRM) is the means by which HRs interact effectively with motivation to achieve both project objectives and

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employee needs [3]. Within the context of project management, HRM is defined as a knowledge area in the Project Management Body Of Knowledge (PMBOK) which is the international recognized consensus on this field [4]. As a prominent managerial domain, HRM implies a multitude of tasks which are interpreted as a set of iterative and interrelated processes [5]. Considering that managing HRs involves applying a set of interoperable knowledge, skills and T&T defined for such specific process. Thus, when HRs are brought together as a team, a common shared framework is required to interchange their knowledge, skills and facilitates their proper use of T&T.

Although PMBOK 5th shows a strong focus on HRM as a knowledge area with defined processes and T&T, it does not illustrate, in a clear way, how to perform each process with the required competencies and the related T&T as depicted in Fig.1.

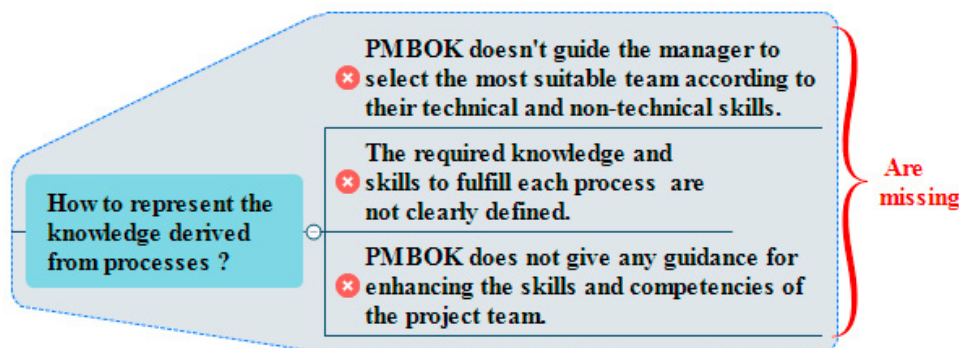


Fig. 1. PMBOK 5th weak points related to Project HR Management.

All PMBOK weak points related to the lack of a clear representation of knowledge derived from HRM processes as explained by Abd Elhameed [6], PMBOK 5th seems to ignore the relevance of knowledge flow theory which creates the environment within organization that enables the team interacting with each other to interchange their knowledge and experiences. In the same line, Sheeba et al. [4] demonstrate how PMBOK lacks the focus on a discipline approach that assigns tasks and responsibilities by using the interrelations between concepts in the domain of interest. To address these issues, this work explores the use of ontology for building a unified conceptual representation that supports the HRM in PMBOK 5th. As 'a formal, explicit description of a shared conceptualization' [7], ontology is the means to represent and share knowledge into specific domain, provides a common vocabulary as well as a description of the meaning of terms, as a way to promote interoperability, knowledge reuse and information integration.

As shown in the literature review, there is a lack of a unified ontology for the four HRM processes and each proposed ontology considered a specific context, the main objective of this work is to develop a domain ontology for HRM based on PMBOK 5th that (1) will provide for the project manager and the project management team a common shared understanding about concepts related to specific process, (2) will enable the project team to better know how and why certain T&T could be used to perform such process, (3) will enhance the selection of team members according to their competencies; thus fostering the interoperability among HRs as well as their efficient use of T&T.

The remainder of this paper is structured as follows: section 2 outlines the project HRM based on PMBOK 5th. In Section 3 the related work is briefly reviewed. In section 4, we detail the proposed ontology. In the conclusion, section 5, we summarize the benefits of such ontology, present its limits and we propose some perspectives.

2. Project Human Resource Management

The Project HR Management Knowledge Area defined as 'the processes that organize, manage and lead the project team' to complete project successfully [5]. Four are the main processes such as; plan human resource (identify the HRs with the required skills), acquire project team (approves the HRs availability and obtains the successful team), develop project team (improves competencies, interaction among team member, and overall team environment), manage project team (evaluates team performance, provides feedback, manages conflicts and resolves issues). This knowledge area allowed us to model the following flowchart (Fig. 2).

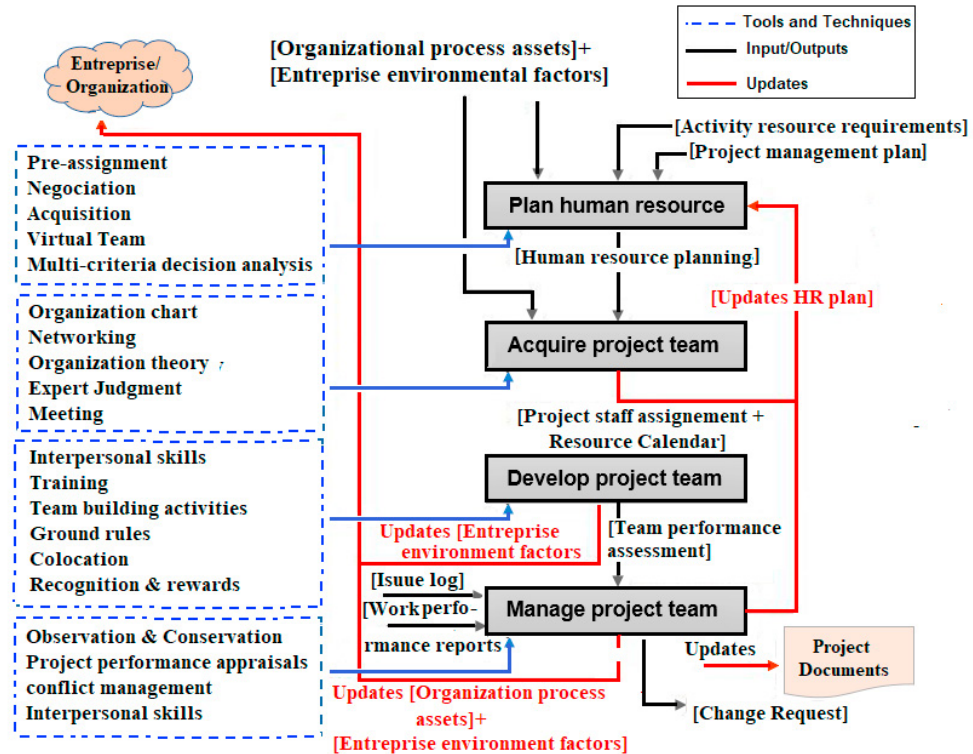


Fig. 2. The Project HRM Processes flowchart.

As shown, these processes defined and executed in an orderly linear manner; even in some case, some processes will overlap and become iterative. HRM Processes are interrelated i.e. for each process; inputs are defined to produce the outputs as the results using T&T. Based on Fig. 2, the relevant concepts and their relationships for modeling the proposed ontology are gathered.

3. Related work

Since the emergence of ontological engineering in the field of project management, the use of ontology has been considered with great interest, especially in HR management. For instance, Mochol et al. [8] have developed a HR-Ontology to support the recruitment process. This ontology based on the German version of the HR-XML standard developed by the HR-XML Consortium⁷; to provide means of semantic annotation of job postings and job applications by using controlled vocabularies. In a similar line, Gómez-Pérez et al. [9] proposed a “SEEMP Reference Ontology” based on standards to describe the detail of a job posting and the curricula data of a job seeker, by structuring thirteen sub-ontologies. Recently, an ontology-supported web-based HR recruitment is proposed by Ma et al. [10] that exploit Formal Concept Analysis (FCA) for building HR ontology, the proposed ontology performs the matching between the position requirements and applicants’ competences using ALN description logic. In [11], Strohmeier and Röhrs presented a methodical paradigm of conceptual modelling to the HRM domain in general and in employee assignment in particular by developing domain ontology for employee assignment, the Ontology construction process follows two main steps: (1) choose an upper-level ontology to base the domain ontology and (2) develop the domain ontology in reference to this upper-level ontology. Similarly, Andrés Paredes et al. [12] developed an ontology-based approach with which to assign HRs to software projects, this work explores the use of ontology for building a decision support system that help selecting the employees who are best fit within a new software project. With regard to competence management, Schmidt and Kunzmann [13] presented a reference model for ontology-based approaches to competency-

oriented HR development that integrate management competencies and offer learning opportunities for employees. Other reference with similar focus is reported in Bodea and Dascălu [14]. In [15], Miranda et al. developed a novel integrated model that represents the knowledge related to competence management in the context of SIRET project.

As each cited research addresses selectively only one HRM process and a unified conceptual representation that covers the overall HRM processes is missed, we propose an integration of the four HRM processes defined in PMBOK 5th in a common shared framework by considering their inputs, outputs and T&T.

4. HR-Ontology based on METHONTOLOGY approach

METHONTOLOGY presented by Fernandez-Lopez et al. [16], was adopted in this work; since unlike most of the methodologies discussed in literature [17] which lack sufficient details and remain abstract, METHONTOLOGY covers enough details about the techniques and activities employed in it [16]. This approach includes five main steps that represent the ontology development process (see Fig. 3). Each of these steps and their outcomes will be described below.

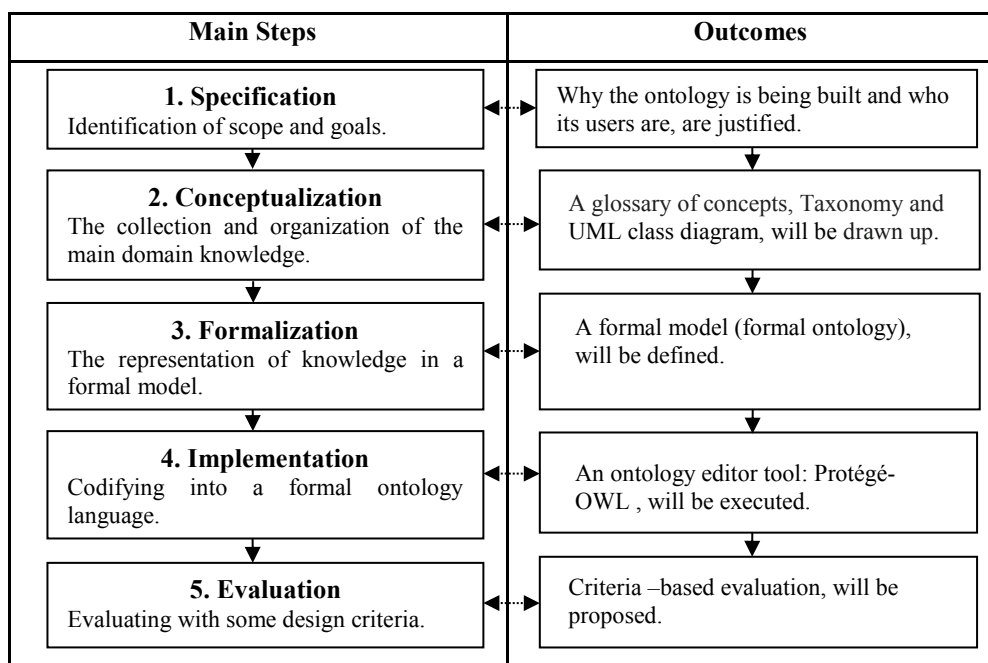


Fig. 3. The ontology development process and their associated outcomes.

- **Specification:** during this step, the scope (why being build) and ontology users (who the end users are) are defined. To start with why it is being built, the need for the HR-Ontology is justified in the Introduction and Related work sections. Referring to its users, project manager and project management team who are the main responsible for HRs decision making are selected. Also, companies may need the HR-Ontology to develop decision support system that enhances HRM.
- **Conceptualization:** the conceptualization was the key step in which the main concepts and their relationships are analyzed. Fig. 4 shows the UML class diagram where the relevant classes (with their attributes and their data types) and their relationships (with their cardinalities) are defined in accordance with the HRM knowledge area of PMBOK 5th.

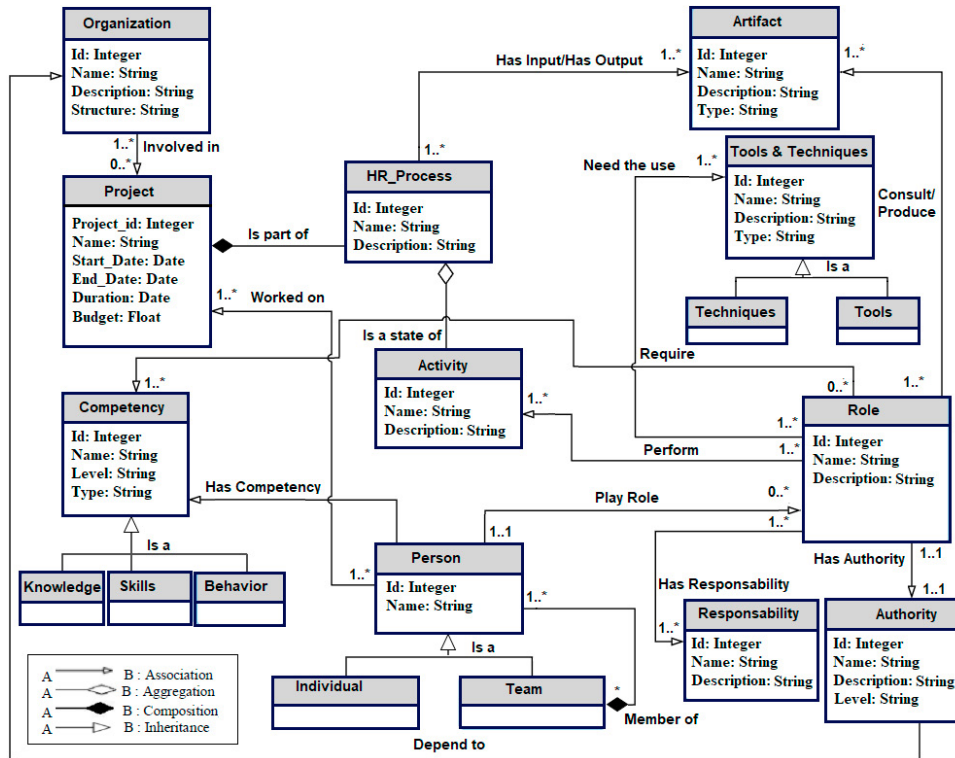


Fig. 4. Conceptual model of HR-Ontology.

- **Formalization:** in this step, the proposed conceptual model is transformed into a formalized model. Thus, axioms are required to define the semantics of concepts and their relationships; since the formal axiom ensures a declarative specification for the definitions of and constraints on the concepts and their relations [18]. Such specification is defined by a knowledge representation language (descriptive logic) such as SHOIN logic [19]. The following are some examples of axioms defined for HR-Ontology (shown in Fig. 5).

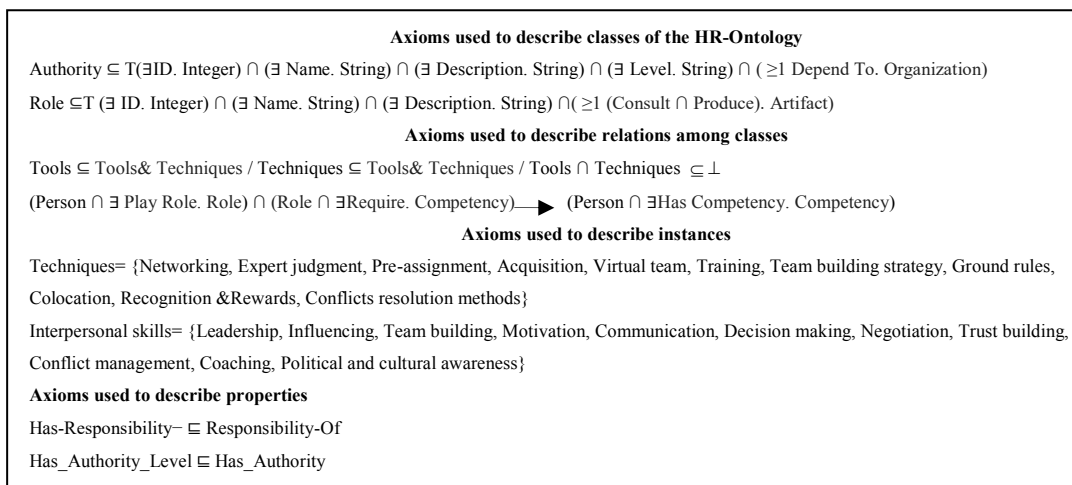


Fig. 5. Axioms of HR-Ontology.

- Implementation: the formalized knowledge acquired in step3 was converted into Protégé editor tool which is frame-based representation and generates the code OWL (Ontology Web Language) which can be used in. In our case, HR-Ontology was coded using Protégé 5.5 that support creating OWL ontology. The first sub-step is to model the hierarchy of the ontology's concepts and their relationships as shown in Fig. 6.

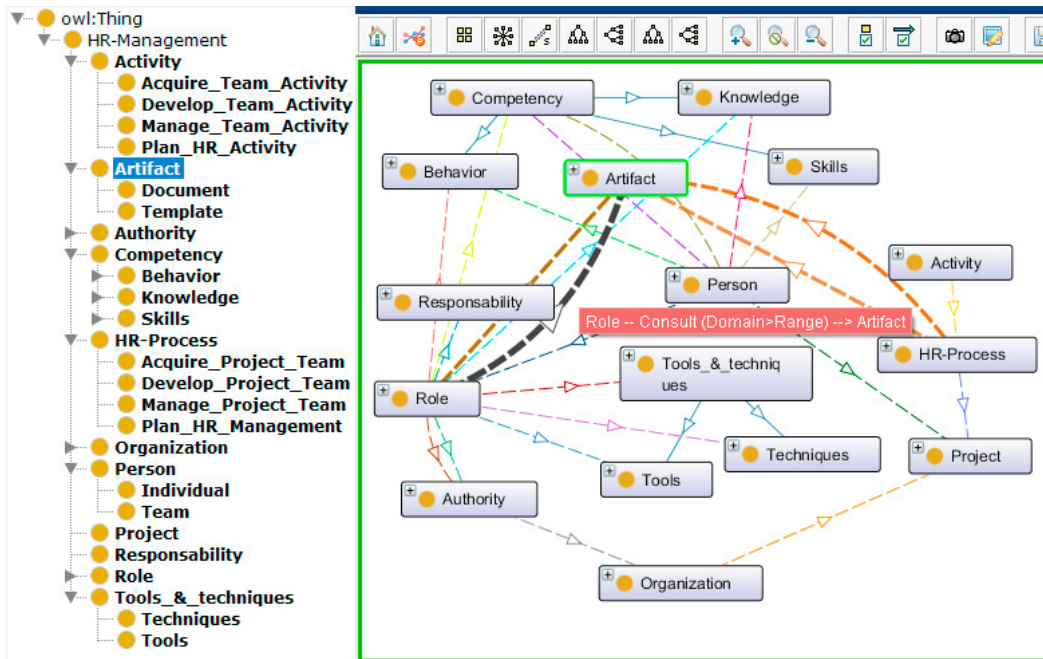


Fig. 6. Protégé screenshots of HR-Ontology Graph using Onto Graf plug-in.

The next step is to present the properties (relationships), its characteristics (functional, inverse, disjoint, etc) and their restrictions. Fig.7 presents the description of Project_Manager subclass where object property (i.e. Has_Authority_Level), universal restriction (Only) and existential restriction (Some) are defined.

Description: Project_Manager

SubClass Of +

- Assigned only
(Full_Time or Part_Time)
- Has_Authority_Level only
(Hight_To_almost_Total or Little_or_None or Low or Moderate_To_Hight or low_To_Moderate)
- Require_Behavior some Professional_Behavior
- Require_Knowledge some General_Project_Mangement
- Require_skill some Conceptual_Skills
- Require_skill some Interpersonnal_skills
- Require_skill some Technical_Skills
- Role

Fig. 7. Protégé screenshots of Project_Manger.

The Role class has five subclasses (Fig. 6); instances of each role are related to the instances of Artifact class through two properties “Consult” and “Produce”. Further, the activity class has a direct property with Role class using “perform”. Also, Tools_&techniques class has two sub-properties “Need_The_Use_Of_Tool” and

“Need_The_Use_Of_Technique” with Role class. Fig.8 describes these properties related to Project Manager in order to perform Plan_HR_Activity.

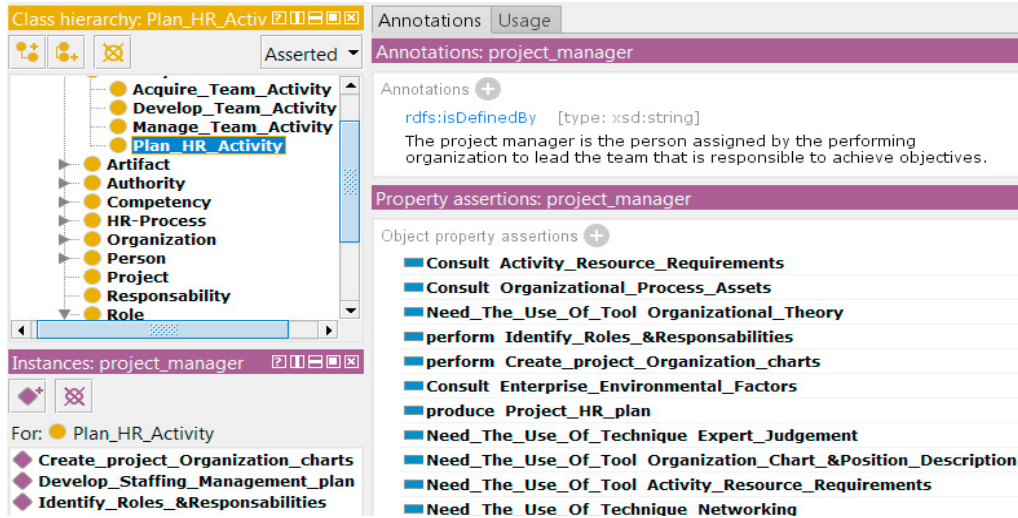


Fig. 8. Relation between Project manager with artifact, activity, and Tools & Techniques classes.

- Evaluation: the evaluation is a crucial step to determine ontology’s reliability in a specific domain. HR-Ontology is evaluated through criteria –based evaluation approach. Three core criteria are selected which match with our objective as shown in Table 1.

Table 1. The Evaluation criteria of HR-Ontology.

Criteria	Definition	Measure
Completeness	How the HR domain is appropriately covered (all HRs attributes in the context of PMBOK are identified).	Number of terms determined by experts which are not included within HR-Ontology (coverage).
Adaptability	How HR-Ontology can be easy used in other contexts by allowing it to be extended and specialized.	Number of cases that can be determined by it with regard to different project types, sizes, etc.
Effectiveness	Does the ontology improve managing HRs by PMBOK.	Measuring project effectiveness (with and without HR-Ontology in the context of PMBOK).

5. Conclusion and Perspectives

The main purpose of HR-Ontology is two-fold. First, this ontology fills the knowledge gap of HRM in the context of PMBOK by providing a formal and shared vocabulary about concepts related to specific process. For achieving this objective, HR-Ontology provides a knowledge base, offer possibility to query each role according to their competencies, authority etc, and to query each process according to the assigned role, the necessary T&T and the needed artifacts. Second, the proposed ontology can be exploited as a reliable tool to develop decision support systems that enhances managing HRs. Further, this study involves several perspectives that can be investigated:

- As the evaluation step based on criteria–based evaluation approach which implies the calculation of criteria measures like project effectiveness, the proposed ontology can be used as a tool to provide a consistent formula orchestrating ontology features.
- As OWL is enabling to infer and assert new instances, the rule-based reasoning such as open-source DL reasoner FaCT++, will be used to extend the reasoning abilities of HR-Ontology.

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