Progress of work in 2010

The research proceeded according to the original plan, with only minor modifications. All results corresponding to internal deliverables have been achieved in time (D2.2 and partly D4.2 even ahead of time), and mostly included in reviewed publications.

WP1 – Formal Model and Pattern Language

The *formal model* of ontology patterns was developed, and an *ontology pattern language* was designed, in which the structural part of several common 'logical ontology patterns' was expressed. The model and pattern language were described in (respective sections of) paper [1], which was accepted as full paper for EKAW, the leading European conference in the Knowledge Engineering field (the acceptance rate for the full paper category was 22 out of 166 submissions, i.e. 13%). The *naming aspects* of ontology patterns were systematically described in [9]. At the EKAW conference, an informal 'birds-of-feather' meeting on 'logical ontology patterns' representation was organized (from the initiative of the PatOMat team), with participants from five different research centers.

WP2 – Metamorphic Ontologies

A *transformation pattern language* was built on the top of the ontology pattern language from WP1. A small collection of *style transformation patterns* was designed in this language. A generic *ontology transformation framework* was designed (as a multi-step one, consisting of source pattern detection, transformation instructions generation, and transformation instructions execution) and implemented in the form of *PatOMat ontology transformation services* available online at http://owl.vse.cz:8080/. The transformation pattern language, transformation framework and implementation of services was described in sections of paper [1] already mentioned above. The implementation partly builds upon state-of-the-art tools from the Manchester University, *OWL-API* and *OPPL*; the lead developer of the latter, L. Iannone, collaborated on the content of the paper.

The logical part of the transformation patterns is represented in the form of *matching patterns*. The interplay between matching and transformation, also including the *naming aspect*, was characterized in paper [13]; more substantial linguistic analysis of naming patterns in the context of matching patterns is covered in [7]. Ontology matching patterns (outside the context of ontology transformation) were also studied in a section of [8].

During collaboration with the foreign partner ISTC-CNR, a tool with similar functionality was identified, which is called *Semion*. Unlike *PatOMat* services, which address the transformation of OWL ontologies proper, *Semion* aims at 'smart triplification' of non-RDF resources: it first straightforwardly converts the schema of the original resource to an OWL 'quasi-ontology', and then transforms the 'quasi-ontology' into a conceptually sound ontology through manually defined transformations; the resulting ontology can then be populated with transformed original data. We started to explore the functionality of *Semion*, as the second phase of its workflow could possibly be assisted with transformation patterns (and even *PatOMat* services). The envisaged use case for the combination of the two approaches is in transforming XML-based models of *data mining processes* into ontological models. This part of work was carried out by a starting PhD student, Andrej Hazucha.

WP3 – Ontology Repair

Joint research on debugging ontologies based on *anti-patterns* was started with Universidad Politécnica de Madrid. As collection of anti-patterns represented at high level was reused that from Madrid, while the Czech part of the team developed its operational form in *SPARQL* language [3]. A large collection of ontologies downloaded from the web was analyzed [4].

WP4 – Use Cases

The first use case, *ontology mapping using style transformation*, was addressed by a tentative (not yet implemented) method aiming to intertwine style transformation with use of a simple matcher, described in a chapter to appear in a book by Springer Verlag [11] (a significantly extended and revised version of a conference paper published before the project start). A sideways task was that of *recommending* a suitable simple matcher (using machine learning techniques, with input features including presence of ontology patterns from WP1); a simple matcher recommender, called *TakeMat*, was designed, and described in the short paper [10].

In connection to the ontology mapping use case, too, the problem of *ontology similarity* was studied in cooperation with INRIA Rhone-Alps, resulting in a joint paper at ISWC [2] – the most prominent conference in the Semantic Web field (22% acceptance rate). This result does not directly contribute to the ontology transformation task (as principal in *PatOMat*) at the moment but is rather corroborated by the previously mentioned research on matcher recommendation. In long term, ontology similarity computation could be also enhanced in the future through (*PatOMat*-based) awareness of the possibility of style transformation.

Although the *ontology import* use case was only planned to start in year 2, the visit of the *PatOMat* team at ISTC-CNR, Rome, in May 2010, gave this research an earlier impetus. A specific setting of importing *ontology content patterns* (as small, consensual 'chunks' of ontological knowledge) to legacy ontologies was investigated from then on. The new scenario was successfully embedded into *PatOMat* services, and was tested in the narrow domain of adopting *role-based* modelling (through adaptation import of the AgentRole content pattern), as described in [13]. Integration of *PatOMat* into the ISTC-CNR's eXtreme Design (XD) toolset was envisaged, which would enable to apply *PatOMat* transformations when ontology patterns are imported as 'best practice' into a structurally incompatible legacy ontology.

Newly started research – WP5 – Ontology Relationship Disambiguation

Thanks to faster progress in WP2, WP3 and WP4, partly achieved due to reusing tools and data developed by foreign partners, there was available capacity for adding a new, topical research stream, which deals with *pattern-based disambiguation of relationships* expressed using RDFS/OWL properties in popular ontologies (vocabularies), in particular in the context of the Linked Open Data cloud.

The first study in this research stream dealt with 'human relationships' as expressed in the popular *FOAF vocabulary* and its 'relation extension'. It was shown that the *foaf:knows* property exhibits implicit assumptions, and how these assumptions can be made explicit, through transformation patterns, when another ontology reuses the original vocabulary [5].

A *generic framework* (starting point of building a meta-level ontology) for relating simple vocabulary patterns to more complex (increasingly granular) content patterns was outlined in the short paper [6].

Publications and web presence

Overview of publications

13 reviewed papers (published in 2010 or accepted for publication in 2011) resulted from the first year of the project. Of these, 3 are in the ISI Proceedings category.

The research leveraged on extensive collaboration with leading European centers of research in ontological engineering and ontology matching. Namely: papers [2,10,11] arose in collaboration with INRIA Rhone-Alps, France; paper [1] with the Manchester University; papers [3,4] with Universidad Politécnica de Madrid; paper [7] with the University of Mannheim; paper [12] was largely influenced by the cooperation with ISTC-CNR, Rome; finally, paper [8] is a result of a multinational collaboration involving partners from 7 institutions.

Web presence of the project

The publications as well as other information about the *PatOMat* project are gradually made public at the *general website* of the project, http://patomat.vse.cz. The implemented services are available from the user-oriented *implementation website*, http://owl.vse.cz:8080/. Finally, the source codes of the application/s are at http://sourceforge.net/projects/patomat/.

Papers with RIV category D

1. Šváb-Zamazal, O., Svátek, V., Iannone, L.: Pattern-Based Ontology Transformation Service Exploiting OPPL and OWL-API. In: EKAW 2010 - 17th International Conference on Knowledge Engineering and Knowledge Management, Lisbon, Portugal. Springer LNCS 6317, 105-119.
2. David J., Euzenat J., Šváb-Zamazal, O.: Ontology similarity in the alignment space. In: 9th International Semantic Web Conference, ISWC 2010, Shanghai, China, Springer LNCS 6496, 129-144.

Papers from an international conference without ISI listing

3. Roussey, C., Scharffe, F., Corcho, O., Šváb-Zamazal, O.: Une méthode de débogage d'ontologies OWL baséés sur la détection d'anti-patrons. In: 21. Journeés Francophones d'Ingénierie des Connaissances, Nimes. INRIA, 2010, 43–54.
4. Corcho, O., Roussey, C., Zamazal, O.: SPARQL-based Detection of Antipatterns in OWL Ontologies. In: EKAW 2010 - 17th International Conference on Knowledge Engineering and Knowledge Management, Lisbon, Portugal. Poster proceedings. ISSN 1613-0073. URL: http://ceur-ws.org/Vol-674/Paper149.pdf.
5. Vacura, M., Svátek, V.: Ontological Analysis of Human Relations for Semantically Consistent Transformations of FOAF Data. In: KIELD-2010, 1st Workshop on Knowledge Injection into and Extraction from Linked Data, Lisbon, Portugal. CEUR-WS, 2010. ISSN 1613-0073. URL: http://ceur-ws.org/Vol-631/paper3.pdf.
6. Vacura, M., Svátek, V.: Ontology of Ontology Patterns as Linked Data Integration Tool. In: KIELD-2010, 1st Workshop on Knowledge Injection into and Extraction from Linked Data,

Lisbon, Portugal. CEUR-WS, 2010. ISSN 1613-0073. URL: http://ceur-ws.org/Vol-631/paper7.pdf.
7. Ritze, D., Völker, J., Meilicke, C., Šváb-Zamazal, O.: Linguistic analysis for complex ontology matching. In: 5th International Workshop on Ontology Matching (OM-2010) collocated with the 9th International Semantic Web Conference (ISWC-2010). URL: http://ceur-ws.org/Vol-689/om2010_Tpaper1.pdf.
8. Euzenat, J., Ferrara, A., Meilicke, C., Pane, J., Scharffe, F., Shvaiko, P., Stuckenschmidt, H., Šváb-Zamazal, O., Svátek, V., Trojahn dos Santos, C.: Results of the Ontology Alignment Evaluation Initiative 2010. In: 5th International Workshop on Ontology Matching (OM-2010) collocated with the 9th International Semantic Web Conference (ISWC-2010). URL: http://ceur-ws.org/Vol-689/oaei10_paper0.pdf.

Papers from a local (Czecho-Slovak) conference

9. Svátek, V., Šváb-Zamazal, O.: Entity Naming in Semantic Web Ontologies: Design Patterns and Empirical Observations. In: Znalosti 2010, Jindřichův Hradec. Praha : Oeconomica, 2010, s. 142–153. ISBN 978-80-245-1636-3.
10. Šváb-Zamazal, O., David, J., Svátek, V.: TakeMat: Recommend an Ontology Matcher. In: Znalosti 2010, Jindřichův Hradec. Praha : Oeconomica, 2010, s. 271-274. ISBN 978-80-245-1636-3.

Accepted paper with RIV category D

11. Šváb-Zamazal, O., Svátek, V., Scharffe, F., David, J.: Detection and transformation of ontology patterns. In: Knowledge Discovery, Knowledge Engineering and Knowledge Management, IC3K 2009, Funchal, Madeira, Portugal, Revised Selected Papers, Springer CCIS, Vol. 128, to appear 2011.

Paper accepted for an international conference without ISI listing

12. Svátek, V., Šváb-Zamazal, O., Vacura, M.: Adapting Ontologies to Content Patterns using Transformation Patterns. In: 2nd Workshop on Ontology Patterns - WOP2010. CEUR-WS, to appear in 2011.

Paper accepted for a local (Czecho-Slovak) conference

13. Šváb-Zamazal, O., Svátek, V.: OWL Matching Patterns Backed by Naming and Ontology Patterns. In: Znalosti 2011, Stará Lesná, Vysoké Tatry, 218-229. VŠB-FEI, 2011.

Exploitation of equipment purchased from project resources

No equipment has been purchased.

Report on travel related to the project

- At the 9th Czecho-Slovak knowledge technology conference, Znalosti 2010, in Jindřichův Hradec, Vojtěch Svátek presented the paper “Entity Naming in Semantic Web Ontologies: Design Patterns and Empirical Observations”.

- At the 1st Workshop on Knowledge Injection into and Extraction from Linked Data associated with the EKAW 2010 conference, Lisbon, Portugal, Miroslav Vacura presented the two papers „Ontological Analysis of Human Relations for Semantically Consistent Transformations of FOAF Data“ and „Ontology of Ontology Patterns as Linked Data Integration Tool“.
- Andrej Hazucha (PhD student) attended the Data Mining Ontology Jamboree in Ljubljana, Slovenia. The visit was related to the envisaged application of ontology transformation in the task of converting XML-based models of data mining processes to ontological models.
- Vojtěch Svátek and Miroslav Vacura visited ISTC-CNR, Rome. The visit further stimulated joint research in the field of ontology content patterns and ontology transformation.

Additional travel cost (especially V. Svátek's to the EKAW conference and O. Zamazal's to the ISWC conference) was covered by institutional funding.

Work plan for 2011

WP2 will focus on

- Enlargement of the *collection of logical patterns* and their *systematization* from the point of view of practical usage, especially regarding the possibility to express them in the ontology pattern *model/language* and *transform* one to another while preserving the informal semantics. The collection will be ported to the *OntologyDesignPatterns.org* portal.
- Inclusion of *rich OWL annotations* aspects of ontology patterns, in cooperation with Manchester University.
- More extensive and principled application of *naming patterns* incl. linguistic erudition.
- Implementation of new features of the *PatOMat* transformation framework that will support its applicability on *large ontological structures* (recursive application of transformation) and *conceptual consistency* preservation (handling axioms that are not part of the pattern itself but can be affected by the transformation).
- Practical evaluation of usability of the framework on *real ontologies* from the web.
- Completion of the comparison study of *PatOMat* with the *Semion* tool from ISTC-CNR, and possibly integration of the two tools, exploiting their complementary benefits. Application of the tools in the *data mining processes* domain.

WP3 will focus on

- Analyzing the results of the first evaluation of anti-patterns; the strategy for the next stage of implementation and experiments will be decided in cooperation with Universidad Politécnica de Madrid.
- Establishing closer cooperation with University of Leipzig, where a similar approach has recently been developed (called *EvoPat*), with the aim of cross-fertilizing between both approaches.

WP4 will focus on

- Further progressing with the import use case, in particular by integrating *PatOMat* services with the ISTC-CNR's *eXtreme Design* toolset.
- Initiating the *reasoning* use case, in tight collaboration with the University of Mannheim.

The new WP5 will focus on

- Analysis of further *Linked Data vocabularies* aside FOAF with respect to their possible disambiguation. Submission to the *Applied Ontology* journal is envisaged.
- Creation of specifications for a *software tool* supporting the disambiguation. (We assume that the first prototype of such tool will arise in the third year of the project; a pre-requisite is availability of an excellent student developer for this complex implementation task.).
- Elaboration of *relationships among content patterns* in the OntologyDesignPatterns.org portal, which will allow for *gradual increase of granularity* when performing disambiguation of relationships.