LUCAS FRANCISCO DA MATTA VEGI

UM PERFIL DE METADADOS DUBLIN CORE PARA DOCUMENTAR PADRÕES DE ANÁLISE EM UMA INFRAESTRUTURA DE REUSO

Dissertação apresentada à Universidade Federal de Viçosa, como parte das exigências do Programa de Pós-Graduação em Ciência da Computação, para obtenção do título de *Magister Scientiae.*

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APROVADA: 18 de junho de 2012.

José Luís Braga
(Coorientador)

Regina Maria Maciel Braga Villela

Jugurta Lisboa Filho
(Orientador)

Dedico esta dissertação especialmente aos meus pais Heleno e Sandra, à minha querida avó Alzira, à minha irmã Nathália, à minha namorada Aline, aos meus tios Fernando e Maria Luisa e ao meu orientador Jugurta. Vocês foram os principais responsáveis por essa conquista.

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Pela primeira vez fora da casa dos meus pais em Muriaé e passando por uma experiência completamente nova morando em Viçosa, passei por momentos de felicidade e realização, mas também de desânimo, saudades e angústia. Em todos esses momentos tive do meu lado meus amigos, a quem agradeço muito. Em especial agradeço ao Augusto e ao Ciro, meus amigos/irmãos desde a infância e que pra minha sorte dividiram apartamento comigo durante o mestrado. Tivemos sempre uma convivência harmoniosa dentro de casa e compartilhamos de bons momentos, seja assistindo ao futebol na TV, ou jogando um vídeo game para relaxar e esquecer os problemas. Muito obrigado meus amigos.

É difícil expressar com palavras o amor e a gratidão que tenho pela minha família. Tenho muito orgulho dos meus pais Heleno e Sandra, dois verdadeiros guerreiros que apesar das várias dificuldades estiveram sempre me apoiando e assim me permitiram chegar até aqui. Sou grato aos meus pais por tudo, eles são os principais responsáveis pela minha formação como pessoa, que em muito refletiu na minha formação acadêmica. À minha avó Alzira, minha segunda mãe, agradeço por todas as orações em minha intenção, pelo suporte financeiro quando necessário e por todo amor e carinho que sempre me deu. As comidas que minha avó preparava pra eu trazer pra Viçosa quando eu ia visitá-la em Muriaé sempre salvaram minhas noites, pois sou um péssimo cozinheiro e quase sempre no momento da janta a única coisa que eu não queria ter que fazer era cozinhar. Minha irmã Nathália e meu cunhado Michael também merecem agradecimentos especiais. Sempre que precisei eles estiveram prontamente dispostos a me ajudar resolver alguns problemas em Muriaé me poupando tempo. Aos meus tios Fernando e Maria Luisa agradeço muito por financiarem boa parte dessa jornada, sem eles talvez eu não tivesse conseguido estar aqui hoje finalizando esse trabalho.

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Viçosa quando eu vinha totalmente perdido participar de eventos na UFV. Durante esses dois anos e meio cursando o mestrado nós ficamos ainda mais próximos e a Aline demonstrou-se ser uma verdadeira companheira. Terei muitas saudades desse período que passamos tão próximos em Viçosa, ele serviu para provar que realmente iremos dar novos passos em nosso relacionamento, atingindo estágios mais elevados num futuro próximo. A você meu amor, agradeço por fazer parte da minha vida.

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Agradeço muito ao Departamento de Informática da UFV por ter acreditado no meu potencial e me permitido viver dois anos e meio de muito crescimento não só intelectual, mas como pessoa. Lá sempre tive todo o respaldo necessário de funcionários e professores para conseguir concretizar essa etapa importante da minha vida.

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Por fim agradeço à Deus, sempre tão generoso comigo.

BIOGRAFIA

LUCAS FRANCISCO DA MATTA VEGI é filho de Heleno Vegi e Sandra Maria Francisco da Matta Vegi, brasileiro, nascido em 20 de junho de 1987, na cidade de Muriaé, no estado de Minas Gerais.

No ano de 2005, concluiu o ensino médio no Centro Cenecista Educacional de Muriaé (CCEM). Iniciou no ano de 2006, na Faculdade de Minas (FAMINAS), o curso superior em Sistemas de Informação, através do qual se tornou Bacharel no ano de 2009. No ano seguinte ingressou no programa de pós-graduação *Stricto Sensu* em Ciência da Computação do Departamento de Informática da Universidade Federal de Viçosa, onde obteve o título de mestre, defendendo sua dissertação em junho de 2012.

SUMÁRIO

LISTA DE FIGURAS

Artigo I

Artigo III

Artigo IV

Artigo V

LISTA DE TABELAS

Artigo II

Artigo III

Artigo IV

APÊNDICE B

RESUMO

VEGI, Lucas Francisco da Matta, M.Sc., Universidade Federal de Viçosa, junho de 2012. **Um perfil de metadados Dublin Core para documentar padrões de análise em uma infraestrutura de reuso**. Orientador: Jugurta Lisboa Filho. Coorientadores: Alcione de Paiva Oliveira e José Luís Braga.

Os padrões de análise são artefatos computacionais reutilizáveis, voltados para a etapa de análise do processo de desenvolvimento de software. Embora os padrões de análise possam facilitar o trabalho de analistas e desenvolvedores por meio da reutilização de ideias comprovadamente úteis e testadas, o acesso aos mesmos ainda é deficiente devido à maneira como eles são usualmente documentados e disponibilizados. O potencial de reuso dos padrões de análise é prejudicado por não existir uma maneira padronizada de se documentar esse tipo de padrão e, além disso, os padrões de análise são usualmente disponibilizados por meios não processáveis por máquina, dificultando dessa forma a recuperação dos mesmos. O objetivo geral dessa dissertação foi reduzir as deficiências de documentação e disponibilização de padrões de análise, apoiando a catalogação e incentivando a reutilização desses padrões por meio de uma Infraestrutura de Reuso de Padrões de Análise (APRI). Essa infraestrutura, análoga a uma Infraestrutura de Dados Espaciais (IDE), é composta por um repositório de padrões de análise documentados por meio de um perfil de metadados específico e acessados via serviços Web. Dentre os objetivos específicos desta dissertação está o desenvolvimento de um perfil de metadados processável por máquina específico para a documentação de padrões de análise. Esse perfil de metadados, chamado Perfil de Aplicação do Dublin Core para Padrões de Análise (DC2AP), foi proposto para ser integrado à arquitetura de uma APRI. O DC2AP foi descrito por meio de arquivos RDF identificados via URI, fornecendo dessa forma *Linked Data* que permitem documentar e disponibilizar padrões de análise interpretáveis por máquina. A utilização do DC2AP para documentar padrões de análise permite uma recuperação mais adequada dos mesmos por meio de mecanismos de busca computadorizados, ampliando assim o potencial de reuso dos padrões de análise.

ABSTRACT

VEGI, Lucas Francisco da Matta, M.Sc., Universidade Federal de Viçosa, June, 2012. **A Dublin Core metadata profile to document analysis patterns in a reuse infrastructure**. Adviser: Jugurta Lisboa Filho. Co-Advisers: Alcione de Paiva Oliveira and José Luís Braga.

Analysis patterns are reusable computational artifacts, aimed at the analysis stage of the development process of software. Although the analysis patterns can facilitate the work of analysts and developers by the reuse of proven useful and tested ideas, the access to them is still poor because of the way they are usually described and made available. The potential for reuse of analysis patterns is impaired because there is not a standardized way to document this kind of patterns, and in addition, the analysis patterns are usually made available by means not processable by machine, thereby complicating their retrieval. The general objective of this master's thesis was to reduce deficiencies in documentation and provision of analysis patterns, supporting cataloging and encouraging the reuse of these patterns by means of an Analysis Patterns Reuse Infrastructure (APRI). This infrastructure, analogous to a Spatial Data Infrastructure (SDI), comprises a repository of analysis patterns documented through a specific metadata profile and accessed via Web services. Among the specific objectives of this master's thesis is the development of a machine-processable metadata profile suitable to the documentation of analysis patterns. This metadata profile, called Dublin Core Application Profile to Analysis Patterns (DC2AP), was proposed to be integrated into the architecture of an APRI. DC2AP was described by RDF files identified via URI, thus providing Linked Data that allow document and provide analysis patterns interpretable by machine. The use of DC2AP to document analysis patterns allows a more adequate retrieval of these patterns by means of computerized search engines, thereby increasing the potential for reuse of analysis patterns.

1 INTRODUÇÃO

1.1. O problema e sua importância

Reutilização é um conceito importante e muito discutido no processo de desenvolvimento de software, pois com reutilização evita-se retrabalho e, consequentemente se ganha produtividade e diminuem-se custos. Existem diversos meios utilizados para reutilização nas diversas etapas do desenvolvimento de software, um deles é a utilização de padrões (GAMMA et al., 1994), que podem ser divididos em categorias como padrões de análise, padrões de projeto, padrões de arquitetura e padrões de implementação (BLAIMER; BORTFELDT; PANKRATZ, 2010). No escopo dessa pesquisa, pretende-se estudar especificamente padrões de análise (FOWLER, 1997), que é a categoria de padrões voltada para a reutilização de artefatos computacionais gerados durante a análise de requisitos e modelagem conceitual.

Padrões de análise foram muito pesquisados no passado, resultando em publicações que abrangem diversos contextos (COAD, 1992; HAY, 1995; FOWLER, 1997), entretanto nos últimos anos o número de pesquisas nessa linha diminuiu. O trabalho de Blaimer, Bortfeldt e Pankratz (2010) colocou o tema novamente em foco, nele os autores realizaram uma revisão bibliográfica detalhada sobre padrões de análise e traçaram caminhos futuros de pesquisa com esse tema. A utilização de serviços Web (DOYLE; REED, 2001) e infraestruturas análogas às Infraestruturas de Dados Espaciais (IDE) (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005) também abrem novas possibilidades de pesquisa com padrões.

Existem diversos padrões de análise documentados na literatura, entretanto não existe uma maneira amplamente aceita para documentá-los. Alguns autores documentam seus padrões de análise em forma textual não estruturada, como em Hay (1995) e Fowler (1997), outros optam pela documentação de padrões de análise utilizando *templates*, que são estruturas com tópicos pré-estabelecidos (MESZAROS; DOBLE, 1997).

Por outro lado, no contexto de dados espaciais, existe um problema similar ao dos padrões de análise no que diz respeito à padronização. O compartilhamento de dados espaciais é dificultado por questões relativas à falta de padronização dos formatos de

codificação, do armazenamento, da qualidade dos dados e das estruturas de dados (RAJABIFARD; WILLIAMSON, 2001).

Essa heterogeneidade dos padrões de análise e dos dados espaciais dificulta a recuperação e reutilização mais ampla dos mesmos.

A utilização de IDEs permite a disponibilização de bases de dados espaciais advindas de provedores diferentes, trazendo facilidades para o usuário adquirir novos conjuntos de dados, sem haver a necessidade de construí-los ou converte-los, gerando duplicidade e onerando seu trabalho (RAJABIFARD; WILLIAMSON, 2001).

Atualmente, as IDEs são baseadas em uma arquitetura orientada a serviços, permitindo criar ambientes compartilhados, distribuídos e interoperáveis através de serviços Web (DAVIS JÚNIOR.; ALVES, 2005).

A documentação apropriada dos dados e serviços é um ponto importante no desenvolvimento de uma IDE. Essa documentação é feita por meio de metadados especificados por algum padrão de metadados, por exemplo, Dublin Core, CSGDM e ISO 19115 (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005).

Assim, este estudo pretende basear-se nos conceitos e facilidades proporcionados pelas IDEs, para então desenvolver uma infraestrutura análoga voltada para a reutilização de padrões de análise.

Segundo Blaimer, Bortfeldt e Pankratz (2010), ainda não existe um *template* para documentar padrões de análise que seja amplamente aceito, sendo assim, cada autor utiliza uma metodologia diferente de documentação, muitas vezes derivadas de *templates* voltados para documentar padrões de projeto e que não atendem às especificidades dos padrões de análise.

Essa questão caracteriza um problema importante, pois padrões de análise são aperfeiçoados a partir do reuso e da agregação de novas contribuições realizadas pelos projetistas. Entretanto, a falta de um *template* padrão para documentação de padrões de análise dificulta o acesso e o entendimento desses padrões e, consequentemente, diminui o potencial de reuso dos mesmos.

1.2. Hipótese

O uso de uma infraestrutura voltada para padrões de análise, análoga às Infraestruturas de Dados Espaciais, utilizando metadados como *template* para

documentação de padrões e serviços Web para busca, visualização, aplicação e contribuição de experiências de uso dos padrões de análise, pode contribuir para a disseminação e potencializar o reuso dos padrões.

1.3. Objetivos

O objetivo geral desta pesquisa é especificar uma infraestrutura para padrões de análise que possibilite documentar, buscar, visualizar, aplicar e compartilhar experiências de uso dos padrões de análise com base em metadados e serviços Web, possibilitando assim um reuso mais amplo dos mesmos.

Especificamente, pretende-se:

a) Investigar a viabilidade de se utilizar um padrão de metadados genérico, por exemplo, o Dublin Core, para descrição dos padrões de análise;
b) Estudar como especificar metadados para documentar padrões de análise;
c) Propor a adaptação de um padrão de metadados para metadados de padrões de análise;
d) Estruturar um repositório de padrões de análise documentados com o padrão de metadados proposto no item (c);

1.4. Organização da dissertação

Esta dissertação foi elaborada de acordo com um dos formatos recomendados pela Comissão do Programa de Pós-Graduação em Ciência da Computação da UFV. A dissertação está organizada como uma coletânea de artigos produzidos durante o curso. Ao todo são cinco artigos, sendo quatro artigos resultantes dessa pesquisa, e um artigo resultante de um trabalho paralelo realizado durante uma disciplina cursada no mestrado. Dentre os cinco artigos, quatro foram publicados em conferências e um foi submetido à avaliação de uma revista.

A dissertação está organizada da seguinte forma:

O Capítulo 1 apresenta o problema, sua importância e os objetivos da pesquisa.

O Capítulo 2 é composto de quatro artigos resultantes da pesquisa realizada. O Artigo I (Seção 2.1) propõe uma arquitetura para Infraestruturas de Reuso de Padrões de Análise. O Artigo II (Seção 2.2) apresenta a proposta de um perfil de metadados específico para documentar padrões de análise, descrevendo seus elementos e regras de

aplicação. O Artigo III (Seção 2.3) apresenta uma forma processável por máquina do perfil de metadados, proposto no Artigo II. Por fim, o Artigo IV (Seção 2.4) apresenta uma versão estendida do Artigo III, oferecendo maiores detalhes a respeito da descrição processável por máquina do perfil de metadados específico para documentar padrões de análise.

No Capítulo 3 são apresentadas as conclusões gerais, são comentados os resultados obtidos e os avanços alcançados. Ainda nesse capítulo, algumas oportunidades de pesquisa em aberto que podem proporcionar trabalhos futuros para avançar os conhecimentos gerados nesta dissertação são apresentadas.

O Apêndice A inclui uma descrição técnica detalhada do perfil de metadados proposto nessa dissertação, contendo a descrição semântica completa dos elementos do perfil de metadados e detalhes das regras de aplicação, sintaxes e vocabulários controlados associados a cada um desses elementos.

Por último, o Artigo V, descrito no Apêndice B, apresenta um trabalho paralelo à pesquisa realizado de forma colaborativa durante disciplina INF624-Bancos de Dados Espaciais cursada no mestrado. Nesse artigo é apresentado os passos para a criação de uma nova Infraestrutura de Dados Espaciais para o antigo projeto GeoMINAS, que foi uma iniciativa pioneira do estado de Minas Gerais para disponibilizar dados espaciais. Durante os estudos que deram origem ao Artigo V surgiram as primeiras ideias para a criação de uma infraestrutura análoga voltada para padrões de análise. Uma versão estendida do Artigo V (LISBOA FILHO et al, 2012) foi aceita para publicação na Revista Brasileira de Cartografia (RBC), entretanto, por motivos de espaço esse artigo foi omitido nesta dissertação.

A seguir estão relacionados às referências completas dos artigos que compõem esta dissertação:

Capítulo 2:

- VEGI, L. F. M.; PEIXOTO, D. A.; SOARES, L. S.; LISBOA-FILHO, J.; OLIVEIRA, A. P. An infrastructure oriented for cataloging services and reuse of analysis patterns. In: INT. WORKSHOP ON REUSE IN BUSINESS PROCESS MANAGEMENT (rBPM in conjunction with The 9th Int. Conf. on Business Process Management), 2, 2011, Clermont-Ferrand, France. **Proceedings…** Berlin Heidelberg: Springer LNBIP N.100, Part 4 – Lecture Notes in Business Information Processing, 2012. p. 338-343

- VEGI, L. F. M.; LISBOA-FILHO, J.; COSTA, G. L. S.; OLIVEIRA, A. P.; BRAGA, J. L. DC2AP: A Dublin Core application profile to analysis patterns. In: INT. CONF. ON SOFTWARE ENGINEERING AND KNOWLEDGE ENGINEERING (SEKE), 24, 2012, Redwood City, California, USA. **Proceedings…** 2012. Artigo aceito para publicação.

- VEGI, L. F. M.; LISBOA-FILHO, J.; CROMPVOETS, J. **A machine-processable Dublin Core application profile for analysis patterns to provide linked data**. In: INT. CONF. ON DUBLIN CORE AND METADATA, 2012, Kuching, Sarawak, Malaysia. Artigo aceito para publicação.

- VEGI, L. F. M.; LISBOA-FILHO, J.; SOARES, L. S.; BRAGA, J. L. A Dublin Core application profile for documenting analysis patterns in a reuse infrastructure. Artigo submetido ao **Journal of Universal Computer Science**, 2012.

Apêndice B:

- VEGI, L. F. M.; LISBOA-FILHO, J.; SOUZA, W. D.; LAMAS, J. P. C.; COSTA, G. L.; OLIVEIRA, W. M.; CARRASCO, R. S.; FERREIRA, T. G.; BAIA, J. W. Um infraestrutura de dados espaciais para o projeto GeoMINAS. In: BRAZILIAN SYMPOSIUM ON GEOINFORMATICS, 12, 2011, Campos do Jordão, SP, Brazil. **Proceedings…** Campos do Jordão, 2012. p. 105-110.

2 ARTIGOS

Este capítulo apresenta uma coletânea contendo quatro artigos resultantes da pesquisa que deu origem a essa dissertação. O primeiro artigo, intitulado "*An Infrastructure Oriented for Cataloging Services and Reuse of Analysis Patterns*" apresenta a proposta de uma arquitetura para infraestruturas de reuso de padrões de análise.

No segundo artigo, intitulado "*DC2AP: A Dublin Core application profile to analysis patterns*" é apresentada a proposta de um perfil de metadados específico para documentar padrões de análise, descrevendo seus elementos e regras de aplicação. Esse perfil de metadados foi criado para ser integrado à arquitetura proposta no primeiro artigo.

O terceiro artigo, intitulado "*A machine-processable Dublin Core application profile for analysis patterns to provide linked data*" apresenta uma forma processável por máquina do perfil de metadados proposto no segundo artigo. Essa descrição processável por máquina permite uma recuperação mais adequada dos padrões de análise por meio de ferramentas de busca.

O quarto artigo, intitulado "*A Dublin Core application profile for documenting analysis patterns in a reuse infrastructure*" é uma versão estendida do terceiro artigo, que foi submetida a um periódico. Ele apresenta maiores detalhes a respeito da descrição processável por máquina do perfil de metadados proposta no terceiro artigo e explica como se comporta uma infraestrutura de reuso de padrões de análise quando os padrões de análise presentes em seus repositórios são documentados com o perfil de metadados proposto nessa dissertação.

2.1. Artigo I: An Infrastructure Oriented for Cataloging Services and Reuse of Analysis Patterns

Lucas Francisco da Matta Vegi, Douglas Alves Peixoto, Liziane Santos Soares,

Jugurta Lisboa-Filho e Alcione de Paiva Oliveira

In: INT. WORKSHOP ON REUSE IN BUSINESS PROCESS MANAGEMENT (rBPM in conjunction with The 9th Int. Conf. on Business Process Management), 2, 2011, Clermont-Ferrand, France. **Proceedings…** Berlin Heidelberg: Springer LNBIP N.100, Part 4 – Lecture Notes in Business Information Processing, 2012. pp. 338-343

RESUMO

Padrões têm sido empregados como mecanismo de reuso nas diversas fases do desenvolvimento de software. Os padrões de análise são artefatos voltados para a reutilização durante as etapas de análise de requisitos e modelagem conceitual. No entanto, eles são em geral, documentados em uma forma textual que não é precisa para ser tratada por um computador, limitando assim a difusão e uma reutilização mais ampla. Na área de geoprocessamento, as Infraestruturas de Dados Espaciais (IDE) têm sido empregadas de forma bastante eficiente como instrumento de reuso de dados geoespaciais e serviços. Com base no desenvolvimento de IDEs, este artigo propõe uma Infraestrutura de Reuso de Padrões de Análise (APRI) compreendendo os serviços Web e uma representação de metadados para a especificação de padrões de análise, a fim de apoiar a catalogação e reutilização de padrões de análise.

Palavras-chave: Padrões de Análise, Reutilização, Dublin Core, SOA, Infraestrutura de Dados Espaciais.

ABSTRACT

Patterns have been employed as a mechanism for reuse in several phases of software development. Analysis patterns consist of artifacts for reuse during the requirements analysis and conceptual modeling. However, they are generally, documented in a textual manner which is not precise to be treated by a computer, thus limiting the dissemination and a wider reuse. Within the geo-processing area, Spatial Data Infrastructures (SDI) has been used quite effectively as an instrument for the reuse of geospatial data and services. Based on the development of SDIs, this article proposes an Analysis Patterns Reuse Infrastructure (APRI) comprising web services and a metadata representation for the specification of analysis patterns, in order to support the cataloging and reusing of analysis patterns.

Keywords: Analysis Patterns, Reuse, Dublin Core, SOA, Spatial Data Infrastructure.

1 INTRODUCTION

Spatial Data Infrastructure (SDI) is a relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general (NEBERT, 2004). Currently, most of SDI are based on Service-Oriented Architecture (SOA), allowing to create shared environments, distributed and interoperable based on Web Services (DAVIS JÚNIOR; ALVES, 2005).

The use of SDI allow the availability of spatial data bases resulting from different providers, bringing facilities to the user to acquire new datasets, without the need to build them or convert them, generating duplicity and overcharging his work (RAJABIFARD; WILLIAMSON, 2001)

Appropriate documentation of data and services is a very important point in the development of an SDI. This documentation is produced through defined metadata from a standard metadata specification, for instance, Dublin Core (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005).

Fowler (1997) describes analysis patterns as an idea that has proven to be useful in a given practical context and that can be useful in other contexts. This category of patterns is focused on the reuse of artifacts generated during the requirements analysis and conceptual modeling phases.

Analysis patterns were a well-researched topic in the past, resulting in publications in various domains. However, recently the number of publications in this subject decreased. The work of Blaimer, Bortfeldt and Pankratz (2010) places the theme back in focus, wherein the authors present a detailed review of the literature about analysis patterns and propose new research challenges in this subject.

Documentation of analysis patterns is important to describe the context in which they can be reused and make possible the sharing of knowledge among designers (SILVA et al., 2008). Describing a pattern improperly can generate redundant patterns or patterns in an inadequate context, thus compromising their reuse by other designers (HAMZA, 2004).

In the field of Geographic Information Systems (GIS), SDI has been used very efficiently as a tool for reusing services and geospatial data. In a way analogous to how geospatial data are documented and recovered in an SDI, the documentation of analysis patterns by means of metadata and its recovery made through Web services can contribute to the dissemination and increase of reuse of these patterns.

Thus, the aim of this paper is to propose a service-oriented infrastructure to support the cataloging and reuse of analysis patterns.

The rest of the paper is organized as follows: Section 2 describes related work with metadata standards and ways of specifying analysis patterns. Section 3 describes the architecture of a service-oriented infrastructure for reuse of analysis patterns. Section 4 presents some concluding remarks.

2 RELATED WORK

2.1. Metadata Standards

Metadata consists of data about data. Metadata standards are used to standardize the set of elements of the data description. For example, a standard for geospatial metadata may contain the title, a general description, authors, the spatial limits of the data, quality aspects, and other elements, thus facilitating the search, retrieval and reuse data appropriately (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005).

The structure of a data description, given by metadata, can vary according to the domain of the described data. Considering this situation, many standards have been created in order to establish structures of metadata for specific areas and thus enable a common understanding for a community of users.

The standard CSDGM (Content Standard for Digital Geospatial Metadata) is the most used standard worldwide to describe spatial data. It was created by the FGDC (Federal Geographic Data Committee) in 1994 to support construction of U.S. SDI (NSDI - National Spatial Data Infrastructure) (FGDC, 2000). This standard is composed by 469 elements.

The ISO 19115 standard (ISO, 2003) was proposed with the aim of becoming the main standard in the field of spatial data and services. This metadata standard is very wide and rich in detail, consisting of 509 elements.

There are also generic standards metadata that can be used more widely, for example, the Dublin Core Metadata Initiative (DCMI) (DCMI, 1998). The Dublin Core standard is only composed of 15 elements, and usually all of these elements are present in any broader metadata standard. No element of the Dublin Core is mandatory and all of them can be repeated many times during a data description. Its simplicity brings benefits such as lower costs of implementation and promotion of interoperability between data from different domains, however, the small number of elements that make up the standard does not provide sufficient semantic descriptions of data to describe complex domains (NISO U.S., 2001).

Although the Dublin Core standard is generic and very simple, it can be used as a basis for creating profiles for specific domains from the addition of new elements, specification of rules for the occurrence of the elements and definition of types of values for each element (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005).

2.2. Templates for analysis patterns specification

Analysis patterns can be specified from predefined templates and outlines. The usability of an analysis pattern is reduced if the author does not use a template or uses an incomplete one to specify the pattern (BLAIMER; BORTFELDT; PANKRATZ, 2010).

So far, there is no widely accepted template for specifying analysis patterns, therefore, different methodologies are used for specification. Quite often they are derived from templates geared to specify design patterns and does not fully meet the specificities of analysis patterns (BLAIMER; BORTFELDT; PANKRATZ, 2010).

Considering the shortcomings in the templates oriented to specification of analysis patterns, Pantoquilho, Raminhos and Araújo (2003) propose a specific template for analysis patterns documentation. This template contains the elements of the previous approaches used to describe patterns, as well as several additional elements for a more complete description of the analysis patterns.

3 A WEB SERVICES INFRASTRUCTURE FOR REUSE OF ANALYSIS PATTERNS

Based on the infrastructure for the reuse of geospatial data, this paper proposes an Analysis Patterns Reuse Infrastructure (APRI), composed of Web services, thereby featuring architecture of SOA (Service-Oriented Architecture) (DOYLE; REED, 2001).

The scenario offered by SOA has providers, integrators and service users as actors, and users can be human or software clients. Thus, data and services of the APRI can be accessed by human users and software clients.

The APRI (Figure 1) consists of the following components:

- ***Pattern Portal:*** contains a set of Web sites focused on obtaining the analysis patterns and tools and services that provide discovery, cataloging and reuse of them.
- ***Metadata Repository:*** are repositories that contain metadata in XML (eXtensible Markup Language) for the specification of analysis patterns and services contained in the APRI. The template used for the specification of analysis patterns is a customization of the 15 elements of the Dublin Core standard with the items of the template proposed by Pantoquilho, Raminhos and Araújo (2003).

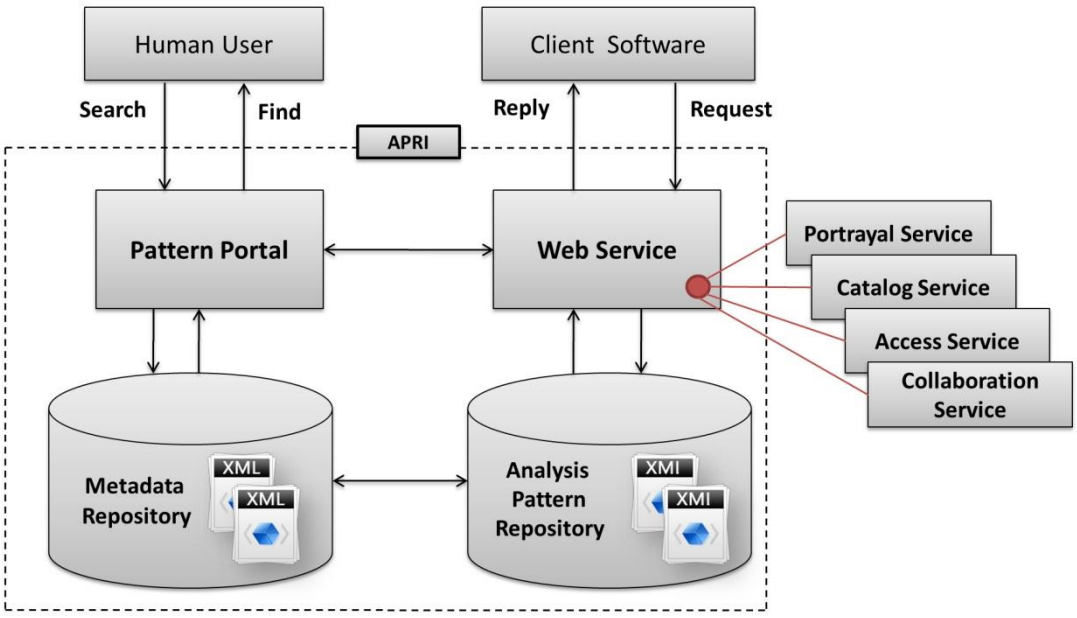

Figure 1 - Analysis Patterns Reuse Infrastructure (APRI)

- ***Analysis Pattern Repository:*** are repositories that contain the analysis patterns in the XMI format (XML Metadata Interchange), allowing their use for visualization and collaboration services.
- ***Portrayal Service:*** are services that support the visualization of the analysis patterns of APRI.
- ***Catalog Service:*** these services enable the discovery and use of analysis patterns and services of APRI, based on their metadata.
- ***Access Service:*** these services allow to access and download the analysis patterns.
- ***Collaboration Service:*** these services allow the experienced designer to contribute improving the analysis patterns.

The definition of this services infrastructure for reuse of analysis patterns is based on components proposed by Béjar et al. (2009), for creating SDI.

4 FINAL CONSIDERATIONS

The architecture proposed in this paper allows the development of a service-oriented infrastructure for the cataloging and reusing of analysis patterns. This proposal seeks to solve a problem in the reuse of analysis patterns, related to the manner through which patterns are documented. With a more suitable documentation, analysis patterns can be more easily discovered, studied and reused.

The Dublin Core standard has being widely used for items documentation such as work of art, museum pieces, maps, websites, etc. One of the advantages of this standard is that the metadata can be easily found by Web search engines, as they are structured by tags, making easy the semantic contextualization. Thus, the Dublin Core can also be adapted to document analysis patterns.

The use of Web services allows as much the reuse of analysis patterns by human designers as the automatic reuse done with CASE tools support. An APRI prototype is being developed by the information systems research group of *Departamento de Informática* at *Universidade Federal de Viçosa*.

As future work, we can mention the studies on the use of the Dublin Core as a metadata standard for documenting other computational artifacts.

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2.2. Artigo II: DC2AP: A Dublin Core Application Profile to Analysis Patterns

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RESUMO

Os padrões de análise são artefatos computacionais reutilizáveis, voltados para a etapa de análise do processo de desenvolvimento de software. Embora os padrões de análise possam facilitar o trabalho de analistas e programadores agregando valores através da reutilização de ideias comprovadamente úteis e testadas, o acesso aos mesmos ainda é muito deficiente devido a maneira como eles são usualmente descritos e disponibilizados. Com o intuito de reduzir essas deficiências, apoiando a catalogação e incentivando a reutilização dos padrões de análise, surgiu a proposta da *Analysis Patterns Reuse Infrastructure* (APRI). Essa infraestrutura é composta por um repositório de padrões de análise, documentados por meio de um perfil de metadados específico e acessados via serviços web. Tendo como base a proposta da APRI, esse artigo apresenta o perfil de metadados específico para a documentação de padrões de análise, chamado *Dublin Core Application Profile to Analysis Patterns* (DC2AP).

Palavras-chave: Padrões de Análise, Reutilização, Padrões de Metadados, Dublin Core.

ABSTRACT

Analysis patterns are reusable computational artifacts, aimed at the analysis stage of the process of software development. Although the analysis patterns can facilitate the work of analysts and programmers adding value through reuse of proven useful and tested ideas, the access to them is still very poor because of the way they are usually described and made available. In order to reduce these deficiencies, supporting cataloging and encouraging the reuse of analysis patterns, it was proposed the Analysis Patterns Reuse Infrastructure (APRI). This infrastructure comprises a repository of analysis patterns documented through a specific metadata profile and accessed via web services. Based on the proposal of APRI, this article presents the specific metadata profile to the documentation of analysis patterns called Dublin Core Application Profile to Analysis Patterns (DC2AP).

Keywords: Analysis Patterns, Reuse, Metadata Standards, Dublin Core.

1 INTRODUCTION

Correction of errors made during the encoding of a software is usually more costly than the correction performed during the stages of analysis and design. The costs for correction of errors increase on each stage and in advanced stages they can be up to 100 times higher than in the early stages (BOEHM; BASILI, 2001).

Due to the needs of companies, programmers and analysts are constantly pressured to deliver encoded projects of software as soon as possible, and the analysis stage is often left in the background (FERNANDEZ; YUAN, 2000). This common situation in companies ends up generating software errors identified too late, thus burdening the costs of the final product.

According to Fernandez and Yuan (2000), analysis patterns can make the analysis stage faster and more accurate for developers, thus preventing that this important stage of development is ignored. The analysis patterns are reusable computational artifacts, aimed at the analysis stage of the process of software development. According to Fowler (1997), the analysis patterns are ideas proved useful in a given practical context and that may be useful in other contexts.

Although the analysis patterns can facilitate the work of analysts and programmers adding value through reuse of proven useful and tested ideas, the access to them is still very poor (BLAIMER; BORTFELDT; PANKRATZ, 2010). So far there is no template to specify the analysis patterns that is widely accepted making each set of analysis patterns is specified according to the preferences of its authors. In addition to not having a pattern specification, the analysis patterns are normally provided in scientific books and papers which are restricted access means and do not allow the efficient retrieval of patterns performed, for example, through a search tool (BLAIMER; BORTFELDT; PANKRATZ, 2010).

In order to minimize these problems of specification and retrieval of analysis patterns, it was proposed the Analysis Patterns Reuse Infrastructure (APRI) (VEGI et al., 2012). This infrastructure, which was inspired by the Spatial Data Infrastructure (SDI) (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005), consists of a repository of analysis patterns, documented in a specific metadata profile and accessed via web services.

This article proposes a specific metadata profile to the documentation of analysis patterns compatible with the APRI (VEGI et al., 2012). The metadata profile is based on the Dublin Core metadata standard (DCMI, 1998) and on the template proposed in (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003) and (RAMINHOS et al., 2006) to specify analysis patterns.

The remainder of this paper is organized as follows: Section 2 describes related works to documentation of analysis patterns and to the Dublin Core metadata standard. Section 3 describes the proposed metadata profile. Section 4 presents an example of analysis pattern specified with the proposed metadata profile and Section 5 presents some conclusions and possible future works.

2 RELATED WORK

2.1. Documentation and Organization of Analysis Patterns

Documentation of analysis patterns is an important way for contextualizing the reuse scope of a pattern and for enabling the sharing of knowledge among designers. However, this documentation is performed in a heterogeneous manner among the authors, since there is no standardized way to specify analysis patterns (BLAIMER; BORTFELDT; PANKRATZ, 2010). There are many approaches to specify analysis patterns, ranging from non-formalized textual descriptions to formalized descriptions based on templates.

Some analysis patterns specified in a non-formalized textual manner can be found in (FOWLER, 1997) and (HAY, 1995). This little formal way of describing a analysis pattern affects reuse, because it makes harder for designers to quickly understand the contextual scope of patterns, and, mostly, it limits the retrieval of analysis patterns through computerized search engines. Thus important detailed information for designers may not be described or even retrieved, thus limiting the spread of these patterns and thereby their potential for reuse.

Analysis patterns have also been described through the use of templates, which are structures with predetermined topics similar to those used to describe design patterns (GAMMA et al., 1994). Usually a template is composed of essential topics such as context, problem, motivation and solution (FOWLER, 1997), combined with other specific topics defined by their authors.

Some analysis patterns documented through templates can be found in (LISBOA FILHO; IOCHPE; BORGES, 2002) and (FERNANDEZ; YUAN, 2010). Meszaros and Doble (1997) present in their work a template composed of topics: name, problem, context, motivation, solution, participants and related patterns. This template was used in (LISBOA FILHO; IOCHPE; BORGES, 2002). Pantoquilho, Raminhos and Araújo (2003) and Raminhos et al. (2006) present in their work a proposal of detailed template specifically for documentation of analysis patterns. This template combines common topics used previously by several authors, with new topics aimed at describing the analysis patterns more broadly.

Besides adequate documentation, another important factor to increase the potential for reuse of analysis patterns is the way they are organized and therefore available because before a pattern is applied to a project, the designer needs to know of its existence and then select it (BLAIMER; BORTFELDT; PANKRATZ, 2010). Usually analysis patterns are organized together forming collections of patterns, and in one collection, usually the patterns are documented homogeneously by the same author, although this is not a rule.

The collection of analysis patterns can have different formats, such as books, articles and websites, and they can still be classified as pattern languages and pattern catalogues (BLAIMER; BORTFELDT; PANKRATZ, 2010). The pattern languages are basically collections of analysis patterns aimed at solving a specific problem. In a pattern language, the patterns are related to each other and must follow application rules, for example, the order in which they must be applied to solve the problem in question (BLAIMER; BORTFELDT; PANKRATZ, 2010). The pattern catalogues are collections of analysis patterns not necessarily related, but organized based on criteria in common and searchable. Fowler's book (1997) is an example of an analysis pattern catalog, because the organization of the patterns described in that book was obtained from groups of patterns with application domains in common and they may be found by potential users through a table of contents (BLAIMER; BORTFELDT; PANKRATZ, 2010).

2.2. Dublin Core Metadata Initiative

Metadata are data about data, i.e., information that makes it possible to know the resources of the data. They can be used to standardize data representation based on the description of their authors, quality levels, application domains and other elements, thereby encouraging the appropriate reuse of data (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005).

The metadata standards are metadata structures used to describe the data. According to the domain of the data to be described, these description structures may have variations compared to other domains due to peculiarities of each of them. Thus, several metadata standards have already been proposed in order to meet the specific needs of some domains. Examples of metadata standards for specific domains can be found in (USLOC, 2004) and (ISO, 2003).

The Dublin Core metadata standard (DCMI, 1998) appeared in 1995 from a workshop held in Dublin city in the U.S. state of Ohio. This event brought together professionals from several fields of knowledge in order to establish a generic metadata standard composed of a small set of recurring elements in all areas (NISO U.S., 2001). This metadata standard has two levels, Simple Dublin Core and Qualified Dublin Core.

The Simple Dublin Core consists of fifteen elements, as the Qualified Dublin Core has seven additional elements that allow more detailed descriptions of data. Beyond the twenty-two elements that compose the levels of the Dublin Core standard, it has many element refinements that can be used to specialize the semantics of an element in certain situations and thus facilitate the discovery of the data (DCMI, 2005).

A major advantage of the Dublin Core standard is its versatility. Although it is very simple and does not provide enough resources to describe data of complex domains (NISO U.S., 2001), it can be specialized from the creation of application profiles for specific domains (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005).

Coyle and Baker (2009) describe in their work the basic steps for creating a Dublin Core application profile. An example of a Dublin Core application profile for specific domain can be found in (DCMI, 2007).

3 A DUBLIN CORE APPLICATION PROFILE TO ANALYSIS PATTERNS

The Dublin Core Application Profile to Analysis Patterns (DC2AP) was developed based on the template proposed in (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003) to specify analysis patterns. The main objectives of DC2AP are to improve retrieval and reuse of analysis patterns by means of a description that allows a more precise treatment performed by a computer, providing detailed information about the analysis patterns that were not retrieved by search engines.

3.1. Mapping between Dublin Core Metadata Elements and Pantoquilho's Analysis Pattern Template

In contrast to the Dublin Core metadata standard, which is generic and therefore aimed to document resources of several domains, the template proposed in (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003) is designed specifically for the documentation of analysis patterns, so it is rich in specific details of this domain. Due to such level of detail, this template was chosen to be used as a basis for the creation of DC2AP.

An important task for the creation of DC2AP was the realization of a mapping between the elements proposed by the Dublin Core and elements of the template proposed in (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003). In this mapping process, elements of both structures were compared and classified based on their semantic correspondences and some conceptual conflicts were identified. These conflicts are characterized by similar concepts that are expressed differently by each of the mapped structures. After identifying and resolving the existing conceptual conflicts between structures it became possible to combine the elements of Dublin Core and Pantoquilho's template, thus creating a single structure free of redundancies and semantic inconsistencies. Table 1 shows the result of the mapping between the Dublin Core standard and Pantoquilho's template. Although Table 1 shows only the mapping between the elements of Simple Dublin Core and the Pantoquilho's template, the elements contained in Qualified Dublin Core were also considered in this comparative process, but none of them had equivalents in the template used.

Several mappings between elements of the Dublin Core and elements of other structures have already been performed and made available in the literature. An example of such mapping is presented in (USLOC, 2008).

3.2. Addition of New Metadata Elements and Creation of Application Rules

From the mapping described above, all equivalent elements have been identified and combined, thereby allowing that the Pantoquilho's template to be merged with Dublin Core, giving rise to the basic structure of the DC2AP.

Most elements of the Pantoquilho's template that had direct equivalent mapping became element refinements of others from the Dublin Core. This happened because Dublin Core elements are generic and therefore require specializations to compose an application profile for a specific domain. These necessary specializations were made by the elements of the chosen template (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003).

Table 1 - Mapping Dublin Core to Pantoquilho's Analysis Pattern Template

Simple Dublin Core	Pantoquilho's template
Title	1. Name 2. Also Known As
Creator	3. History [a]
Subject	7. Context
Description	5. Problem 6. Motivation 7. Context 8. Applicability 14. Examples [a] 18. Known Uses [a]
Publisher	No equivalent
Contributor	3. History [a]
Date	3. History [a]
Type	No equivalent
Format	No equivalent
Indentifier	1. Name [a]
Source	15. Related Patterns [a]
Language	No equivalent
Relation	13. Anti-Patterns Trap [a] 15. Related Patterns [a] 16. Design Patterns [a]
Coverage	No equivalent
Rights	No equivalent

Table 1 (cont.) - Mapping Dublin Core to Pantoquilho's Analysis Pattern Template

Simple Dublin Core	Pantoquilho's template
No equivalent	4. Structural adjustments 9. Requirements 9.1. Functional requirements 9.2. Non-functional requirements 9.3. Dependencies and contributions 9.4. Conflict identification & guidance to resolution 9.5. Priorities 9.6. Participants 10. Modelling 10.1. Structure 10.1.1. Class diagram 10.1.2. Class description 10.2. Behaviour 10.2.1. Collaboration or sequence diagrams 10.2.2. Activity diagrams 10.2.3. State diagrams 10.3. Solution Variants 11. Resulting context 12. Consequences 17. Design guidelines

Note: Table notes.
[a] *Partly equivalent.*

During the merge process of the structures in question, two elements from Pantoquilho's template were discarded. The element "Applicability" was discarded because it has semantics very similar to the element "Problem" and therefore was considered redundant. The element "Structural adjustments" was discarded for not fitting in the context of an application profile of metadata, where application rules are well defined, not being necessary to document structural adjustments performed during use of the profile.

Following the fusion of structures, some elements have undergone semantic adjustments and new ones were proposed to complete the set of elements that composes DC2AP. Table 2 presents all the elements that make up the profile proposed by this work.

Table 2 - DC2AP Elements and Application Rules

Elements and their Application Rules			New
1. Identifier [M] [S] [UNS]			
2. Title [M] [S] [St]	2.1. Alternative Title [O] [Mu] [St]		
3. Creator [M] [Mu] [St]			
4. Subject [M] [Mu] [St]			
5. Description [M] [S] [N]	5.1. Problem [M] [S] [St]		
	5.2. Motivation [M] [Mu] [St]	5.2.1. Example [M] [Mu] [St]	
		5.2.2. Known Uses [O] [Mu] [St] [a]	
	5.3. Context [M] [S] [St]		

Table 2 (cont.) - DC2AP Elements and Application Rules

Elements and their Application Rules			New
6. Publisher [O] [Mu] [St]			
7. Contributor [Cd] [Mu] [St]			
8. Date [M] [S] [N]	8.1. Created [M] [S] [D]		
	8.2. Modified [Cd] [S] [D]		
9. Type [M] [S] [US]	9.1. Notation [M] [S] [St]		YES
10. Format [M] [Mu] [US]			
11. Source [Cd] [S] [UNS]			
12. Language [M] [S] [US]			
13. Relation [Cd] [S] [N]	13.1. Is Version of [Cd] [S] [UNS]		
	13.2. Is Replaced by [Cd] [Mu] [UNS] [b]		
	13.3. Replaces [Cd] [Mu] [UNS] [b]		
	13.4. Is Part of [O] [Mu] [UNS]		
	13.5. Has Part [O] [Mu] [UNS]		
	13.6. Is Designed With [O] [Mu] [UNS] [a]		YES
	13.7. Should Avoid [O] [Mu] [UNS] [a]		YES
	13.8. Complemented by [O] [Mu] [UNS] [a]		YES
	13.9. About [Cd] [S] [St]		
14. Coverage [O] [Mu] [St]			
15. Rights [Cd] [Mu] [US]			
16. History [M] [Mu] [N] [b]	16.1. Event Date [M] [S] [D]		YES
	16.2. Author [M] [Mu] [St]		YES
	16.3. Reason [M] [S] [St]		YES
	16.4. Changes [Cd] [S] [St]		YES
17. Requirements [M] [S] [N]	17.1. Functional Requirements [M] [Mu] [St]		
	17.2. Non-functional Requirements [O] [Mu] [St]		
	17.3.Dependencies and Contributions [M] [S] [St]	17.3.1. Dependency Graph [M] [S] [U]	YES
		17.3.2. Contribution Graph [Cd] [S] [U]	YES
	17.4. Conflict identification & Guidance to Resolution [Cd] [Mu] [St]		
	17.5. Priorities Diagram [M] [S] [U]		
	17.6. Participants [M] [Mu] [St]		
18. Modelling [M] [S] [N]	18.1. Behaviour [M] [S] [N]	18.1.1. Use Case Diagram [M] [S] [U]	YES
		18.1.2. Collaboration/Sequence Diagrams [M] [Mu] [U]	
		18.1.3. Activity/State Diagrams [O] [Mu] [U]	YES
	18.2. Structure [M] [S] [N]	18.2.1. Class Diagram [M] [S] [U]	
		18.2.2. Class Descriptions [M] [S] U]	
		18.2.3. Relationship Descriptions [M] [Mu] [St]	YES
	18.3. Solution Variants [O] [Mu] [U] [a]		
19. Resulting Context [O] [Mu] [St] [a]			
20. Design Guidelines [O] Mu] [St] [a]			
21. Consequences [M] [S] N]	21.1. Positive [M] [Mu] [St]		YES
	21.2. Negative [M] [Mu] [St]		YES

Rules' Acronyms

Obligatoriness	*Occurrence*	*Value Type*
[M] Mandatory [O] Optional [Cd] Conditional	[S] Single [Mu] Multiple	[St] String [D] Date [U] URI [N] Null [UNS] URI, number or string [US] URI or string

Note: Table notes.

[a] *Element for collaboration of use experiences.*

[b] *Element to version control.*

As shown in Table 2, DC2AP has some elements for version control of documented patterns and others for the sharing of experiences of use. These features were incorporated into this profile to allow the creation of dynamic collections of analysis patterns, where new improved versions of the patterns can be proposed from the collaboration of experience of usage of them. Moreover, all the versions of the analysis patterns may be related to each other, thereby providing the creation of a repository of analysis patterns rich in details. These resources allow potential users to retrieve the version that best meets their needs more efficiently. All these characteristics are consistent with the proposal of the APRI (VEGI et al., 2012).

The analysis patterns usually have rules controlling their application. After defining the elements that compose DC2AP, it was proposed rules on the obligation, occurrence and type of value of each of the proposed elements. These rules are presented in Table 2 by acronyms, described at the table end.

Due to limited space, the semantic description of each of the elements that compose DC2AP, as well as some details of the rules for applying them are not presented in this paper. However a detailed technical description of this application profile can be obtained at (VEGI, 2012).

4 EXAMPLE

In order to demonstrate the application of metadata profile proposed in this work, Table 3 presents an example that uses DC2AP to specify the well-known Fowler's analysis pattern called Organization Hierarchies, proposed in (FOWLER, 1997). Not all DC2AP elements are presented in this specification, since some necessary information for these elements are absent in the original specification made by Fowler.

Table 3 - Organization Hierarchies Pattern Specification

Example of use DC2AP	
1. Identifier: OrganizationHierarchies-v1	
2. Title: Organization Hierarchies	2.1. Alternative Title: Hierarquias de organização
3. Creator: Martin Fowler	
4. Subject: Companies, Hierarchy, Organizational Structure, Sudsidiaries	
5. Description	5.1. Problem: There are many systems where we need to manage the hierarchy of an organization, registering its subsidiaries and linking them in accordance with the rules of hierarchy. How can we represent this process in a general and abstract way?

Table 3 (cont.) - Organization Hierarchies Pattern Specification

<table>
<tr><th colspan="3">Example of use DC2AP</th></tr>
<tr><td rowspan="2">5. Description</td><td>5.2. Motivation:
- An organizational hierarchy has subdivisions like Operating Units, Regions, Divisions and Sales Offices.
- Operating Units are divided into Regions.
- Regions are divided into Divisions.
- Divisions are divided into Sales Offices.
- We need to provide a solution easy to be changed because organizations undergo changes in its hierarchy over the course of time.</td><td>5.2.1. Example:
- A management system of a multinational company, for example, Microsoft.

- A management system of a national company that has several branches scattered throughout the territory of a country.</td></tr>
<tr><td colspan="2">5.3. Context: This pattern is valuable to institutions or companies that have any subsidiaries. In some cases institutions may have more than one hierarchical organizational structure, but this is not a rule.</td></tr>
<tr><td colspan="3">6. Publisher: Lucas F. M. Vegi</td></tr>
<tr><td colspan="3">7. Contributor: Lucas F. M. Vegi</td></tr>
<tr><td rowspan="2">8. Date</td><td colspan="2">8.1. Created: 1997</td></tr>
<tr><td colspan="2">8.2. Modified: 2012-01-15</td></tr>
<tr><td>9. Type: Analysis Pattern</td><td colspan="2">9.1. Notation: UML</td></tr>
<tr><td colspan="3">10. Format: JPEG and XMI</td></tr>
<tr><td colspan="3">11. Source: Party Pattern (FOWLER, 1997)</td></tr>
<tr><td colspan="3">12. Language: English</td></tr>
<tr><td rowspan="4">13. Relation</td><td colspan="2">13.2. Is Replaced by: Organization Structure Pattern (FOWLER, 1997)</td></tr>
<tr><td colspan="2">13.4. Is Part of: Organization Structure Pattern (FOWLER, 1997)</td></tr>
<tr><td colspan="2">13.8. Complemented by: Party Pattern (FOWLER, 1997)</td></tr>
<tr><td colspan="2">13.9. About: This analysis pattern can be replaced by Structure Organization pattern, because it contains the pattern Hierarchies Organization specialized with a higher level of details, and thus to more complex organizational hierarchies the analysis patter Organization Structure may be more suitable. The Organization Hierarchies pattern can be complemented by Party pattern because an Organization can be a specialization of Party, as well as the user of the system responsible for registering and changing the hierarchy can also be like that. Thus the Party pattern can be used as a complement of Hierarchies Organization pattern.</td></tr>
<tr><td colspan="3">15. Rights:This analysis pattern was originally published in (FOWLER, 1997).</td></tr>
<tr><td rowspan="3">16. History</td><td colspan="2">16.1. Event Date: 1997</td></tr>
<tr><td colspan="2">16.2. Author: Martin Fowler</td></tr>
<tr><td colspan="2">16.3. Reason: Criation of this analysis pattern.</td></tr>
<tr><td rowspan="4">16. History</td><td colspan="2">16.1. Event Date: 2012-01-15</td></tr>
<tr><td colspan="2">16.2. Author: Lucas F. M. Vegi</td></tr>
<tr><td colspan="2">16.3. Reason: Specification of this analysis pattern with the DC2AP metadata profile.</td></tr>
<tr><td colspan="2">16.4. Changes: Structuring the analysis pattern proposed by Fowler in a metadata profile. Within this process new diagrams referring to the solution presented by this pattern were proposed and the initial ideas of Fowler were reorganized into a structure that promotes its retrieval and subsequent reuse.</td></tr>
<tr><td rowspan="2">17. Requirements</td><td colspan="2">17.1. Functional Requirements:
(R1) Create Organizational Hierarchy - The user should be able to register the hierarchical levels of an organization for all its units.
(R2) Alter Organizational Hierarchy - The user should be able to change the hierarchical levels of an organization whenever necessary, because as time goes on, with the expansion or contraction of it, such changes will certainly happen.</td></tr>
<tr><td colspan="2">17.2. Non-functional Requirements:
(R3) Facility - User must make changes in the hierarchy of an organization in a fast and simple way .
(R4) Security – Only users should be allowed to register and make changes in the hierarchy.</td></tr>
</table>

Table 3 (cont.) - Organization Hierarchies Pattern Specification

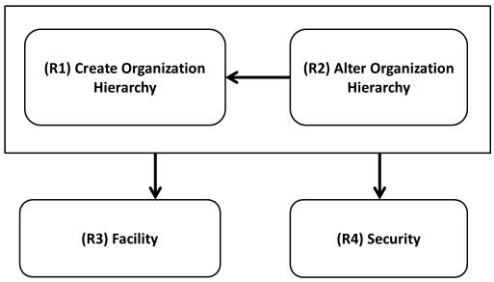
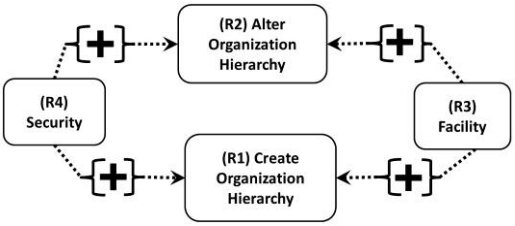
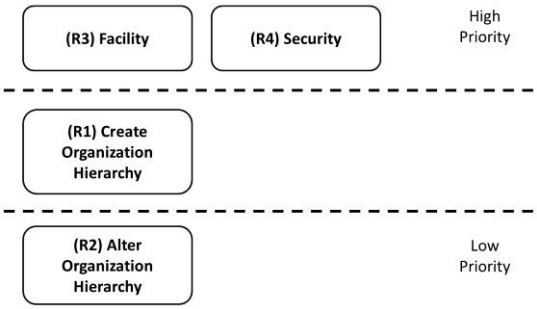
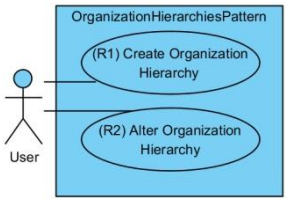
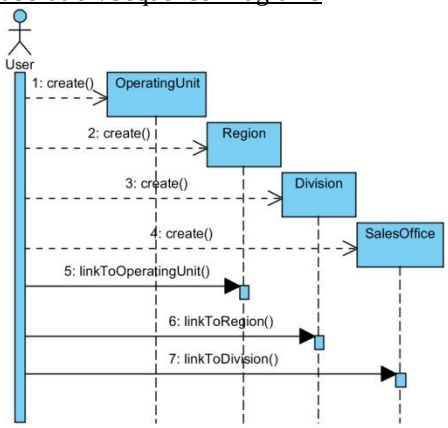
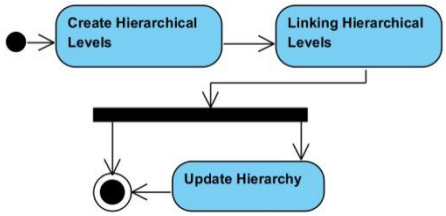
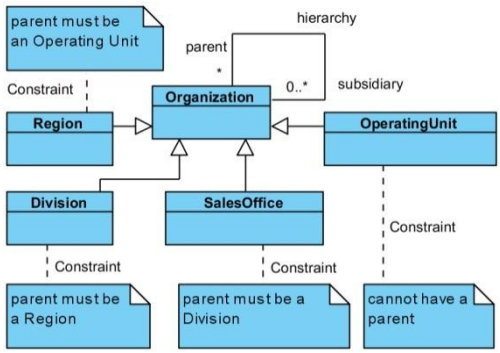
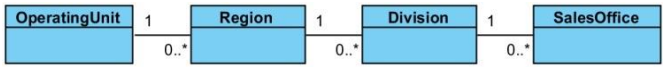
<table>
<tr><th colspan="4">Example of use DC2AP</th></tr>
<tr><td rowspan="3">17. Requirements</td><td rowspan="2">17.3.
Dependencies
and Contributions:
R2 depends on R1 because only registered hierarchies can be changed.
R1 and R2 depends om R3 and R4 because it is desired that all these processes are being made only by authorized users, and in a simple way.</td><td colspan="2">17.3.1. Dependency Graph
 
</td></tr>
<tr><td colspan="2">17.3.2. Contribution Graph
 
</td></tr>
<tr><td colspan="3">17.5. Priorities Diagram
 
</td></tr>
<tr><td colspan="3">17.6. Participants: User</td></tr>
<tr><td>18. Modelling</td><td>18.1. Behaviour</td><td colspan="2">18.1.1. Use Case Diagram
 
</td></tr>
</table>

Table 3 (cont.) - Organization Hierarchies Pattern Specification

<table>
<tr><th colspan="3">Example of use DC2AP</th></tr>
<tr><td rowspan="3">18. Modelling</td><td rowspan="2">18.1. Behaviour</td><td>18.1.2. Collaboration/Sequence Diagrams
 
</td></tr>
<tr><td>18.1.3. Activity/State Diagrams
 
</td></tr>
<tr><td>18.2. Structure</td><td>18.2.1. Class Diagram
 

18.2.2. Class Descriptions:
- Organization: This class holds all the attributes common to all possible types of subsidiaries of an organization.
- Operating Unit: This class represents the highest hierarchical level of an organization.
- Region: This class represents a hierarchical level of an organization. This is the level immediately below an Operating Unit in a hierarchy.
- Division: This class represents a hierarchical level of an organization. This is just below a Region in a hierarchy.
- SalesOffice: This class represents a hierarchical level of an organization. This is just below a Division in a hierarchy.</td></tr>
</table>

Table 3 (cont.) - Organization Hierarchies Pattern Specification

<table>
<tr><th colspan="3">Example of use DC2AP</th></tr>
<tr><td rowspan="2">18. Modelling</td><td>18.2. Structure</td><td>18.2.3. Relationship Descriptions:
The self-relationship between the Organization class, super-class of all hierarchical levels, represents that the hierarchical levels communicate with each other. To correctly obey the hierarchical structure, there are restrictions establishing what hierarchical level each of them can communicate directly with.</td></tr>
<tr><td colspan="2">18.3. Solution Variants:
 
</td></tr>
<tr><td rowspan="2">21. Consequences</td><td colspan="2">21.1. Positive:
- This analysis pattern represents an organizational hierarchy easy to change, thus making it useful in different contexts.
- To change the hierarchical structure of an organization of this pattern, it is not necessary to change the model structure, but the subtypes and restrictions of the pattern. This makes the pattern flexible and reusable.</td></tr>
<tr><td colspan="2">21.2. Negative:
- This pattern supports only a single organizational hierarchy, thereby limiting some contexts of use.
- If restrictions are not well established for the context of use of this pattern, the self-relationship in it can be dangerous, allowing some hierarchical levels relate directly improperly.</td></tr>
</table>

5 CONCLUSIONS AND FUTURE WORK

DC2AP allows a detailed specification of the analysis patterns, since it was developed specifically for this domain. This profile was developed to be integrated into the proposal of Analysis Patterns Reuse Infrastructure (APRI) (VEGI et al., 2012). Thus it aims to solve the problem of documentation, organization, search and access to analysis patterns.

The use of DC2AP in an APRI allows the creation of digital collections of analysis patterns in the form of pattern catalogues and pattern languages. Through web services proposed by APRI, the analysis patterns specified with DC2AP can be retrieved more quickly and efficiently, offering to potential users an easier access to well-documented analysis patterns, and consequently, with greater potential for reuse.

Because it is a generic metadata standard, Dublin Core allows interoperability between data of different domains, so DC2AP, being an application profile of Dublin Core, can be combined with future works aimed at creating new Dublin Core application profiles to document other types of reusable computational artifacts.

As future work, it is intended to align current description of DC2AP to the Singapore Framework. This framework is a set of descriptive components recommended to document an application profile (NILSSON; BAKER; JOHNSTON, 2008). With this alignment, DC2AP will fit in the concept of machine-processable application profile and thus can serve as basis for the definition and implementation of web services proposed in APRI for search, visualization, application and contribution of use experience of analysis patterns.

ACKNOWLEDGMENT

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2.3. Artigo III: A Machine-Processable Dublin Core Application Profile for Analysis Patterns to Provide Linked Data

Lucas Francisco da Matta Vegi, Jugurta Lisboa Filho e Joep Crompvoets

In: **INT. CONF. ON DUBLIN CORE AND METADATA**, 2012, Kuching, Sarawak, Malaysia. Artigo aceito para publicação.

RESUMO

Os padrões de análise são artefatos computacionais reutilizáveis, voltados para a etapa de análise do processo de desenvolvimento de software. Embora os padrões de análise possam facilitar o trabalho de analistas e desenvolvedores, o acesso aos mesmos ainda é muito deficiente devido à maneira como eles são usualmente descritos e disponibilizados. A *Analysis Patterns Reuse Infrastructure* (APRI) foi proposta com intuito de reduzir essas deficiências, apoiando a catalogação e incentivando a reutilização dos padrões de análise. Essa infraestrutura é composta por um repositório de padrões de análise documentados por meio de um perfil de metadados específico e que podem ser acessados via serviços Web. Tendo como base a proposta da APRI, esse artigo apresenta o perfil de metadados processável por máquina específico para a documentação de padrões de análise, chamado *Dublin Core Application Profile for Analysis Patterns* (DC2AP). Esse perfil de aplicação é descrito por arquivos RDF e identificado via URI, fornecendo dessa forma *Linked Data* que ampliam o potencial de reuso dos padrões de análise.

Palavras-chave: Padrões de Análise, Reutilização, Padrões de Metadados, Dublin Core, Web Semântica, Linked Data.

ABSTRACT

Analysis patterns are reusable computational artifacts aimed at the analysis stage of the software development process. Although the analysis patterns can facilitate the work of analysts and developers, the access to them is still very poor because of the way they are usually described and made available. The Analysis Patterns Reuse Infrastructure (APRI) was proposed in order to reduce these deficiencies for supporting, cataloging and encouraging the reuse of analysis patterns. This infrastructure comprises a repository of analysis patterns documented through a specific metadata profile and that can be accessed via Web services. Based on the proposal of APRI, this article presents the specific metadata profile to the documentation of analysis patterns called Dublin Core Application Profile for Analysis Patterns (DC2AP). This application profile is described by RDF files and identified via URI, thus providing Linked Data that increase the potential for reuse of the analysis patterns.

Keywords: Analysis Patterns, Reuse, Metadata Standards, Dublin Core, Semantic Web, Linked Data.

1 INTRODUCTION

Analysis patterns are reusable computational artifacts aimed at the analysis stage of the software development process. Ideas applied during the requirements analysis and conceptual modeling of specific domain software, can be expressed abstractly through analysis patterns. From the application of analysis patterns, these ideas can be reused by other analysts during the software project of any domain. According to Fowler (1997), analysis patterns are ideas proven to be useful in a given context that may be applicable for other practical contexts. Thus, these reusable computational artifacts can make analysis stage faster and more accurate for analysts and developers (FERNANDEZ; YUAN, 2000) avoiding rework to develop and test solutions that already exist.

Although the analysis patterns can facilitate the work of analysts and programmers by adding value through reuse of proven useful and tested ideas, the access to them is still very poor (BLAIMER; BORTFELDT; PANKRATZ, 2010). So far there is no template to specify the analysis patterns that is widely accepted, making each set of analysis patterns being specified according to the preferences of its authors. In addition to not having a pattern specification, the analysis patterns are normally provided in scientific books and papers which are means of access that are not machine-processable. These restrictions do not allow analysis patterns to be effectively retrieved by a search software (BLAIMER; BORTFELDT; PANKRATZ, 2010), thus burdening the time taken to retrieve an analysis pattern and limiting the quality of the results obtained by searches. It happens because the understanding of the descriptions of these analysis patterns is restricted to the human ability of comprehension.

In order to minimize these problems of specification and enhance retrieval of analysis patterns and therefore increase the potential for reuse of them, Vegi et al. (2012) proposed the architecture of an Analysis Patterns Reuse Infrastructure (APRI). This infrastructure, which was inspired by the components of Spatial Data Infrastructures (SDI) proposed by Béjar et al. (2009), consists of a repository of analysis patterns, documented in a specific metadata profile and that can be accessed via Web services.

This article presents an application profile of Dublin Core metadata standard created specifically to describe analysis patterns in a manner consistent with the proposal of APRI (VEGI et al., 2012). The semantic base of the elements of this

application profile is provided by the template proposed by Pantoquilho, Raminhos and Araújo (2003) and Raminhos et al. (2006) to describe the analysis patterns. The application profile presented by this work is machine-processable, enabling analysis patterns to be described and published as Linked Data (BIZER; HEATH; BERNERS-LEE, 2009) through files in the format Resource Description Framework (RDF) (KLYNE; CARROLL, 2004).

The remainder of this paper is organized as follows: Section 2 describes related work to documentation of analysis patterns, Semantic Web and Linked Data. The machine-processable metadata profile proposed by this article is presented in Section 3, while Section 4 presents some conclusions and future work.

2 RELATED WORK

2.1. Documentation and Organization of Analysis Patterns

Documentation of analysis patterns is an important way for contextualizing the reuse scope of a pattern and for enabling the sharing of knowledge among designers. However, this documentation is performed in a heterogeneous manner among the authors, since there is no standardized way to specify analysis patterns (BLAIMER; BORTFELDT; PANKRATZ, 2010). There are many approaches to specify analysis patterns ranging from non-formalized textual descriptions to formalized descriptions based on templates.

Some analysis patterns specified in a non-formalized textual manner can be found in Fowler (1997) and Hay (1995). This little formal way of describing a analysis pattern affects reuse, because it makes harder for designers to quickly understand the contextual scope of patterns, and, mostly, it limits the retrieval of analysis patterns through computerized search engines. Thus important detailed information for designers may not be described or even retrieved, thus limiting the spread of these patterns and thereby their potential for reuse.

Analysis patterns have also been described through the use of templates, which are structures with predetermined topics similar to those used to describe design patterns (GAMMA et al., 1994). Usually a template is composed of essential topics such as context, problem, motivation and solution (FOWLER, 1997), combined with other specific topics defined by their authors.

Some analysis patterns documented through templates can be found in the work of Lisboa-Filho, Iochpe and Borges (2002) and Fernandez and Yuan (2009). Meszaros and Doble (1997) present in their work a template composed of topics: name, problem, context, motivation, solution, participants and related patterns. This template was applied by Lisboa-Filho, Iochpe and Borges (2002) as shown in Figure 1. Pantoquilho, Raminhos and Araújo (2003) and Raminhos et al. (2006) propose a detailed template developed specifically for the documentation of analysis patterns. This template combines common topics used previously by several authors, with new topics aimed at describing the analysis patterns more broadly.

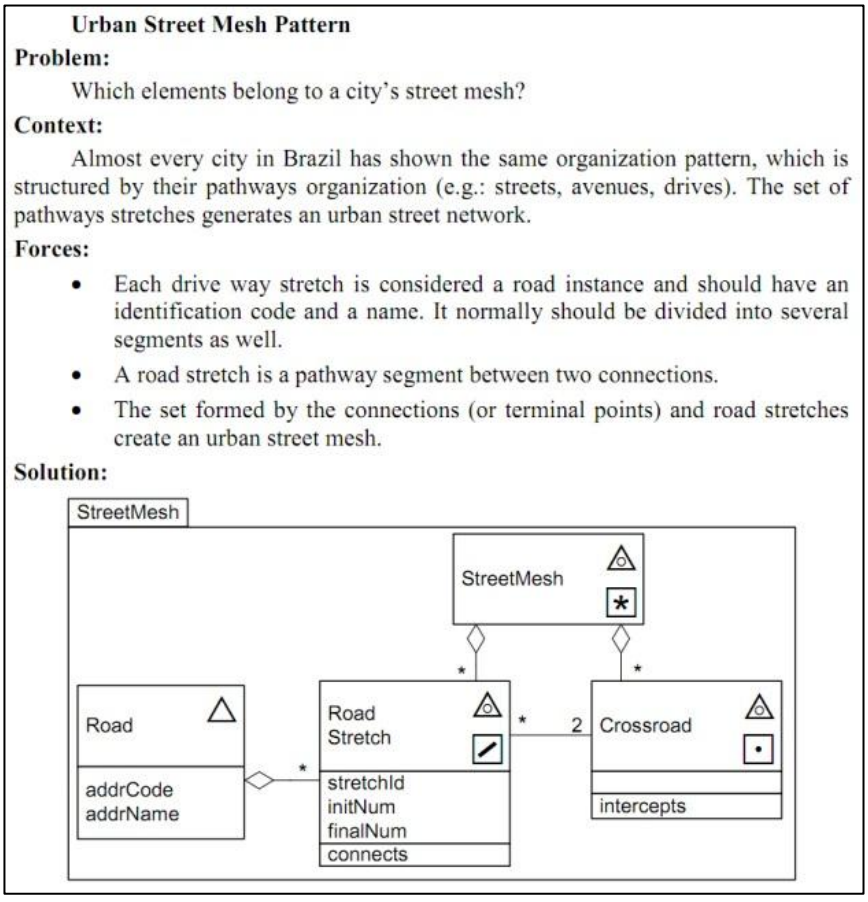

Figure 1 - Urban Street Mesh Pattern (LISBOA-FILHO; IOCHPE; BORGES, 2002)

Besides adequate documentation, another important factor to increase the potential for reuse of analysis patterns is the way it is organized and therefore made available. This is because before a pattern is applied to a project, the designer needs to know of its existence and then select it (BLAIMER; BORTFELDT; PANKRATZ, 2010). Usually analysis patterns are organized together forming collections. These

collections can have different formats, such as books, articles and Websites, and they can still be classified as pattern languages and pattern catalogues (BLAIMER; BORTFELDT; PANKRATZ, 2010). The pattern languages are basically collections of analysis patterns aimed at solving a specific problem. In a pattern language, the patterns are related to each other and must follow application rules, for example, the order in which they must be applied to solve the problem in question (BLAIMER; BORTFELDT; PANKRATZ, 2010). The pattern catalogues are collections of analysis patterns not necessarily related, but organized based on criteria in common and searching ability. Fowler (1997) presents an example of an analysis pattern catalog. The organization of the patterns described in his book is made from groups of patterns that have an application domain in common and may be found by potential users through a table of contents (BLAIMER; BORTFELDT; PANKRATZ, 2010).

2.2. Analysis Patterns Reuse Infrastructure

Spatial Data Infrastructure (SDI) is a relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data (NEBERT, 2004). Currently, most SDIs are based on Service-Oriented Architecture (SOA), allowing to create shared environments, distributed and interoperable based on Web Services (DAVIS JÚNIOR; ALVES, 2005).

In the field of Geographic Information Systems (GIS), SDIs have been used very efficiently as a tool for reusing services and geospatial data. In a way analogous to how geospatial data are documented and retrieved in an SDI, Vegi et al. (2012) proposed in their work an architecture for Analysis Patterns Reuse Infrastructure (APRI). In the proposed infrastructure, analysis patterns should be documented using metadata and can be retrieved through Web services. Figure 2 presents the infrastructure architecture proposed by Vegi et al. (2012) facilitating the dissemination and increase of reuse of analysis patterns.

The APRI (Figure 2) consists of the following components:

- ***Pattern Portal:*** contains a set of Websites focused on obtaining the analysis patterns, and tools and services that provide the discovery, cataloging and reuse of them.

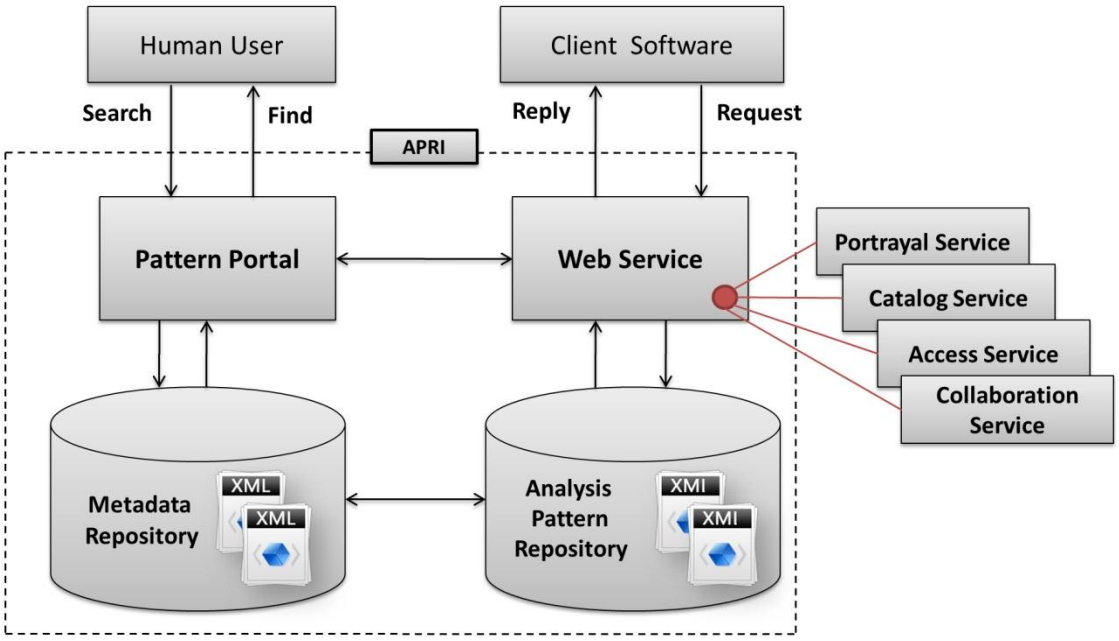

Figure 2 - Analysis Patterns Reuse Infrastructure Architecture (VEGI et al., 2012)

- ***Metadata Repository:*** are repositories that contain metadata in XML (eXtensible Markup Language) for the specification of analysis patterns and services contained in an APRI. The machine-processable Dublin Core Application Profile proposed later in this paper should be used to specify analysis patterns contained in these metadata repositories.
- ***Analysis Pattern Repository:*** are repositories that contain the diagrams that represents the solutions proposed by analysis patterns in the XMI format (XML Metadata Interchange), allowing their use for visualization and collaboration services.
- ***Portrayal Service:*** are services that support the visualization of diagrams that represents the solutions proposed by analysis patterns contained in an APRI.
- ***Catalog Service:*** these services enable the discovery and use of analysis patterns and services of an APRI, based on their metadata.
- ***Access Service:*** these services allow to access and download the analysis patterns.
- ***Collaboration Service:*** these services allow designers to share their use experiences to improve the analysis patterns.

2.3. Semantic Web and Linked Data

The Semantic Web is seen as a layer of the Web where it is possible to publish, obtain and use data that can be processed directly or indirectly by machines (BERNERS-LEE, 2000). The desire to extend the capabilities of conventional Web consisting of hypertext documents for a global environment, where machine-processable structured data are widely published and used, is not new. Berners-Lee et al. (1994) predicted in their work that in the course of time the Web in which the objects were predominantly documents interpretable by humans would evolve into an environment with more machine-processable semantic information.

While the Semantic Web aims to transform the conventional Web in an environment composed of machine-processable data, Linked Data provides the means to make this possible. Linked Data are machine-processable structured data published on the Web. These data are well defined and are linked to other data of different sources through semantic relationships (BIZER; HEATH; BERNERS-LEE, 2009). The main difference between conventional hypertext Web and Linked Data is the types of relationships established between the data. While in conventional Web the nature of the relationship between two documents is implicit, in Linked Data that nature is explicit and understandable by computer (BIZER; HEATH; BERNERS-LEE, 2009).

Linked Data uses three main technologies to support the Semantic Web. Uniform Resource Identifiers (URIs) (BERNERS-LEE; FIELDING; MASINTER, 2005) are used to identify the data. The HTTP protocol on the other hand is used as a mechanism for data retrieval and RDF is used to describe the machine-processable data (KEIZER et al., 2011).

RDF is a framework of machine-processable metadata used to describe both Web documents and concepts of real-world in a network such as people and companies (SAUERMANN et al., 2008). From the use of RDF to describe the data, it becomes possible to establish semantic relationships between them due to the way how data is encoded. Each relationship between RDF data consists of the triple formed by the concepts of subject, predicate and object. In this triple, subject and object are URI identifiers of the related data and predicate specifies the semantics of the relationship, i.e., the kind of relationship between the data (KLYNE; CARROLL, 2004).

The main objective of Linked Data is to build the so-called Web of data, thus allowing the Web to be used as a single global database, thereby reducing barriers to the reuse, integration and implementation of data from distributed heterogeneous sources (BIZER; HEATH; BERNERS-LEE, 2009).

The Web of data created from the publication of Linked Data on the Web enables the creation of new types of applications classified into three main categories: 1) Linked Data browsers, 2) Linked Data search engines and 3) applications of a specific domain. Linked Data browsers allow users to navigate between data from different sources through semantic relationships established between them, and then to browse through a particular source of data and from that to go through the entire network by relationships among the data. The Linked Data search engines allow to perform complex searches similar to those offered by database management systems, thus allow data to be retrieved from Web of data through searches that consider the nature of relationships between them (BIZER; HEATH; BERNERS-LEE, 2009).

Linked Data must be published on the Web accompanied by metadata to enable potential users, humans or machines, to assess their quality and reliability (HARTIG, 2009). These metadata can be provided by using the metadata standards, e.g., Dublin Core (DCMI, 1998).

3 A MACHINE-PROCESSABLE DUBLIN CORE APPLICATION PROFILE FOR ANALYSIS PATTERNS

The Dublin Core Application Profile for Analysis Patterns (DC2AP) was developed based on the template to specify analysis patterns as proposed by Pantoquilho, Raminhos and Araújo (2003). The main objectives of DC2AP are to improve the retrieval and reuse of analysis patterns by means of a description that allows a more precise treatment performed by a computer, and thus provide detailed information about the analysis patterns that were not retrieved by search engines.

3.1. Mapping of Dublin Core Metadata Elements to Pantoquilho et al.'s Template

In contrast to the Dublin Core metadata standard, which is generic and therefore aimed to document resources of several domains, the template proposed by Pantoquilho, Raminhos and Araújo (2003) is designed specifically for the documentation of analysis

patterns, so it is rich in specific details of this specific domain. Due to such level of details, this template was chosen to be used as a basis for the creation of DC2AP.

The first step in creating the DC2AP was the realization of a mapping between the elements proposed by the Dublin Core and the elements of the template as proposed by Pantoquilho, Raminhos and Araújo (2003). With this mapping, the elements of both structures were compared and classified based on their semantic intersections, allowing a subsequent fusion between them. Table 1 shows the result of mapping done between the Dublin Core standard and Pantoquilho et al.'s template.

Table 1 - Mapping Dublin Core to Pantoquilho et al.'s Analysis Pattern Template

Simple Dublin Core	Pantoquilho et al.'s template
Title	1. Name 2. Also Known As
Creator	3. History [a]
Subject	7. Context
Description	5. Problem 6. Motivation 7. Context 8. Applicability 14. Examples [a] 18. Known Uses [a]
Publisher	No equivalent
Contributor	3. History [a]
Date	3. History [a]
Type	No equivalent
Format	No equivalent
Indentifier	1. Name [a]
Source	15. Related Patterns [a]
Language	No equivalent
Relation	13. Anti-Patterns Trap [a] 15. Related Patterns [a] 16. Design Patterns [a]
Coverage	No equivalent
Rights	No equivalent
No equivalent	4. Structural adjustments 9. Requirements 9.1. Functional requirements 9.2. Non-functional requirements 9.3. Dependencies and contributions 9.4. Conflict identification & guidance to resolution 9.5. Priorities 9.6. Participants 10. Modelling 10.1. Structure 10.1.1. Class diagram 10.1.2. Class description 10.2. Behaviour 10.2.1. Collaboration or sequence diagrams 10.2.2. Activity diagrams 10.2.3. State diagrams

Table 1 (cont.) - Mapping Dublin Core to Pantoquilho et al.'s Analysis Pattern Template

Simple Dublin Core	Pantoquilho et al.'s template
No equivalent	10.3. Solution Variants 11. Resulting context 12. Consequences 17. Design guidelines

Note: Table notes.
[a] *Partly equivalent.*

Although Table 1 shows only the mapping between the elements of Simple Dublin Core and the Pantoquilho et al.'s template, the elements contained in Qualified Dublin Core were also considered in this comparative process, but none of them had direct equivalents in the template.

Some elements of Table 1 present the comment "partly." These elements are not semantically identical to the other in which they have been mapped, but are just partially equivalent. Although this is not the ideal scenario, all the elements were mapped taking into account the highest possible equivalence among them.

Several mappings between elements of the Dublin Core and elements of other structures have already been performed and made available in the literature. An example of such mapping is presented in (USLOC, 2008).

3.2. Addition of New Metadata Elements and Creation of Application Rules

From the mapping described above, all equivalent elements have been identified and combined, thereby allowing that the Pantoquilho et al.'s template was fused to Dublin Core, giving rise to the basic structure of the DC2AP.

Most elements of the Pantoquilho et al.'s template that had direct equivalent mapping became element refinements of the others from the Dublin Core. This happened due to the Dublin Core elements are generic, and therefore require specializations to compose an application profile for a specific domain. These necessary specializations were made by the elements of the chosen template (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003).

During the fusion process of the structures in question, two elements from Pantoquilho et al.'s template were discarded. The element "Applicability" was discarded because its semantics are very similar to the element "Problem" and therefore being considered as redundant. The element "Structural adjustments" was also discarded to be

unnecessary in the context of an application profile of metadata. In this context there are many well defined application rules, not being necessary to document structural adjustments performed during use of the profile.

Following the fusion of structures, some elements have undergone semantic adjustments and new ones were proposed to complete the set of elements that composes DC2AP. Table 2 presents all the elements that make up the profile proposed by this work.

The use of application profiles are generally controlled by rules. This work proposed rules on the obligatoriness, occurrence and value type of each DC2AP element:

- ***Obligatoriness:*** [M] Mandatory; [O] Optional; [Cd] Conditional.
- ***Occurrence:*** [S] Single; [Mu] Multiple.
- ***Value Type:*** [St] String; [D] Date; [U] URI; [N] Null; [UNS] URI; Number and String; [US] URI and String.

Table 2 - DC2AP Elements and Application Rules

Elements and their Application Rules			New
1. Identifier [M] [S] [UNS]			
2. Title [M] [S] [St]	2.1. Alternative Title [O] [Mu] [St]		
3. Creator [M] [Mu] [St]			
4. Subject [M] [Mu] [St]			
5. Description [M] [S] [N]	5.1. Problem [M] [S] [St]		
	5.2. Motivation [M] [Mu] [St]	5.2.1. Example [M] [Mu] [St]	
		5.2.2. Known Uses [O] [Mu] [St] [a]	
	5.3. Context [M] [S] [St]		
6. Publisher [O] [Mu] [St]			
7. Contributor [Cd] [Mu] [St]			
8. Date [M] [S] [N]	8.1. Created [M] [S] [D]		
	8.2. Modified [Cd] [S] [D]		
9. Type [M] [S] [US]	9.1. Notation [M] [S] [St]		YES
10. Format [M] [Mu] [US]			
11. Source [Cd] [S] [UNS]			
12. Language [M] [S] [US]			
13. Relation [Cd] [S] [N]	13.1. Is Version of [Cd] [S] [UNS]		
	13.2. Is Replaced by [Cd] [Mu] [UNS] [b]		
	13.3. Replaces [Cd] [Mu] [UNS] [b]		
	13.4. Is Part of [O] [Mu] [UNS]		
	13.5. Has Part [O] [Mu] [UNS]		
	13.6. Is Designed With [O] [Mu] [UNS] [a]		YES
	13.7. Should Avoid [O] [Mu] [UNS] [a]		YES
	13.8. Complemented by [O] [Mu] [UNS] [a]		YES
	13.9. About [Cd] [S] [St]		
14. Coverage [O] [Mu] [St]			
15. Rights [Cd] [Mu] [US]			

Table 2 (cont.) - DC2AP Elements and Application Rules

Elements and their Application Rules			New
16. History [M] [Mu] [N] [b]	16.1. Event Date [M] [S] [D]		YES
	16.2. Author [M] [Mu] [St]		YES
	16.3. Reason [M] [S] [St]		YES
	16.4. Changes [Cd] [S] [St]		YES
17. Requirements [M] [S] [N]	17.1. Functional Requirements [M] [Mu] [St]		
	17.2. Non-functional Requirements [O] [Mu] [St]		
	17.3.Dependencies and Contributions [M] [S] [St]	17.3.1. Dependency Graph [M] [S] [U]	YES
		17.3.2. Contribution Graph [Cd] [S] [U]	YES
	17.4. Conflict identification & Guidance to Resolution [Cd] [Mu] [St]		
	17.5. Priorities Diagram [M] [S] [U]		
	17.6. Participants [M] [Mu] [St]		
18. Modelling [M] [S] [N]	18.1. Behaviour [M] [S] [N]	18.1.1. Use Case Diagram [M] [S] [U]	YES
		18.1.2. Collaboration/Sequence Diagrams [M] [Mu] [U]	
		18.1.3. Activity/State Diagrams [O] [Mu] [U]	YES
	18.2. Structure [M] [S] [N]	18.2.1. Class Diagram [M] [S] [U]	
		18.2.2. Class Descriptions [M] [S] U]	
		18.2.3. Relationship Descriptions [M] [Mu] [St]	YES
	18.3. Solution Variants [O] [Mu] [U] [a]		
19. Resulting Context [O] [Mu] [St] [a]			
20. Design Guidelines [O] Mu] [St] [a]			
21. Consequences [M] [S] N]	21.1. Positive [M] [Mu] [St]		YES
	21.2. Negative [M] [Mu] [St]		YES

Note: Table notes.

[a] *Element for collaboration of use experiences.*

[b] *Element to version control.*

Due to limited text size, the semantic description of each of the elements that composes DC2AP, as well as some details of the rules for applying them are not presented in this paper. However, this information can be obtained at: `http://purl.org/dc2ap/TechnicalDescription`.

As shown in Table 2, DC2AP contains some elements for version control of documented patterns and others for the sharing of experiences of use. These features were incorporated into this profile to allow the creation of dynamic collections of analysis patterns, where new improved versions of the patterns may be proposed from the collaboration of experience of using them. Moreover, all the versions of the analysis patterns may be related to each other, thereby providing the creation of a repository of analysis patterns rich in details. These resources allow potential users to retrieve the version that best fits their needs more efficiently. All these characteristics are consistent with the proposal of the APRI (VEGI et al., 2012).

3.3. Providing Linked Data with RDF Semantic Properties

In order to transform the metadata profile previously presented in a machine-processable profile and therefore suit it to the proposal of Linked Data, each of the elements proposed by DC2AP were associated with URI identifiers and described by RDF semantic properties. According to Coyle and Baker (2009), it is important before creating new RDF semantic properties to look for existing properties that are semantically equivalent to the elements proposed by an application profile, because the use of known properties associated with elements of a profile increases the metadata semantic interoperability. So, initially were performed searches for RDF vocabularies which contains semantic properties equivalent to elements of DC2AP. Table 3 presents the compatible RDF vocabularies selected after the searches.

Table 3 - RDF Compatible Vocabularies

Vocabulary Title	Vocabulary URI
The Dublin Core Metadata Element Set, v1.1	`http://purl.org/dc/elements/1.1/`
Dublin Core Terms	`http://purl.org/dc/terms/`
RDA Group 1 Elements	`http://rdvocab.info/Elements/`
RDA Roles	`http://rdvocab.info/roles/`

Although four RDF vocabularies were found containing semantic properties equivalent to elements of DC2AP, it was also necessary to declare new semantic properties to describe the elements that were not associated with the vocabularies found. All new RDF properties have been declared in accordance with the DCMI Namespace Policy (POWELL et al., 2007), and then identified with URIs redirected by the server `http://purl.org` to RDF schema files on the server `http://dpi.ufv.br`. These new semantic properties together make up the vocabulary "DC2AP Element Set", identified by URI `http://purl.org/dc2ap/elements/`.

Besides the association and the creation of RDF semantic properties to describe the elements of DC2AP, some elements were also associated with Vocabulary Encoding Schemes and Syntax Encoding Schemes. Both types of schemes are lists containing controlled vocabularies used to standardize the registration of metadata of a machine-processable application profile (COYLE; BAKER, 2009), thus preventing the occurrence of ambiguity between the terms used in the documentation of analysis patterns.

Due to text size limitations, both the URIs referring to the RDF semantic properties and the lists of controlled vocabularies associated with elements of DC2AP are not presented in this article. However this information can be obtained from the technical description of this application profile available at: `http://purl.org/dc2ap/TechnicalDescription`.

By applying DC2AP to document analysis patterns through RDF properties, the metadata repository proposed by APRI architecture presented in Figure 2, actually becomes a source of Linked Data of the specific domain of analysis patterns. Examples of analysis patterns documented by machine-processable RDF properties can be found at: `http://purl.org/dc2ap/Examples`. A metadata editor able to document machine-processable analysis patterns with DC2AP is still under construction. A beta version of this software can be found at: `http://purl.org/dc2ap/Editor`.

4 CONCLUSIONS AND FUTURE WORK

DC2AP enables to describe an analysis patterns in detail, since it was designed with the focus on specifics of the domain of this kind of patterns. These specifics are mainly described by the template proposed by Pantoquilho, Raminhos and Araújo (2003), and used as the semantic base in the DC2AP creation. This application profile of Dublin Core was developed in line with the proposal of APRI (VEGI et al., 2012), thus intended to be part of this reuse infrastructure to solve the problems of documentation, organization, searching and access to analysis patterns.

Because it is a machine-processable application profile, DC2AP allows the creation of digital collections of analysis patterns that are searchable via search engines. In this way is enabled that the analysis patterns are retrieved more quickly and efficiently, giving users an ease of access to well documented analysis patterns.

In order to fit in the concept of machine-processable application profile, DC2AP had its elements and application rules described by using RDF files identified through URI. These descriptions provide Linked Data, and therefore allow that the metadata repository proposed by APRI architecture behaves as a source of specific domain Linked Data linked to the global database composed of the Linked Data published on the Web. When they are described as Linked Data, analysis patterns has the potential for

reuse expanded and enable greater integration of these with other data from distributed heterogeneous sources (BIZER; HEATH; BERNERS-LEE, 2009).

As future work, it is intended to validate the acceptability of DC2AP through a quantitative research applied to the user community of analysis patterns. Besides, it is intended as well to use the DC2AP as the basis for the definition and implementation of Web services proposed in APRI to search, view, apply and contribute with experiences of using analysis patterns. These services will be specific domain Linked Data applications and thus can discover new sources of data from the RDF links existing in the analysis patterns described in an APRI. This possibility of finding new sources of data will allow greater dynamism to the metadata repositories of an APRI, since the services will be able to retrieve new related data found in other sources whenever they are published on the Web. As another future work, it is intended to extend the APRI architecture for other types of reusable computational artifacts such as frameworks and design patterns. With this architecture extension it will be possible to create new Dublin Core application profiles to document the new reusable computational artifacts supported by APRI.

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2.4. Artigo IV: A Dublin Core Application Profile for Documenting Analysis Patterns in a Reuse Infrastructure

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RESUMO

Os padrões de análise são artefatos computacionais reutilizáveis, voltados para a etapa de análise do processo de desenvolvimento de software. Embora os padrões de análise possam facilitar o trabalho de analistas e desenvolvedores por meio da reutilização de ideias comprovadamente úteis e testadas, o acesso aos mesmos ainda é muito deficiente devido à maneira como eles são usualmente documentados e disponibilizados. Com o intuito de reduzir essas deficiências, apoiando a catalogação e incentivando a reutilização dos padrões de análise, surgiu a proposta da Infraestrutura de Reuso de Padrões de Análise (APRI). Essa infraestrutura é composta por um repositório de padrões de análise, documentados por meio de um perfil de metadados específico e acessados via serviços Web. Tendo como base a proposta da APRI, esse artigo apresenta um perfil de metadados processável por máquina específico para a documentação de padrões de análise, chamado *Dublin Core Application Profile to Analysis Patterns* (DC2AP). Esse perfil de metadados é descrito por arquivos RDF identificados via URI, fornecendo dessa forma *Linked Data* que ampliam o potencial de reuso dos padrões de análise.

Palavras-chave: Padrões de Análise, Reutilização, Padrões de Metadados, Dublin Core, Web Semântica, Linked Data.

ABSTRACT

Analysis patterns are reusable computational artifacts, aimed at the analysis stage of the development process of software. Although the analysis patterns can facilitate the work of analysts and developers by the reuse of proven useful and tested ideas, the access to them is still very poor because of the way they are usually described and made available. In order to reduce these deficiencies, supporting cataloging and encouraging the reuse of analysis patterns, it was proposed the Analysis Patterns Reuse Infrastructure (APRI). This infrastructure comprises a repository of analysis patterns documented through a specific metadata profile and accessed via Web services. Based on the proposal of APRI, this article presents a machine-processable metadata profile suited to the documentation of analysis patterns, called Dublin Core Application Profile to Analysis Patterns (DC2AP). This metadata profile is described by RDF files identified via URI, thus providing Linked Data that increase the potential for reuse of the analysis patterns.

Keywords: Analysis Patterns, Reuse, Metadata Standards, Dublin Core, Semantic Web, Linked Data.

1 INTRODUCTION

Analysis patterns are reusable computational artifacts, aimed at the reuse of ideas during the analysis stage of the development process of software. According to (FOWLER, 1997), analysis patterns are ideas proven useful in a given practical context of software that may be useful and reused at the development of software for other practical contexts. Thus, these reusable computational artifacts can make analysis stage faster and more accurate for analysts and developers (FERNANDEZ; YUAN, 00), avoiding rework to develop and test solutions that already exist.

Although the analysis patterns can facilitate the work of analysts and programmers by adding value through reuse of proven useful and tested ideas, the access to them is still very poor (BLAIMER; BORTFELDT; PANKRATZ, 2010). So far there is no template to specify the analysis patterns that are widely accepted, being each set of analysis patterns documented according to the preferences of their authors. In addition to not having a pattern specification, the analysis patterns are normally provided in scientific books and papers which are not machine-processable. These restrictions do not allow analysis patterns to be effectively retrieved by a search software (BLAIMER; BORTFELDT; PANKRATZ, 2010). It burdens the time taken to retrieve an analysis pattern and limits the quality of the results obtained by searches. It occurs because the understanding of the patterns documentations is restricted to human ability of comprehension and interpretation.

In order to minimize these problems of specification and enhance retrieval of analysis patterns and therefore increase the potential for reuse of them, the architecture of an Analysis Patterns Reuse Infrastructure (APRI) was proposed in (VEGI et al., 2012). This infrastructure, which was inspired by the components of Spatial Data Infrastructures (SDI) proposed in (BÉJAR et al., 2009), consists of a repository of analysis patterns documented through a specific metadata profile and that can be accessed via Web services.

This article presents an application profile of Dublin Core metadata standard (DCMI, 1998) created specifically for documenting analysis patterns in a manner consistent with the proposal of APRI (VEGI et al., 2012). The template proposed in (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003) and (RAMINHOS et al., 2006) provides the semantic base for the elements of the application profile proposed here for

describing analysis patterns. The application profile presented by this work enables the documentation and publishing of analysis patterns as Linked Data (BIZER; HEATH; BERNERS-LEE, 2009) through Resource Description Framework (RDF) files (KLYNE; CARROLL, 2004), which is a machine-processable file format.

The remainder of this paper is organized as follows: Section 2 describes related work to documentation of analysis patterns, the Dublin Core metadata standard, the Semantic Web and Linked Data. The machine-processable metadata profile proposed by this article is presented in Section 3 and Section 4 presents an example of analysis pattern documented with the proposed metadata profile. Section 5 presents some conclusions and future work.

2 RELATED WORK

2.1. Documentation and Organization of Analysis Patterns

Documentation of analysis patterns consists on an important way for contextualizing the reuse scope of a pattern and for enabling the sharing of knowledge among analysts and designers. However, this documentation is performed in a heterogeneous manner among the authors, since there is no standardized way to document analysis patterns (BLAIMER; BORTFELDT; PANKRATZ, 2010). There are many approaches to document analysis patterns, ranging from non-formalized textual descriptions to formalized descriptions based on templates.

Some analysis patterns documented in a non-formalized textual manner can be found in (FOWLER, 1997) and (HAY, 1995). This impacts analysis patterns reuse, because it makes harder for designers to understand the contextual scope of patterns, and it also limits the retrieval of analysis patterns through computerized search engines. Thus important detailed information for designers may not be documented or even retrieved, thus limiting the spread of these patterns and thereby their potential for reuse.

Analysis patterns have also been described through the use of templates, which are structures with predetermined topics similar to those used to describe design patterns (GAMMA et al., 1994). Usually a template is composed of essential topics such as context, problem, motivation and solution (FOWLER, 1997), combined with other specific topics defined by their authors. Some analysis patterns that are documented through templates can be found in (LISBOA-FILHO; IOCHPE; BORGES,

2002) and (FERNANDEZ; YUAN, 2010). In the work of (LISBOA-FILHO; IOCHPE; BORGES, 2002), the analysis patterns presented are documented using the template proposed in (MESZAROS; DOBLE, 1997). This template is composed of topics: name, problem, context, motivation, solution, participants and related patterns. The work of (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003) and (RAMINHOS et al., 2006) propose a detailed template developed specifically to document analysis patterns. This template combines common topics used previously by several authors, with new topics aimed to document the analysis patterns more broadly.

Besides adequate documentation, another important factor to increase the potential for reuse of analysis patterns is the way it is organized and therefore available. Before a pattern is applied to a project, the designer needs to know of its existence and then select it (BLAIMER; BORTFELDT; PANKRATZ, 2010). Usually, analysis patterns are organized together forming collections of patterns, and in one collection, usually the patterns are documented homogeneously by the same author, although this is not a generally accepted rule.

Collections of analysis patterns can be available through different manners, such as books, articles and Websites, and they can still be classified as pattern languages or pattern catalogues (BLAIMER; BORTFELDT; PANKRATZ, 2010). The pattern languages are basically collections of analysis patterns aimed at solving a specific problem. In a pattern language, the patterns are related to each other and must follow application rules, for example, the order in which they must be applied to solve a problem (BLAIMER; BORTFELDT; PANKRATZ, 2010). The pattern catalogues are collections of analysis patterns not necessarily related, they are organized based on some criteria that makes it easy to find them. Fowler (1997) presents an example of an analysis pattern catalog. The organization of the patterns described in his book is made from groups of patterns that have an application domain in common and may be found by potential users through a table of contents (BLAIMER; BORTFELDT; PANKRATZ, 2010).

2.2. Analysis Patterns Reuse Infrastructure

Spatial Data Infrastructure (SDI) is a relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to

spatial data (NEBERT, 2004). Currently, most SDIs are based on Service-Oriented Architecture (SOA), allowing to create shared, distributed and interoperable environments, based on Web services (DAVIS JÚNIOR; ALVES, 2005).

In the field of Geographic Information Systems (GIS), SDIs have been used very efficiently as a tool for reusing services and geospatial data. In order to increase the potential for reuse of analysis patterns it was proposed an architecture for Analysis Patterns Reuse Infrastructure (APRI) analogous to a SDI regarding the way data is documented and retrieved (VEGI et al., 2012). In the proposed infrastructure, analysis patterns should be documented using metadata (DUVAL, 2001) and can be retrieved through Web services of various kinds. Figure 1 presents the infrastructure architecture proposed in (VEGI et al., 2012).

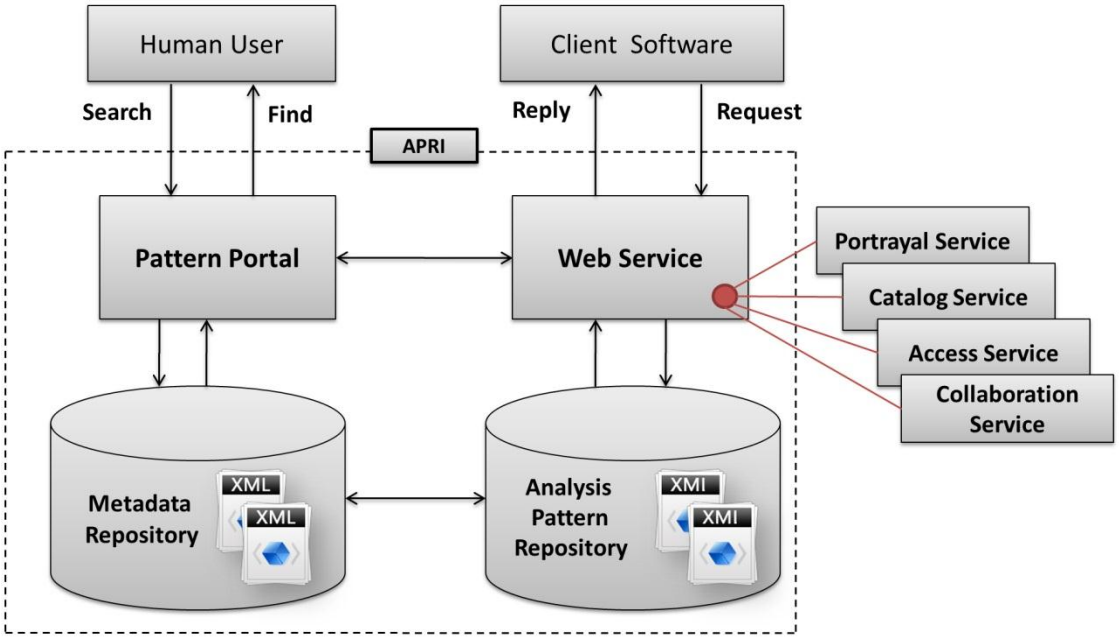


Figure 1 - Architecture of the Analysis Patterns Reuse Infrastructure (VEGI et al., 2012)

- ***Pattern Portal:*** Contains a set of tools, services and Websites focused on discovery, obtaining, cataloging and reuse of analysis patterns.
- ***Metadata Repository:*** Are repositories that contain metadata in XML (eXtensible Markup Language) for the documentation of analysis patterns and services contained in an APRI. The documentations of analysis patterns present in these repositories are made following the elements and rules of the metadata profile proposed later in this article.

- ***Analysis Pattern Repository:*** Are repositories that contain the solutions proposed by analysis patterns represented by means of diagrams in the XMI format (XML Metadata Interchange). These diagrams in XMI format can be used by visualization and collaboration services.
- ***Portrayal Service:*** Are services that support the visualization of diagrams contained in analysis patterns of an APRI.
- ***Catalog Service:*** Are services that enable the cataloging, discovery and use of analysis patterns and services of an APRI, based on their metadata.
- ***Access Service:*** Are services that allow to access and obtain analysis patterns.
- ***Collaboration Service:*** Are services that allow analysts and designers to share their use experiences to improve analysis patterns available in an APRI.

2.3. Dublin Core Metadata Standard

Metadata are data about data, i.e., they are means to provide information that makes it possible to know in detail the attributes of data. They can be used to standardize data representation based on the description of their authors, quality levels, application domains and other elements, thereby encouraging the appropriate reuse of data (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005).

The metadata standards are collections of data elements that can be used to describe objects, thus providing interoperability degrees among data (DUVAL, 2001). According to the domain of the data to be documented, these description structures may have variations compared to other domains due to peculiarities of each domain. Thus, several metadata standards have already been proposed in order to meet the specific needs of some domains. Examples of metadata standards for specific domains can be found in (USLOC, 2004) and (ISO, 2003).

The Dublin Core metadata standard (DCMI, 1998) appeared from a workshop held in Dublin city in the U.S. state of Ohio. This event brought together professionals from several fields of knowledge in order to establish a generic metadata standard composed of a small set of recurring elements in all areas (NISO U.S., 2001). This metadata standard has two levels: Simple Dublin Core and Qualified Dublin Core. The Simple Dublin Core consists of fifteen elements, as the Qualified Dublin Core has seven additional elements that allow more detailed descriptions of data. Beyond the twenty-

two elements that compose the levels of the Dublin Core standard, it has many element refinements that can be used to specialize the semantics of an element in certain situations and thus facilitate the discovery of the data (DCMI, 2005).

A major advantage of the Dublin Core standard is its versatility. Although it is a very simple metadata standard and does not provide enough resources to describe data of complex domains (NISO U.S., 2001), it can be specialized into metadata profiles for application in specific domains (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005). In (COYLE; BAKER, 2009) the authors described the steps for creating a Dublin Core application profile. An example of a Dublin Core application profile for specific domain can be found in (DCMI, 2007).

2.4. Semantic Web and Linked Data

The Semantic Web is seen as a layer of the Web where it is possible to publish, obtain and use data that can be processed directly or indirectly by machines (BERNERS-LEE, 2000). The desire to extend the capabilities of conventional Web, consisting of hypertext documents, for a global environment, where machine-processable structured data are widely published and used is not new. In (BERNERS-LEE et al., 1994) the authors predicted that the Web in which the objects were predominantly documents interpretable by humans would evolve into an environment with more machine-processable semantic information.

While the Semantic Web aims to transform the conventional Web in an environment composed of machine-processable data, Linked Data provides the means to make this possible. Linked Data are machine-processable structured data published on the Web. These data have their meanings well defined and are linked to other data of different sources through semantic relationships (BIZER; HEATH; BERNERS-LEE, 2009). The main difference between conventional hypertext Web and Linked Data are the types of relationships established among the data. While in conventional Web the nature of the relationship between two documents is implicit and interpretable only by humans, in Linked Data that nature it is explicit and also interpretable by computers (BIZER; HEATH; BERNERS-LEE, 2009).

Linked Data uses three main technologies to support the Semantic Web. Uniform Resource Identifiers (URIs) (BERNERS-LEE; FIELDING; MASINTER, 2005) are

used to identify the data, the Hypertext Transfer Protocol (HTTP) on the other hand is used as a mechanism for data retrieval and Resource Description Framework (RDF) is used to describe the machine-processable data (KEIZER et al., 2011).

RDF is a framework of machine-processable metadata used to describe both Web documents and concepts of the real-world as a network, such as people and companies (SAUERMANN et al., 2008). From the use of RDF to describe the data, it becomes possible to establish semantic relationships between them due to the way how data is encoded. Each relationship between RDF data consists of the triple formed by the concepts of subject, predicate and object, where subject and object are URI identifiers that represent the related data and predicate specifies the semantics of this relationship, i.e., the kind of relationship between the data (KLYNE; CARROLL, 2004). This RDF triple can be represented by the graph shown in Figure 2.

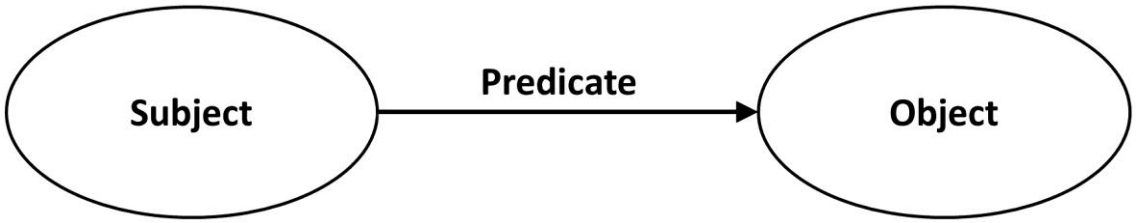


Figure 2 - RDF Triple (KLYNE; CARROLL, 2004)

The main objective of Linked Data is to build the so-called Web of data, thus allowing the Web to be used as a single global database, thereby reducing barriers to the reuse, integration and implementation of data from distributed heterogeneous sources (BIZER; HEATH; BERNERS-LEE, 2009).

The Web of data created from the publication of Linked Data on the Web enables the creation of new types of applications classified into three main categories: Linked Data browsers, Linked Data search engines and applications of specific domain. Linked Data browsers allow users to navigate between data from different sources through semantic relationships established between them, and then to browse through a particular source of data and from that to go through the entire network by relationships among the data. The Linked Data search engines allow to perform complex searches similar to those offered by database management systems, thus allow data to be retrieved from Web of data through searches that consider the nature of relationships among them (BIZER; HEATH; BERNERS-LEE, 2009).

Linked Data must be published on the Web accompanied by metadata to enable potential users, humans or machines, to assess their quality and reliability (HARTIG, 2009). These metadata can be provided by using the metadata standards, e.g., Dublin Core (DCMI, 1998).

3 A DUBLIN CORE APPLICATION PROFILE FOR ANALYSIS PATTERNS

In order to improve retrieval and reuse of analysis patterns by means of a documentation that allows a more precise treatment carried out by computer, this section describes the proposed application profile DC2AP (Dublin Core Application Profile for Analysis Patterns). This profile is an extension of the Dublin Core metadata standard for the domain of analysis patterns. The profile DC2AP is machine-processable and was developed based on the template proposed in (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003) to describe analysis patterns. The DC2AP provides detailed information about the analysis patterns which were not provided by documentations and were not retrieved properly by search engines.

3.1. Semantic Mapping between Metadata Elements

In contrast to the Dublin Core metadata standard, which is generic and therefore aimed to document resources of several domains, the template proposed by (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003) is designed specifically for the documentation of analysis patterns, so it is rich in specific details of this specific domain. Due to such level of details, it was chosen to be used as a basis for the creation of DC2AP.

An important task for the creation of DC2AP was the realization of a mapping between the elements proposed by the Dublin Core and elements of the template proposed in (PANTOQUILHO; RAMINHOS; ARAÚJO, 2003). In this mapping process, elements of both structures were compared and classified based on their semantic correspondences and some conceptual conflicts were identified. These conflicts are characterized by similar concepts that are expressed differently by each of the mapped structures. After identifying and resolving the existing conceptual conflicts between structures it became possible to combine the elements of Dublin Core and Pantoquilho et al.'s template, thus creating a single structure free of redundancies and

semantic inconsistencies. Table 1 shows the result of the mapping between the Dublin Core standard and Pantoquilho et al.'s template. Although Table 1 shows only the mapping between the elements of Simple Dublin Core and the Pantoquilho et al.'s template, the elements contained in Qualified Dublin Core were also considered in this comparative process, but none of them had equivalents in the template used.

Table 1 - Mapping between Dublin Core and Pantoquilho et al.'s Template

Simple Dublin Core	Pantoquilho et al.'s template
Title	1. Name 2. Also Known As
Creator	3. History [a]
Subject	7. Context
Description	5. Problem 6. Motivation 7. Context 8. Applicability 14. Examples [a] 18. Known Uses [a]
Publisher	No equivalent
Contributor	3. History [a]
Date	3. History [a]
Type	No equivalent
Format	No equivalent
Indentifier	1. Name [a]
Source	15. Related Patterns [a]
Language	No equivalent
Relation	13. Anti-Patterns Trap [a] 15. Related Patterns [a] 16. Design Patterns [a]
Coverage	No equivalent
Rights	No equivalent
No equivalent	4. Structural adjustments 9. Requirements 9.1. Functional requirements 9.2. Non-functional requirements 9.3. Dependencies and contributions 9.4. Conflict identification & guidance to resolution 9.5. Priorities 9.6. Participants 10. Modelling 10.1. Structure 10.1.1. Class diagram 10.1.2. Class description 10.2. Behaviour 10.2.1. Collaboration or sequence diagrams 10.2.2. Activity diagrams 10.2.3. State diagrams 10.3. Solution Variants 11. Resulting context 12. Consequences 17. Design guidelines

Note: Table notes.
[a] *Partly equivalent.*

Several mappings between elements of the Dublin Core and elements of other structures have already been performed and made available in the literature. An example of such mapping is presented in (USLOC, 2008).

3.2. Addition of New Elements and Application Rules

From the mapping described in Table 1, all equivalent elements have been identified and merged, giving rise to the basic structure of the DC2AP. After this merge, most elements of the Pantoquilho et al.'s template that had direct equivalent mapping became element refinements of the others from the Dublin Core. This happened due to the Dublin Core elements require specializations that enable them to compose an application profile for a specific domain and the elements of Pantoquilho et al.'s template have the specialization degree necessary to Dublin Core.

During the merge process of the structures, which resulted in the set of elements that make up DC2AP, some elements have undergone adaptations, new ones were proposed and two elements from Pantoquilho et al.'s template were discarded. The element "Applicability" was discarded because its semantics are very similar to the element "Problem" and therefore was considered as redundant. The element "Structural adjustments" was also discarded to be unnecessary in the context of an application profile of metadata.

In order to control the application of DC2AP during the documentation of analysis patterns, rules on the obligatoriness, occurrence and type of value of each of the elements were proposed. These application rules and their acronyms are presented in Table 2.

Table 3 presents all the elements that make up the DC2AP associated with their respective application rules. Some of these elements are intended to version control and others are intended to sharing of experiences of use. These features were incorporated into this metadata profile to allow the creation of dynamic collections of analysis patterns, where new improved versions of the patterns may be proposed from the experience of their usage. Moreover, all the versions of the analysis patterns may be related to each other, thereby providing the creation of a repository of analysis patterns that is rich of details about the patterns evolution. These resources allow potential users

to retrieve the version that best meets their needs more adequately. All these characteristics are consistent with the proposal of the APRI (VEGI et al., 2012).

A brief description about the semantics of each of the elements that make up the DC2AP is presented in Appendix A. A complete description about the DC2AP elements, as well as some details about the application rules associated with them can be found at (VEGI, 2012), where a detailed technical description of this metadata profile is performed.

Table 2 - DC2AP Application Rules

Rule Type	Rules and Acronyms	Description
Obligatoriness	Mandatory [M]	Element must always be filled in the documentation of an analysis patterns.
	Optional [O]	Element is optional, as it refers to additional information.
	Conditional [Cd]	Element must be filled if there is corresponding information.
Occurrence	Single [S]	Element can occur only once in the documentation of an analysis pattern.
	Multiple [Mu]	Element can occur multiple times in the documentation of an analysis pattern.
Value type	String [St]	Element should be filled with textual descriptions.
	Date [D]	Element must be filled with a date following a format previously specified.
	URI [U]	Element should be filled with a string used to identify a resource on the Internet.
	Null [N]	Element should not be filled with any value because their data are concentrated in its element refinements.
	URI, Number or String [UNS]	Element can be filled with a resource identifier, with a number or a textual description.
	URI or String [US]	Element can be filled with a resource identifier or a textual description.

Table 3 - DC2AP Element Set

Elements and their Application Rules			New
1. Identifier [M] [S] [UNS]			
2. Title [M] [S] [St]	2.1. Alternative Title [O] [Mu] [St]		
3. Creator [M] [Mu] [St]			
4. Subject [M] [Mu] [St]			
5. Description [M] [S] [N]	5.1. Problem [M] [S] [St]		
	5.2. Motivation [M] [Mu] [St]	5.2.1. Example [M] [Mu] [St]	
		5.2.2. Known Uses [O] [Mu] [St] [a]	
	5.3. Context [M] [S] [St]		
6. Publisher [O] [Mu] [St]			
7. Contributor [Cd] [Mu] [St]			
8. Date [M] [S] [N]	8.1. Created [M] [S] [D]		
	8.2. Modified [Cd] [S] [D]		
9. Type [M] [S] [US]	9.1. Notation [M] [S] [St]		YES
10. Format [M] [Mu] [US]			
11. Source [Cd] [S] [UNS]			
12. Language [M] [S] [US]			
13. Relation [Cd] [S] [N]	13.1. Is Version of [Cd] [S] [UNS]		
	13.2. Is Replaced by [Cd] [Mu] [UNS] [b]		
	13.3. Replaces [Cd] [Mu] [UNS] [b]		
	13.4. Is Part of [O] [Mu] [UNS]		
	13.5. Has Part [O] [Mu] [UNS]		
	13.6. Is Designed With [O] [Mu] [UNS] [a]		YES
	13.7. Should Avoid [O] [Mu] [UNS] [a]		YES
	13.8. Complemented by [O] [Mu] [UNS] [a]		YES
	13.9. About [Cd] [S] [St]		
14. Coverage [O] [Mu] [St]			
15. Rights [Cd] [Mu] [US]			
16. History [M] [Mu] [N] [b]	16.1. Event Date [M] [S] [D]		YES
	16.2. Author [M] [Mu] [St]		YES
	16.3. Reason [M] [S] [St]		YES
	16.4. Changes [Cd] [S] [St]		YES
17. Requirements [M] [S] [N]	17.1. Functional Requirements [M] [Mu] [St]		
	17.2. Non-functional Requirements [O] [Mu] [St]		
	17.3.Dependencies and Contributions [M] [S] [St]	17.3.1. Dependency Graph [M] [S] [U]	YES
		17.3.2. Contribution Graph [Cd] [S] [U]	YES
	17.4. Conflict identification & Guidance to Resolution [Cd] [Mu] [St]		
	17.5. Priorities Diagram [M] [S] [U]		
	17.6. Participants [M] [Mu] [St]		
18. Modelling [M] [S] [N]	18.1. Behaviour [M] [S] [N]	18.1.1. Use Case Diagram [M] [S] [U]	YES
		18.1.2. Collaboration/Sequence Diagrams [M] [Mu] [U]	
		18.1.3. Activity/State Diagrams [O] [Mu] [U]	YES
	18.2. Structure [M] [S] [N]	18.2.1. Class Diagram [M] [S] [U]	
		18.2.2. Class Descriptions [M] [S] U]	
		18.2.3. Relationship Descriptions [M] [Mu] [St]	YES
	18.3. Solution Variants [O] [Mu] [U] [a]		
19. Resulting Context [O] [Mu] [St] [a]			
20. Design Guidelines [O] Mu] [St] [a]			
21. Consequences [M] [S] N]	21.1. Positive [M] [Mu] [St]		YES
	21.2. Negative [M] [Mu] [St]		YES

Note: Table notes.

[a] *Element for collaboration of use experiences.*

[b] *Element to version control.*

3.3. Providing Linked Data with DC2AP

In order to transform the metadata profile previously presented in a machine-processable profile and therefore suit it to the proposal of Linked Data, each of the elements proposed by DC2AP were associated with URI identifiers and described by RDF semantic properties. According to (COYLE; BAKER, 2009), it is important before creating new RDF semantic properties to look for existing properties that are semantically equivalent to the elements proposed by an application profile. The use of known properties associated with elements of a profile increases the metadata semantic interoperability. Then, initially, some researches were performed looking for element sets described as RDF that contains semantic properties equivalent to elements of DC2AP. The Open Metadata Registry tool (OPEN METADATA REGISTRY, 2005) was used to perform these searches. This tool provides open services to register and search element sets, metadata application profiles, vocabularies and syntaxes controlled described as RDF. Table 4 presents the compatible element sets described as RDF selected after the searches. They were associated with elements of DC2AP.

Table 4 - Element Sets Selected for Association

Name	URI
The Dublin Core Metadata Element Set, v1.1	`http://purl.org/dc/elements/1.1/`
Dublin Core Terms	`http://purl.org/dc/terms/`
RDA Group 1 Elements	`http://rdvocab.info/Elements/`
RDA Roles	`http://rdvocab.info/roles/`

Besides associating known semantic properties to elements of DC2AP, it was also necessary to declare new semantic properties to describe the elements that were not associated with the sets found. All new RDF properties have been declared in accordance with the DCMI Namespace Policy (POWELL et al., 2007), and then identified with URIs redirected by the server `http://purl.org` to RDF schema files on the server `http://dpi.ufv.br`. These new semantic properties together make up the element set called "DC2AP Element Set". This element set is identified by URI `http://purl.org/dc2ap/elements/`.

To avoid ambiguity between the terms used during the documentation of analysis patterns and improve the degree of semantic interoperability, i.e., the likelihood that such metadata will be understood by end users, some elements of DC2AP were also

associated with vocabularies and syntaxes controlled used to standardize the metadata registration (DUVAL, 2001). Initially searches were performed by existing vocabularies and syntaxes controlled that could standardize the filling of DC2AP elements. These searches were again made using the Open Metadata Registry tool (OPEN METADATA REGISTRY, 2005). In addition to standardizing filling some elements of DC2AP through association with vocabularies and syntaxes controlled already existing, two new controlled vocabularies have also been proposed to fill gaps that could compromise the documentation of analysis patterns by means of ambiguous terms. The vocabulary and syntaxes controlled used in the definition of DC2AP are presented in Table 5, while the technical description of this metadata profile (VEGI, 2012) presents in detail what are the vocabulary and syntaxes controlled associated with each element of it.

Table 5 - Vocabularies and Syntaxes Controlled Associated to DC2AP

Name	URI	New
IMT	http://purl.org/dc/terms/IMT	
ISO 639-3	http://purl.org/dc/terms/ISO639-3	
Uniform Resource Identifier	http://purl.org/dc/terms/URI	
W3C-DTF	http://purl.org/dc/terms/W3CDTF	
DC2AP Type Vocabulary	http://purl.org/dc2ap/ves/type	YES
DC2AP Format Vocabulary	http://purl.org/dc2ap/ves/format	YES

By applying DC2AP to document analysis patterns through RDF properties, the metadata repository proposed by APRI architecture presented in Figure 1, becomes a source of Linked Data of specific domain connected with the Web of data. Figure 3 shows the behavior of metadata repository of an APRI when analysis patterns are documented as Linked Data.

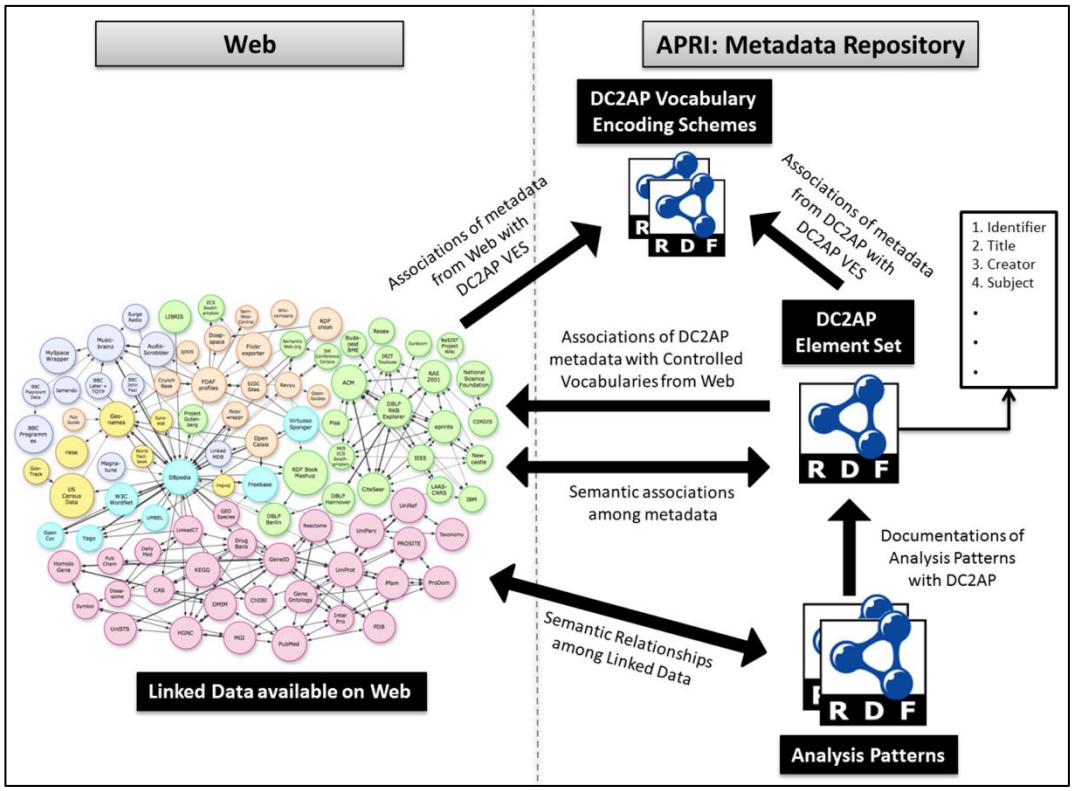


Figure 3 - Providing Linked Data in an APRI

Due to text size limitations, the URIs referring to RDF semantic properties of the DC2AP elements are not presented in this article, but they can be found in (VEGI, 2012).

A small metadata repository containing descriptions of analysis patterns made on RDF properties was created to exemplify the use of DC2AP in the documentation of analysis patterns interpretable by machines. This repository can be accessed from the URI `http://purl.org/dc2ap/Examples`.

4 EXAMPLE

In order to demonstrate the application of the metadata profile proposed in this work, Table 6 presents an example that uses the core of DC2AP to document the analysis pattern called Urban Street Mesh, proposed in (LISBOA FILHO; IOCHPE; BORGES, 2002). The core of a metadata profile corresponds to a subset of the profile elements that comprises the elements that are mandatory. Thus any analysis pattern documented with DC2AP must have at least the filling of the elements of the subset displayed in Table 6.

Table 6 - Urban Street Mesh Pattern Documentation

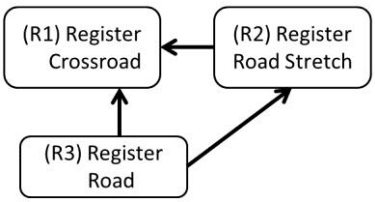
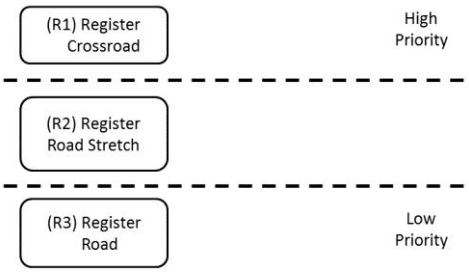
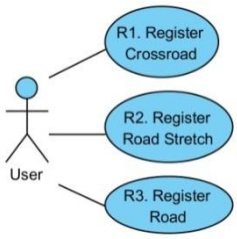
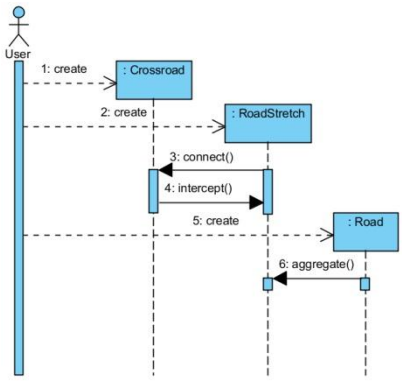
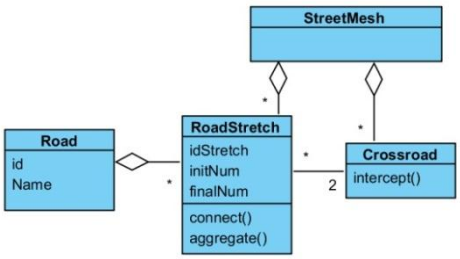
<table>
<tr><th colspan="3">Analysis pattern documented with DC2AP</th></tr>
<tr><td colspan="3">1. Identifier: http://purl.org/apri/metadata/UrbanStreetMesh-v1</td></tr>
<tr><td colspan="3">2. Title: Urban Street Mesh</td></tr>
<tr><td colspan="3">3. Creator: Jugurta Lisboa-Filho, Cirano Iochpe and Karla A. V. Borges</td></tr>
<tr><td colspan="3">4. Subject: Urban Management Systems, Geographic Information Systems and Streets</td></tr>
<tr><td rowspan="3">5. Description</td><td colspan="2">5.1. Problem: What are the elements that belong to the street mesh of a city?</td></tr>
<tr><td>5.2. Motivation:
- Each drive way stretch is considered a road instance. It normally should be divided into several segments as well.
- A road stretch is a pathway segment between two connections.
- The set formed by the connections and road stretches create an urban street mesh.</td><td>5.2.1. Example:
- Can be used as a basis for creating a system of urban bus routing.
- Can be used as a basis for the creation of a system to calculate the shortest path between locations.</td></tr>
<tr><td colspan="2">5.3. Context: Almost every city in Brazil has shown the same organization pattern, which is structured by their pathways organization (e.g. streets, avenues, drives). The set of pathways stretches generates an urban street network.</td></tr>
<tr><td>6. Date</td><td colspan="2">6.1. Created: 2002</td></tr>
<tr><td>7. Type:
Analysis Pattern</td><td colspan="2">7.1. Notation: UML</td></tr>
<tr><td colspan="3">8. Format: JPEG and XMI</td></tr>
<tr><td colspan="3">9. Language: English</td></tr>
<tr><td rowspan="3">10. History</td><td colspan="2">10.1. Event Date: 2002</td></tr>
<tr><td colspan="2">10.2. Author: Jugurta Lisboa-Filho, Cirano Iochpe and Karla A. V. Borges</td></tr>
<tr><td colspan="2">10.3. Reason: Creation of this analysis pattern</td></tr>
<tr><td rowspan="4">11. Requirements</td><td colspan="2">11.1. Functional Requirements:
(R1) Register Crossroad - User must register all crossroads of a urban street mesh.
(R2) Register Road Stretch - User must register all roads stretches of a urban street mesh.
(R3) Register Road - User must register all roads of a urban street mesh.</td></tr>
<tr><td>11.2. Dependencies and Contributions:
R2 depends of R1 because every stretch begins at an crossroad and ends at another. R3 depends of R2 and R1 because every road is composed of roads stretches, and roads stretches have crossroads.</td><td>11.2.1. Dependency Graph
 
</td></tr>
<tr><td colspan="2">11.3. Priorities Diagram
 
</td></tr>
<tr><td colspan="2">11.4. Participants: User.</td></tr>
</table>

Table 6 (cont.) - Urban Street Mesh Pattern Documentation

<table>
<tr><th colspan="3">Analysis pattern documented with DC2AP</th></tr>
<tr><td rowspan="4">12. Modelling</td><td rowspan="2">12.1. Behaviour</td><td>12.1.1. Use Case Diagram:
 
</td></tr>
<tr><td>12.1.2. Collaboration/Sequence Diagram
 
</td></tr>
<tr><td rowspan="2">12.2. Structure</td><td>12.2.1. Class Diagram
 
</td></tr>
<tr><td>12.2.2. Class descriptions: - Crossroad: This class represents the nodes of an street mesh that allow roads stretches are connected to each other.
- RoadStretch: A road stretch can be connected to other stretches through instances of the class Crossroad.
- Road: This is a conventional class usually implemented as a table in a relational DBMS. Each class is made of several roads stretches.
- StreetMesh: This class is a geographic phenomenon represented by a complex spatial object. In this class can be defined many attributes relating to all mesh.
12.2.3. Relationship descriptions:
- The relationship between RoadStretch and Crossroad represents that each road stretch has the beginning and ending represented by a crossroad, being that a crossroad can connect various roads stretches.
- The relationship between Road and RoadStretch demonstrates that a road is an aggregate of several stretches.</td></tr>
<tr><td rowspan="2">13. Consequences</td><td colspan="2">13.1. Positive: - This analysis pattern is very generic, so it fits in any context which involve urban street mesh, regardless of region or city size.
- This pattern can easily be specialized for different contexts, thus having great potential for reuse.</td></tr>
<tr><td colspan="2">13.2. Negative: - Because it is a very generic analysis pattern, many projects can be served poorly for it, so is necessary specialize it to get better results in some cases.</td></tr>
</table>

5 CONCLUSIONS AND FUTURE WORK

Spatial Data Infrastructure is a widely accepted computational infrastructure focused exclusively on the reuse of geospatial data and services, however the way in which SDI organize and promote the reuse of data can be very useful for the Computing area in the reuse of various artifacts for software development, e.g., analysis patterns.

The use of analysis patterns speeds the software development process, since these computational artifacts provide generic solutions that can be reused as the initial basis for development. From the reuse of ideas provided by these patterns, common errors of analysis can be avoided, and the time required by analysts and developers during the conception of software can decrease. However, for a pattern to be reused, it is important that it is well documented and made available in an accessible manner.

The Dublin Core metadata standard was used in this study as a basis for creating a metadata profile to document analysis patterns (DC2AP) in an APRI and it has shown to be adequate for that purpose. Although the Dublin Core is a generic metadata standard, the semantics of its elements can be specialized from the creation of element refinements and thus it can be used not only to adequately document the analysis patterns, but also several other kinds of computational artifacts.

A machine-processable documentation is important to increase the potential for reuse of computational artifacts such as analysis patterns, so they can be retrieved more quickly and adequately by search engines. The elements and application rules of DC2AP were described as Linked Data to permit a better retrieval of analysis patterns by search engines, with it the metadata repository proposed by APRI architecture became a source of specific domain Linked Data, linked to the global database composed of the Linked Data published on Web.

As future work, it is intended to use the DC2AP as the basis for the definition and implementation of Web services proposed in APRI. These services will be specific domain Linked Data applications and thus can facilitate the discovery of new sources of data from the RDF links existing in the analysis patterns documented in an APRI. This possibility of finding new sources of data will allow greater dynamism in metadata repositories of an APRI, since the services will be able to retrieve new related data found in other sources whenever they are published on the Web. As another future work, it is intended to extend the APRI architecture to a more comprehensive

infrastructure, also aimed at reusing other types of computational artifacts such as frameworks and design patterns.

ACKNOWLEDGEMENTS

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APPENDIX A. SEMANTIC DESCRIPTION OF THE ELEMENTS OF DC2AP

- ***Identifier:*** An unambiguous reference given to an analysis pattern (AP) to differentiate it from others.
- ***Title:*** Formal name by which an AP is widely known.
- Alternative Title: Alternative names used to substitute the formal name of an AP.
- ***Creator:*** Creator's name of an AP.
- ***Subject:*** Are keywords related to the scope in which an AP is applied, thus providing a brief contextualization.
- ***Description:*** Agglutinating element of descriptions aimed in the contextualization of an AP over various aspects.
- ***Problem:*** Brief textual description of the problem solved by an AP.
- ***Motivation:*** Peculiarities of the problem which should be solved by the AP, regardless of application domain.
- ***Examples:*** Applications where the documented AP can be applied.
- ***Known Uses:*** Real systems where an AP was applied.
- ***Context:*** Description of contextual coverage of the documented AP.
- ***Publisher:*** Names of responsible for providing the AP for the public.
- ***Contributor:*** Names of responsible for changes made in the original version of the AP.
- ***Date:*** Agglutinating element of dates about the creation and modification of the documented AP.
- ***Created:*** Creation date of the version of the documented AP.
- ***Modified:*** Date of the last modification of the documented AP.

- ***Type:*** The nature of documented resource. It should always be Analysis Pattern.
- ***Notation:*** The notation used to create the diagrams during the documentation of an AP.
- ***Format:*** Digital formats of diagrams used in documentation of an AP.
- ***Source:*** Reference to the AP used as the main intellectual source in the creation of an AP.
- ***Language:*** Language used for documenting an AP.
- ***Relation:*** Agglutinating element of existing relationships between the documented AP and other patterns.
- ***Is Version Of:*** Reference to the first version of an AP.
- ***Is Replaced By:*** References for all the most current versions of an AP.
- ***Replaces:*** References for all previous versions of an AP.
- ***Is Part Of:*** References for APs that contain the documented AP as part of its composition.
- ***Has Part:*** References for APs which are contained as part of the composition of the documented AP.
- ***Is Designed With:*** Known design patterns that can be used during the implementation of the documented AP.
- ***Should Avoid:*** Anti-patterns important to avoid common errors identified during the application of the documented AP.
- ***Complemented By:*** Known APs that can be used to complement the documented AP.
- ***About:*** Description of details about relationships established among the documented AP and other patterns.
- ***Coverage:*** Spatial location or time period covered by the scope of an AP. It can compensate regionalisms that generate semantic ambiguities.
- ***Rights:*** Existing rights over the documented AP.
- ***History:*** Agglutinating element of historical data about the evolution of an AP.
- ***Event Date:*** Date of the historic event occurrence.
- ***Author:*** Names of responsible for the occurrence of the historic event.
- ***Reason:*** Reason for the occurrence of the historical event.
- ***Changes:*** Changes made in the AP during an event of changes.

- ***Requirements:*** Agglutinating element of data about the requirements of an AP.
- ***Functional Requirements:*** Responsibilities and restrictions for meet each functional requirement of an AP.
- ***Non-functional Requirements:*** Responsibilities and restrictions for meet each non-functional requirement of an AP.
- ***Dependencies and Contributions:*** Brief explanation about the identified relations of dependency and contributions among the requirements of an AP.
- ***Dependency Graph:*** Graph diagram used to represent the identified relations of dependency among the requirements of an AP.
- ***Contribution Graph:*** Graph diagram used to represent the identified relations of contribution among the requirements of an AP.
- ***Conflict Identification & Guidance to Resolution:*** Brief explanation about the identified conflicts among the requirements of an AP and possible manners to solve them.
- ***Priorities Diagram:*** It represents the order which AP requirements should be satisfied respecting their dependencies.
- ***Participants:*** Entities that interact with AP requirements.
- ***Modelling:*** Agglutinating element of diagrams and descriptions that represents part of the problem solution.
- ***Behaviour:*** Agglutinating element of diagrams that make up the behavioral model of an AP.
- ***Use Case Diagram:*** Is used to represent a system that meets requirements of an AP together with entities which interact with them.
- ***Collaboration/Sequence Diagrams:*** Are used to create scenarios that represent the execution of each use case of an AP.
- ***Activity/State Diagrams:*** Are used to represent the general behaviour of the system specified by an AP.
- ***Structure:*** Agglutinating element of the diagram and descriptions that make up the structural model of an AP.
- ***Class Diagram:*** Is the main part of the problem solution treated by an AP.
- ***Class Description:*** Brief description of each class of the class diagram.

- ***Relationship Descriptions:*** Brief description of the main relationships present in the class diagram.
- ***Solution Variants:*** Alternative models of behaviour and structure to solve the problem treated by an AP.
- ***Resulting Context:*** Adaptations realized in an AP when it is applied in specific systems.
- ***Design Guidelines:*** General tips for implementation of an AP.
- ***Consequences:*** Agglutinating element of descriptions of advantages and disadvantages of use the documented AP.
- ***Positive:*** Positive consequences of use of the documented AP.
- ***Negative:*** Negative consequences of use of the documented AP.

3 CONCLUSÕES GERAIS E TRABALHOS FUTUROS

Com base nos estudos e pesquisas realizadas, esse trabalho inicialmente propôs uma arquitetura para Infraestruturas de Reuso de Padrões de Análise (APRI). Essa arquitetura, proposta no Artigo I, é baseada em metadados e serviços Web, e visa gerar um ambiente propício para o compartilhamento e a disseminação de conhecimento entre analistas e programadores, facilitando dessa forma o acesso aos padrões de análise e ampliando assim o potencial de reuso dos mesmos.

A arquitetura da APRI foi concebida de forma análoga às Infraestruturas de Dados Espaciais (IDE). Uma IDE é uma infraestrutura computacional amplamente aceita que enfoca exclusivamente a reutilização de dados e serviços geoespaciais, no entanto, a maneira pela qual as IDEs organizam e promovem a reutilização de dados pode ser útil para a área de Computação na reutilização de diversos artefatos no desenvolvimento de software.

O uso de padrões de análise acelera o processo de desenvolvimento de software, uma vez que estes artefatos computacionais fornecem soluções genéricas que podem ser reutilizadas nas fases iniciais do processo. A partir da reutilização das ideias fornecidas por estes padrões, erros comuns de análise podem ser evitados, e o tempo requerido por analistas e projetistas durante a concepção do software pode diminuir. No entanto, para um padrão de análise ser reutilizado, é importante que ele esteja bem documentado e disponibilizado em uma forma acessível.

Para alcançar os objetivos específicos dessa pesquisa, o padrão de metadados Dublin Core (DCMI, 1998) foi utilizado como uma base para a criação de um perfil de metadados específico para documentar padrões de análise (DC2AP). Embora o Dublin Core seja um padrão de metadados genérico, a semântica dos seus elementos pode ser especializada a partir da criação de refinamentos dos elementos e, assim, pode ser usado não só para documentar adequadamente os padrões de análise, mas também vários outros tipos de artefatos computacionais.

Uma documentação processável por máquina é importante para aumentar o potencial de reuso de artefatos computacionais. Dessa forma os artefatos podem ser recuperados mais rapidamente e de forma adequada por ferramentas de busca computadorizadas. A semântica dos elementos e as regras de aplicação do DC2AP

foram descritas como *Linked Data* para permitir uma melhor recuperação dos padrões de análise pelas ferramentas de busca. Com isso o repositório de metadados proposto na arquitetura APRI tornou-se uma fonte de *Linked Data* de domínio específico ligado ao banco de dados global composto pelos *Linked Data* publicados em toda a Web. Para uniformizar o preenchimento dos elementos do DC2AP e assim evitar conflitos semânticos, o preenchimento de alguns elementos desse perfil de metadados proposto foi atrelado à utilização de vocabulários e sintaxes controlados, diminuindo assim a existência de padrões de análise documentados de forma ambígua.

Como trabalhos futuros pode-se utilizar o DC2AP como base para a definição e implementação dos serviços Web propostos na APRI para busca, visualização, aplicação e contribuição de experiências de uso dos padrões de análise. Esses serviços serão aplicações de *Linked Data* de domínio específico e, portanto, poderão descobrir novas fontes de dados a partir das ligações RDF existentes nos padrões de análise documentados em uma APRI. Esta possibilidade de descoberta de novas fontes de dados permitirá maior dinamismo aos repositórios de metadados de uma APRI, uma vez que os serviços serão capazes de recuperar novos dados relacionados presentes em outras fontes sempre que eles forem publicados na Web. Ainda como trabalhos futuros pode-se estender a arquitetura da APRI para uma infraestrutura mais abrangente, voltada também para o reuso de outros tipos de artefatos computacionais, como frameworks, padrões de projeto e de arquitetura.

APÊNDICE A

Technical Description of Dublin Core Application Profile to Analysis Patterns

Lucas Francisco da Matta Vegi

Disponível em: `http://www.purl.org/dc2ap/TechnicalDescription`

RESUMO

Esse documento descreve um perfil de aplicação para descrição de padrões de análise desenvolvido pelo grupo de pesquisa em Sistemas de Informação da Universidade Federal de Viçosa. O formato desse documento baseou-se no trabalho de Coyle e Baker (2009).

Palavras-chave: Dublin Core, Perfil de Aplicação, Padrões de Metadados, Padrões de Análise.

ABSTRACT

This document describes an application profile for analysis patterns description developed by the Information Systems Research Group of Federal University of Viçosa. Its format was based in the work of Coyle and Baker (2009).

Keywords: Dublin Core, Application Profile, Metadata Standards, Analysis Patterns.

1 INTRODUCTION

The DC2AP is a Dublin Core Application Profile to analysis patterns description. This Dublin Core Application Profile was developed by the Information Systems Group of Federal University of Viçosa based on the template proposed by Pantoquilho, Raminhos and Araújo (2003) and Raminhos et al. (2006) to specify analysis patterns. The main objectives of DC2AP are to improve the retrieving and reuse of analysis patterns through a more precise way to be treated by a computer, thus offering important information missing before.

2 A NOTE ON DUBLIN CORE APPLICATION PROFILES

A Dublin Core Application Profile (DCAP) specifies how the Dublin Core standard is used to specify some class in a specific domain or community. A DCAP describes:

1 The set of terms used in a class description.
2 How the terms in this set are deployed in this class description. This includes:
   i) the types of resources described by descriptions within these description sets,
   ii) the properties referenced in statements in those descriptions, and how those properties are used to describe resources of the specified type.
   iii) requirements for the occurrence of statements using a specified property,
   iv) constraints on the sets of values which are referenced in a statement using a specified property (vocabulary encoding schemes), and
   v) constraints on the datatypes of the value strings occurring in a statement using a specified property (syntax encoding schemes)

The terms description set, description, property, value, vocabulary encoding scheme, value representation, value string, syntax encoding scheme, and related description are used in the sense they are used in the DCMI Abstract Model (DCAM) (POWELL et al., 2007).

This document is not a description of an RDF/XML format. There may be multiple bindings of this DCAP, to RDF/XML and to other syntaxes.

3 VOCABULARIES/NAMESPACES USED IN THIS DC2AP

All references to properties and classes in DC metadata descriptions are made using URI. In this document, Qualified Names of the form `prefix` ":" `local-part` are sometimes used as abbreviations for URI which identify metadata terms. Prefixes are assumed to be associated with Namespace Names (URI) as follows in Table 1, and the corresponding URI for the term is constructed by concatenating the Namespace Name and the `local-part`.

Table 1 - Metadata Identifiers Prefixes

Vocabulary Title	Namespace Name	Prefix
DC2AP Element Set	http://purl.org/dc2ap/elements/	**dc2ap**
DC2AP Vocabulary Encoding Schemes	http://purl.org/dc2ap/ves/	**dc2apves**
DC2AP Type Vocabulary	http://purl.org/dc2ap/type/	**dc2aptp**
DC2AP Format Vocabulary	http://purl.org/dc2ap/format/	**dc2apft**
The Dublin Core Metadata Element Set, v1.1	http://purl.org/dc/elements/1.1/	**dc**
Dublin Core Terms	http://purl.org/dc/terms/	**dcterms**
Dublin Core Type Vocabulary	http://purl.org/dc/dcmitype/	**dcmitype**
RDA Group 1 Elements	http://rdvocab.info/Elements/	**rdaelem**
RDA Roles	http://rdvocab.info/roles/	**rdaroles**

4 HOW TO READ THE TABLES IN THIS DOCUMENT

The section "Describing a Analysis Pattern" describe how a set of terms (properties, classes, vocabulary encoding schemes, syntax encoding schemes) is used to construct a DC metadata description of a resource of the specified type.

4.1. Class

This section describes how the class, the type of resource, to which the metadata description applies is defined.

- ***Class URI:*** The URI by which the class is referenced in a DC metadata description.
- ***Qualified Name for Class:*** The Qualified Name which is typically used as an abbreviation for the class URI.
- ***Defined By:*** The name and identifier of the metadata vocabulary from which the class is drawn.
- ***Type of Term:*** An indication of the type of the term, according to the typology of the DCMI Abstract Model
- ***Subclass Of:*** Class of which the current class is a subclass.
- ***Label:*** The short label provided for the class by its owner/maintenance agency.
- ***Definition:*** The definition provided for the class by its owner/maintenance agency.
- ***Comments:*** Additional information about the class provided by its owner/maintenance agency.

4.2. Property

This section describes how a specified property is used in a statement within a DC metadata description. The use of the property is described using the following attributes:

- ***Property URI:*** The URI by which the property is referenced in a DC metadata description.
- ***Qualified Name for Property:*** A unique name/identifier for the property. It is presented as a Qualified Name, but is an abbreviation for the property URI.
- ***Defined By:*** The name and identifier of the metadata vocabulary from which the property is drawn.
- ***Type of Term:*** An indication of the type of the term, according to the typology of the DCMI Abstract Model
- ***Subproperty Of:*** A property of which the current property is a subproperty.
- ***Source Label:*** The short label provided for the property by its owner/maintenance agency.
- ***Label in this DCAP:*** A short human-readable label that provides an indication of how the property is to be used in a DC metadata description of a resource of the specified type. The label does not appear in the description. It *may* be used to provide a descriptor for fields in displays of descriptions to human readers, but there is no requirement for display applications to use this label.
- ***Source Definition:*** The definition provided for the property by its owner/maintenance agency.
- ***Usage in this DCAP:*** A description of how the property is to be applied in a description of a resource of the specified type. This information supplements the definition of the property provided by its owner/maintenance agency.
- ***Comments for this DCAP:*** Additional information about the use of the property in a description of a resource of the specified type, typically on the values and their representation.
- ***Uses Vocabulary Encoding Scheme:*** The unique names/identifiers of vocabulary encoding schemes from which values for the property should be drawn. Names are presented as Qualified Names, but are abbreviations for URIs. The URI is used to refer to the vocabulary encoding scheme in DC metadata descriptions. If no vocabulary encoding scheme is listed, then the DCAP does not specify a vocabulary encoding scheme from which values should be drawn. However the definition and usage of the property may determine that values of only certain types are appropriate. For example, the value of the dc:creator property must be an entity capable of action.
- ***Value URI:*** An indication of whether, if a statement using the property (and vocabulary encoding scheme, where specified) is present, a value URI is to be used. Mandatory - a value URI is required; Mandatory, Fixed - a specified value URI is required; Optional = a value URI is optional[1]; Not permitted = a value URI is not permitted
- ***Value String:*** An indication of whether, if a statement using the property (and vocabulary encoding scheme, where specified) is present, a value string is to be used. Mandatory - a value string is required; Mandatory, Fixed - a specified value string is required; Optional = a value string is optional[1]; Not permitted = a value string is not permitted
- ***Syntax Encoding Scheme(s):*** The unique names/identifiers of datatypes from which value strings for the property should be drawn. Names are presented as

[1] For each value, **at least one** of the following components must be present: a value URI, a rich representation, a value string or a (related) description.

Qualified Names, but are abbreviations for URIs. The URI is used to refer to the datatype in DC metadata descriptions. If no datatype is listed, then the DCAP does not specify a datatype from which value strings should be drawn.

- ***Rich Representation:*** An indication of whether, if a statement using the property (and vocabulary encoding scheme, where specified) is present, a rich representation is to be used. Mandatory - a rich representation is required; Optional = a rich representation is optional[1]; Not permitted = a rich representation is not permitted
- ***Obligation:*** An indication of whether a statement using this property is required in a DC metadata description. Mandatory = a statement using this property is required, Conditional = a statement using this property is mandatory if exists the corresponding information, Optional = a statement using this property is optional
- ***Condition:*** Information on any additional conditions on the obligation to include a statement referencing the property in a description of a resource of the specified type
- ***Minimum Occurrences:*** The minimum number of statements referencing this property that can occur in a description of a resource of the specified type
- ***Maximum Occurrences:*** The maximum number of statements referencing this property that can occur in a description of a resource of the specified type

4.3. Vocabulary Encoding Scheme

This section describe the vocabulary encoding schemes referenced above is described.

- ***Vocabulary Encoding Scheme URI:*** The URI by which the vocabulary encoding scheme is referenced in a DC metadata description.
- ***Qualified Name for Vocabulary Encoding Scheme:*** The Qualified Name which is typically used as an abbreviation for the class URI.
- ***Defined By:*** The name and identifier of the metadata vocabulary from which the vocabulary encoding scheme is drawn.
- ***Type of Term:*** An indication of the type of the term, according to the typology of the DCMI Abstract Model
- ***Label:*** The short label provided for the vocabulary encoding scheme by its owner/maintenance agency.
- ***Definition:*** The definition provided for the vocabulary encoding scheme by its owner/maintenance agency.
- ***Comments for this DCAP:*** Additional information about the use of the vocabulary encoding scheme in this DCAP.
- ***See Also:*** A resource which provides further information about the vocabulary encoding scheme.
- ***Used as Vocabulary Encoding Scheme For:*** The type of resource and the property for which the vocabulary encoding scheme provides values.

4.4. Syntax Encoding Scheme

This section describe the syntax encoding schemes referenced above is described.

- ***Syntax Encoding Scheme URI:*** The URI by which the syntax encoding scheme is referenced in a DC metadata description.
- ***Qualified Name for Syntax Encoding Scheme:*** The Qualified Name which is typically used as an abbreviation for the class URI.
- ***Defined By:*** The name and identifier of the metadata vocabulary from which the syntax encoding scheme is drawn.
- ***Type of Term:*** An indication of the type of the term, according to the typology of the DCMI Abstract Model
- ***Label:*** The short label provided for the syntax encoding scheme by its owner/maintenance agency.
- ***Definition:*** The definition provided for the syntax encoding scheme by its owner/maintenance agency.
- ***Comments for this DCAP:*** Additional information about the use of the syntax encoding scheme in this DCAP.
- ***See Also:*** A resource which provides further information about the syntax encoding scheme.
- ***Used as Syntax Encoding Scheme For:*** The type of resource and the property for which the syntax encoding scheme provides value strings.

5 DESCRIBING AN ANALYSIS PATTERN

5.1. Class Description

Analysis Pattern [dc2aptp: analysisPattern]

Class URI	`http://purl.org/dc2ap/type/analysisPattern`
Qualified Name for Class	dc2aptp: analysisPattern
Defined By	DC2AP Type Vocabulary `http://purl.org/dc2ap/type/`
Type of Term	Class
SubClass Of	[n/a]
Label	Analysis Pattern
Definition	The intention of analysis pattern is to encapsulate specialist knowledge and provide it to be reused for solve a particular recurring problem during the analysis phase of the software development.
Comments	Is a computational artifact of re-use developed for the analysis phase of the software development.

5.2. Properties Description

Identifier [dc:identifier]

Property URI	http://purl.org/dc/elements/1.1/identifier
Qualified Name for Property	dc:identifier
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Identifier
Label in this DCAP	[n/a]
Source Definition	An unambiguous reference to the resource within a given context.
Usage in this DCAP	Is an unique reference given to an analysis pattern to differentiate it from others, so it is necessary that every analysis pattern has identification.
Comments for this DCAP	From the identifier must be possible to recover the version of the documented analysis pattern. The identifier must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Title [dc:title]

Property URI	http://purl.org/dc/elements/1.1/title
Qualified Name for Property	dc:title
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Title
Label in this DCAP	[n/a]
Source Definition	A name given to the resource.
Usage in this DCAP	Formal name by which an analysis pattern is widely known.
Comments for this DCAP	This name should be generic, allowing for adjustments for different domains of the same problem covered by the pattern. The title must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Alternative Title [dcterms:alternative]

Property URI	http://purl.org/dc/terms/alternative
Qualified Name for Property	dcterms:alternative
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Property
Subproperty Of	[dc:title] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/title
Source Label	Alternative Title
Label in this DCAP	[n/a]
Source Definition	Any form of the title used as a substitute or alternative to the formal title of the resource.
Usage in this DCAP	Alternative names used to substitute the formal name of an analysis pattern.
Comments for this DCAP	Different alternative names can be registered, preferably using separate iterations of this element refinement. The alternative title must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Optional
Condition	Analysis patterns don't always have alternative names, so don't fill this element refinement doesn't affect the retrieval of information.
Minimum Occurrences	0
Maximum Occurrences	unbounded

Creator [dc:creator]

Property URI	http://purl.org/dc/elements/1.1/creator
Qualified Name for Property	dc:creator
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Creator
Label in this DCAP	[n/a]
Source Definition	An entity primarily responsible for making the resource.
Usage in this DCAP	Creator's name of an analysis pattern.
Comments for this DCAP	The creator can be a person or company. Different creators can be registered, preferably using separate iterations of this element. The creator must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Subject [dc:subject]

Property URI	http://purl.org/dc/elements/1.1/subject
Qualified Name for Property	dc:subject
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Subject
Label in this DCAP	[n/a]
Source Definition	The topic of the resource.
Usage in this DCAP	Are keywords related to the scope in which an analysis pattern is applied, thus providing a brief contextualization.
Comments for this DCAP	Different subjects can be registered, preferably using separate iterations of this element. The subject must be a string.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI**: Not permitted **Value String**: Mandatory **Syntax Encoding Scheme(s)**: **Rich Represent**: Not permitted
Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Description [dc:description]

Property URI	http://purl.org/dc/elements/1.1/description
Qualified Name for Property	dc:description
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Description
Label in this DCAP	[n/a]
Source Definition	An account of the resource.
Usage in this DCAP	Agglutinating element of descriptions aimed in the contextualization of an analysis pattern over various aspects.
Comments for this DCAP	This element is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI**: Not permitted **Value String**: Not permitted **Syntax Encoding Scheme(s)**: **Rich Represent**: Not permitted
Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Problem [dc2ap:problem]

Property URI	http://purl.org/dc2ap/elements/problem
Qualified Name for Property	dc2ap:problem
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc:description] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/description
Source Label	Problem
Label in this DCAP	[n/a]
Source Definition	Brief textual description about the problem solved by an analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	The problem must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Motivation [dc2ap:motivation]

Property URI	http://purl.org/dc2ap/elements/motivation
Qualified Name for Property	dc2ap:motivation
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc:description] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/description
Source Label	Motivation
Label in this DCAP	[n/a]
Source Definition	Specific reasons that justify the existence of the documented analysis pattern. This refinement for element documents peculiarities of the problem which should be solved by the analysis pattern, regardless of application domain.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	Different motivations can be registered, preferably using separate iterations of this element refinement. The motivation must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Example [dc2ap:example]

Property URI	http://purl.org/dc2ap/elements/example
Qualified Name for Property	dc2ap:example
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:motivation] DC2AP Element Set http://purl.org/dc2ap/elements/motivation
Source Label	Example
Label in this DCAP	[n/a]
Source Definition	Examples of applications where the documented analysis pattern can be applied. This element refinement is useful to facilitate the abstraction, since it seeks to illustrate the use of analysis pattern in practice.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	Different examples can be registered, preferably using separate iterations of this element refinement. The example must be a string.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI**: Not permitted; **Value String**: Mandatory; **Syntax Encoding Scheme(s)**: ; **Rich Represent**: Not permitted
Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Known Uses [dc2ap:knownUses]

Property URI	http://purl.org/dc2ap/elements/knownUses
Qualified Name for Property	dc2ap:knownUses
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:motivation] DC2AP Element Set http://purl.org/dc2ap/elements/motivation
Source Label	Known Uses
Label in this DCAP	[n/a]
Source Definition	Known uses of the documented analysis pattern in real systems and applications. This element refinement is intended to share experiences of using of the analysis pattern, since after its use, the responsible analyst can describe briefly the application or system that used the pattern and how it was useful, contributing so to future users.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	Different known uses can be registered, preferably using separate iterations of this element refinement. The known uses must be a string.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI**: Not permitted; **Value String**: Mandatory; **Syntax Encoding Scheme(s)**: ; **Rich Represent**: Not permitted
Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Context [dc2ap:context]

Property URI	http://purl.org/dc2ap/elements/context
Qualified Name for Property	dc2ap:context
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc:description] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/description
Source Label	Context
Label in this DCAP	[n/a]
Source Definition	Description of contextual coverage of the documented analysis pattern. The domains where the problem solved by analysis patterns is recurrent and the possible causes of recurrence are described by this element refinement. This description should be general, enabling new domains of recurrence of the problem are identified.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	The context must be a string.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI** | **Value String** | **Syntax Encoding Scheme(s)** | **Rich Represent** Not permitted | Mandatory | | Not permitted
Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Publisher [dc:publisher]

Property URI	http://purl.org/dc/elements/1.1/publisher
Qualified Name for Property	dc:publisher
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Publisher
Label in this DCAP	[n/a]
Source Definition	An entity responsible for making the resource available.
Usage in this DCAP	Names of responsible for providing the analysis pattern for the public. Publishers can be people or companies.
Comments for this DCAP	Different publishers can be registered, preferably using separate iterations of this element. The publisher must be a string.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI** | **Value String** | **Syntax Encoding Scheme(s)** | **Rich Represent** Not permitted | Mandatory | | Not permitted
Obligation	Optional
Condition	In situations in which the creators of the analysis pattern are also responsible for the availability for the public, it is not necessary to register them again as publishers.
Minimum Occurrences	0
Maximum Occurrences	unbounded

Contributor [dc:contributor]

Property URI	http://purl.org/dc/elements/1.1/contributor
Qualified Name for Property	dc:contributor
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Contributor
Label in this DCAP	[n/a]
Source Definition	An entity responsible for making contributions to the resource.
Usage in this DCAP	Names of responsible for changes made in the original version of the analysis pattern. Contributors may be people or companies.
Comments for this DCAP	Different contributors can be registered, preferably using separate iterations of this element. The contributor must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Conditional
Condition	In situations where the documented analysis pattern is an original version, this element should not be registered, however whenever the documented analysis pattern is a version with modifications, this element must be registered.
Minimum Occurrences	0
Maximum Occurrences	unbounded

Date [dc:date]

Property URI	http://purl.org/dc/elements/1.1/date
Qualified Name for Property	dc:date
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Date
Label in this DCAP	[n/a]
Source Definition	A point or period of time associated with an event in the lifecycle of the resource.
Usage in this DCAP	Agglutinating element of dates about the creation and modification of the documented analysis pattern.
Comments for this DCAP	This element is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Not permitted		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Created [dcterms:created]

Property URI	http://purl.org/dc/terms/created
Qualified Name for Property	dcterms:created
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Property
Subproperty Of	[dc:date] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/date
Source Label	Created
Label in this DCAP	[n/a]
Source Definition	Date of creation of the resource.
Usage in this DCAP	Creation date of the version of the documented analysis pattern.
Comments for this DCAP	The creation date must be in accordance with a format specification of date and time.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:W3CDTF]	Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Modified [dcterms:modified]

Property URI	http://purl.org/dc/terms/modified
Qualified Name for Property	dcterms:modified
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Property
Subproperty Of	[dc:date] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/date
Source Label	Modified
Label in this DCAP	[n/a]
Source Definition	Date on which the resource was changed.
Usage in this DCAP	Date of the last modification of the documented analysis pattern.
Comments for this DCAP	The modification date must be in accordance with a format specification of date and time.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:W3CDTF]	Not permitted

Obligation	Conditional
Condition	If the documented analysis pattern is the current version of the pattern, this element refinement should not be registered, otherwise it should display the creation date of the newest version immediately newer than the documented version.
Minimum Occurrences	0
Maximum Occurrences	1

Type [dc:type]

Property URI	http://purl.org/dc/elements/1.1/type
Qualified Name for Property	dc:type
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Type
Label in this DCAP	[n/a]
Source Definition	The nature or genre of the resource.
Usage in this DCAP	The nature of documented resource. Because it is an element belonging to a profile of analysis pattern documentation, it should always inform only the nature "Analysis Pattern" in the appropriate language used in the documentation.
Comments for this DCAP	The type must be in accordance with a fixed term of a Vocabulary Encoding Scheme.
Uses Vocabulary Encoding Scheme	[dc2apves:type] DC2AP Vocabulary Encoding Schemes http://purl.org/dc2ap/ves/type

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Mandatory, Fixed [dc2aptp:analysisPattern]	Mandatory, Fixed analysisPattern		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Notation [rdaelem:formOfNotation]

Property URI	http://rdvocab.info/Elements/formOfNotation
Qualified Name for Property	rdaelem:formOfNotation
Defined By	RDA Group 1 Elements http://rdvocab.info/Elements/
Type of Term	Property
Subproperty Of	[dc:type] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/type
Source Label	Form of notation
Label in this DCAP	Notation
Source Definition	A set of characters and/or symbols used to express the content of a resource.
Usage in this DCAP	The notation used to create the diagrams during the documentation of an analysis pattern requirements.
Comments for this DCAP	All of these diagrams must follow a single notation in each documented analysis pattern. The notation must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Format [dc:format]

Property URI	http://purl.org/dc/elements/1.1/format
Qualified Name for Property	dc:format
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Format
Label in this DCAP	[n/a]
Source Definition	The file format, physical medium, or dimensions of the resource.
Usage in this DCAP	Digital format of the diagrams used in the documentation of the analysis pattern requirements.
Comments for this DCAP	Different formats can be registered, preferably using separate iterations of this element. The recommended formats for diagrams are JPEG (Joint Photographic Experts Group), PNG (Portable Network Graphics) and XMI (XML Metadata Interchange). The format must be in accordance with a fixed term of a Vocabulary Encoding Scheme.
Uses Vocabulary Encoding Scheme	[dcterms:IMT] Dublin Core Terms http://purl.org/dc/terms/IMT [dc2apves:format] DC2AP Format Vocabulary http://purl.org/dc2ap/ves/format

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Mandatory, Fixed [dc2apft:xmi]	Mandatory, Fixed xmi, jpeg or png		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Source [dc:source]

Property URI	http://purl.org/dc/elements/1.1/source
Qualified Name for Property	dc:source
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Source
Label in this DCAP	[n/a]
Source Definition	A related resource from which the described resource is derived.
Usage in this DCAP	Reference to the analysis pattern used as the main intellectual source in the creation of an analysis pattern.
Comments for this DCAP	The analysis pattern documented may have been derived from part of the source or even fully. The source must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Conditional
Condition	If the documented analysis pattern has not been based on no other, this element should not be registered.
Minimum Occurrences	0
Maximum Occurrences	1

Language [dc:language]

Property URI	http://purl.org/dc/elements/1.1/language
Qualified Name for Property	dc:language
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Language
Label in this DCAP	[n/a]
Source Definition	A language of the resource.
Usage in this DCAP	Language used for documenting the analysis pattern.
Comments for this DCAP	The language must be a string and may also be provided in accordance with a fixed term of a Vocabulary Encoding Scheme.
Uses Vocabulary Encoding Scheme	[dcterms:ISO639-3] Dublin Core Terms http://purl.org/dc/terms/ISO639-3

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Relation [dc:relation]

Property URI	http://purl.org/dc/elements/1.1/relation
Qualified Name for Property	dc:relation
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Relation
Label in this DCAP	[n/a]
Source Definition	A related resource.
Usage in this DCAP	Agglutinating element of existing relationships between the documented analysis pattern and other patterns.
Comments for this DCAP	This element is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Not permitted		Not permitted

Obligation	Conditional
Condition	If there are no relationships between the documented analysis pattern and another pattern, this element should not be registered.
Minimum Occurrences	0
Maximum Occurrences	1

Is Version Of [dcterms:isVersionOf]

Property URI	http://purl.org/dc/terms/isVersionOf
Qualified Name for Property	dcterms:isVersionOf
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Is Version Of
Label in this DCAP	[n/a]
Source Definition	A related resource of which the described resource is a version, edition, or adaptation.
Usage in this DCAP	Reference to the first version of the documented analysis pattern.
Comments for this DCAP	This element refinement must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI**: Optional; **Value String**: Mandatory; **Syntax Encoding Scheme(s)**: [dcterms:URI]; **Rich Represent**: Not permitted
Obligation	Conditional
Condition	If the documented analysis pattern has not earlier versions, this element refinement should not be registered.
Minimum Occurrences	0
Maximum Occurrences	1

Is Replaced By [dcterms:isReplacedBy]

Property URI	http://purl.org/dc/terms/isReplacedBy
Qualified Name for Property	dcterms:isReplacedBy
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Is Replaced By
Label in this DCAP	[n/a]
Source Definition	A related resource that supplants, displaces, or supersedes the described resource.
Usage in this DCAP	References for all the most current versions of the documented analysis pattern.
Comments for this DCAP	Different references to the most current versions can be registered, preferably using separate iterations of this element refinement. This element refinement must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI**: Optional; **Value String**: Mandatory; **Syntax Encoding Scheme(s)**: [dcterms:URI]; **Rich Represent**: Not permitted
Obligation	Conditional
Condition	If the documented analysis pattern is the most current version, this element refinement should not be registered.
Minimum Occurrences	0
Maximum Occurrences	unbounded

Replaces [dcterms:replaces]

Property URI	http://purl.org/dc/terms/replaces
Qualified Name for Property	dcterms:replaces
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Replaces
Label in this DCAP	[n/a]
Source Definition	A related resource that is supplanted, displaced, or superseded by the described resource.
Usage in this DCAP	References for all previous versions of the documented analysis pattern.
Comments for this DCAP	Different references to previous current versions can be registered, preferably using separate iterations of this element refinement. This element refinement must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Conditional
Condition	If the documented analysis pattern is the first version, this element refinement should not be registered.
Minimum Occurrences	0
Maximum Occurrences	unbounded

Is Part Of [dcterms:isPartOf]

Property URI	http://purl.org/dc/terms/isPartOf
Qualified Name for Property	dcterms:isPartOf
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Is Part Of
Label in this DCAP	[n/a]
Source Definition	A related resource in which the described resource is physically or logically included.
Usage in this DCAP	References for analysis patterns that contain the documented analysis pattern as part of its composition.
Comments for this DCAP	Different references to analysis patterns that contains the pattern documented can be registered, preferably using separate iterations of this element refinement. The analysis patterns referenced may contain the whole pattern documented in its composition or only part of it. This element refinement must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Has Part [dcterms:hasPart]

Property URI	http://purl.org/dc/terms/hasPart
Qualified Name for Property	dcterms:hasPart
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Has Part
Label in this DCAP	[n/a]
Source Definition	A related resource that is included either physically or logically in the described resource.
Usage in this DCAP	References for analysis patterns which are contained as part of the composition of the documented analysis pattern.
Comments for this DCAP	Different references for analysis patterns which are contained by the documented analysis pattern can be registered, preferably using separate iterations of this element refinement. The analysis patterns referenced can be contained entirely or partially in the composition of the pattern documented. This element refinement must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Is Designed With [dc2ap:isDesignedWith]

Property URI	http://purl.org/dc2ap/elements/isDesignedWith
Qualified Name for Property	dc2ap:isDesignedWith
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Is Designed With
Label in this DCAP	[n/a]
Source Definition	Known design patterns that can be used during the implementation of the documented analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This element refinement is intended to share experiences of using of the analysis pattern, since after its use, the responsible analyst can report design patterns used during the implementation. Future users of the analysis pattern can be benefit from these reports. Different design patterns can be registered, preferably using separate iterations of this element refinement. This element refinement must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Should Avoid [dc2ap:shouldAvoid]

Property URI	http://purl.org/dc2ap/elements/shouldAvoid
Qualified Name for Property	dc2ap:shouldAvoid
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Should Avoid
Label in this DCAP	[n/a]
Source Definition	Anti-patterns important to avoid common errors identified during the application of the documented analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This element refinement is intended to share experiences of using of the analysis pattern, since after its use, the responsible analyst can report anti-patterns used to avoid the common errors identified. Future users of the analysis pattern can be benefit from these reports. Different anti-patterns can be registered, preferably using separate iterations of this element refinement. This element refinement must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Complemented By [dc2ap:complementedBy]

Property URI	http://purl.org/dc2ap/elements/complementedBy
Qualified Name for Property	dc2ap:complementedBy
Defined By	DC2AP Element Set: http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Complemented By
Label in this DCAP	[n/a]
Source Definition	Known analysis patterns that can be used to complement the documented analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This element refinement is intended to share experiences of using of the analysis pattern, since after its use, the responsible analyst can report analysis patterns used or which can be used together with the documented analysis pattern. Future users of the analysis pattern can be benefit from these reports. Different analysis patterns can be registered, preferably using separate iterations of this element refinement. This element refinement must be a number, string or URI.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

About [rdaelem:note]

Property URI	http://rdvocab.info/Elements/note
Qualified Name for Property	rdaelem:note
Defined By	RDA Group 1 Elements http://rdvocab.info/Elements/
Type of Term	Property
Subproperty Of	[dc:relation] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/relation
Source Label	Note
Label in this DCAP	About
Source Definition	An annotation providing additional information relating to data recorded in another element.
Usage in this DCAP	Description of details about relationships established among the documented analysis pattern and other patterns.
Comments for this DCAP	The relationship description must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Conditional
Condition	All relationships established must be described in detail by this element refinement, so whenever there is at least an established relationship that element refinement must be registered.
Minimum Occurrences	0
Maximum Occurrences	1

Coverage [dc:coverage]

Property URI	http://purl.org/dc/elements/1.1/coverage
Qualified Name for Property	dc:coverage
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Coverage
Label in this DCAP	[n/a]
Source Definition	The spatial or temporal topic of the resource, the spatial applicability of the resource, or the jurisdiction under which the resource is relevant.
Usage in this DCAP	This element contains the spatial location or time period covered by the scope of the documented analysis pattern. Although it is an optional element not apply to all analysis patterns, its use can be very useful to compensate regionalisms that generate semantic ambiguities that may adversely affect the reuse of the pattern. The description of the analysis pattern coverage provides the disambiguation of terms used mainly during the modeling of the pattern.
Comments for this DCAP	Different coverages can be registered, preferably using separate iterations of this element. The coverage must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Rights [dc:rights]

Property URI	http://purl.org/dc/elements/1.1/rights
Qualified Name for Property	dc:rights
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Rights
Label in this DCAP	[n/a]
Source Definition	Information about rights held in and over the resource.
Usage in this DCAP	Existing rights over the documented analysis pattern.
Comments for this DCAP	Different rights can be registered, preferably using separate iterations of this element. The right can be described by a string or through referrals, for example, URLs (Uniform Resource Locator) for their respective approvals.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Not permitted

Obligation	Conditional
Condition	In the case of existence of known rights about the pattern, they must be registered no later to be transparency in the provision of the pattern.
Minimum Occurrences	0
Maximum Occurrences	unbounded

History [dc2ap:history]

Property URI	http://purl.org/dc2ap/elements/history
Qualified Name for Property	dc2ap:history
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	History
Label in this DCAP	[n/a]
Source Definition	Agglutinating element of historical data about the evolution of the documented analysis pattern. Historical events related to the pattern, for example, its creation or modifications made must be registered
Usage in this DCAP	This element was defined for this DCAP.
Comments for this DCAP	Newer versions of an analysis pattern should keep the history of the previous versions, adding data to it when there are new events. Each iteration of this element represents the occurrence of an event. This element is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Not permitted		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Event Date [dc:date]

Property URI	http://purl.org/dc/elements/1.1/date
Qualified Name for Property	dc:date
Defined By	Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/
Type of Term	Property
Subproperty Of	[dc2ap:history] DC2AP Element Set http://purl.org/dc2ap/elements/history
Source Label	Date
Label in this DCAP	Event Date
Source Definition	A point or period of time associated with an event in the lifecycle of the resource.
Usage in this DCAP	Date of the historic event occurrence.
Comments for this DCAP	The event date must be in accordance with a format specification of date and time.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI** / **Value String** / **Syntax Encoding Scheme(s)** / **Rich Represent** Optional / Mandatory / [dcterms:W3CDTF] / Not permitted
Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Author [rdaroles:author]

Property URI	http://rdvocab.info/roles/author
Qualified Name for Property	rdaroles:author
Defined By	RDA Roles http://rdvocab.info/roles/
Type of Term	Property
Subproperty Of	[dc2ap:history] DC2AP Element Set http://purl.org/dc2ap/elements/history
Source Label	Author
Label in this DCAP	[n/a]
Source Definition	A person, family or corporate body responsible for the creation of a work.
Usage in this DCAP	Names of responsible for the occurrence of the historic event.
Comments for this DCAP	Different authors can be registered, preferably using separate iterations of this element refinement. The author must be a string.
Uses Vocabulary Encoding Scheme	[not specified] **Value URI** / **Value String** / **Syntax Encoding Scheme(s)** / **Rich Represent** Not permitted / Mandatory / / Not permitted
Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Reason [dc2ap:reason]

Property URI	http://purl.org/dc2ap/elements/reason
Qualified Name for Property	dc2ap:reason
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:history] DC2AP Element Set http://purl.org/dc2ap/elements/history
Source Label	Reason
Label in this DCAP	[n/a]
Source Definition	Reason for the occurrence of the historical event.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	The reason must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Changes [dc2ap:changes]

Property URI	http://purl.org/dc2ap/elements/changes
Qualified Name for Property	dc2ap:changes
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:history] DC2AP Element Set http://purl.org/dc2ap/elements/history
Source Label	Changes
Label in this DCAP	[n/a]
Source Definition	Changes made in the analysis pattern during an event of changes.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	The change must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Conditional
Condition	This element refinement should not be registered only when the historical event refers to the creation of the documented analysis pattern.
Minimum Occurrences	0
Maximum Occurrences	1

Requirements [dc2ap:requirements]

Property URI	http://purl.org/dc2ap/elements/requirements
Qualified Name for Property	dc2ap:requirements
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Requirements
Label in this DCAP	[n/a]
Source Definition	Agglutinating element of data about the requirements of the documented analysis pattern.
Usage in this DCAP	This element was defined for this DCAP.
Comments for this DCAP	This element is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Not permitted		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Functional Requirements [dc2ap:functionalRequirements]

Property URI	http://purl.org/dc2ap/elements/functionalRequirements
Qualified Name for Property	dc2ap:functionalRequirements
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:requirements] DC2AP Element Set http://purl.org/dc2ap/elements/requirements
Source Label	Functional Requirements
Label in this DCAP	[n/a]
Source Definition	Responsibilities and restrictions for meet each functional requirement of the analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	Different functional requirements can be registered, preferably using separate iterations of this element refinement. The functional requirement must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Non-functional Requirements [dc2ap:nonFunctionalRequirements]

Property URI	http://purl.org/dc2ap/elements/nonFunctionalRequirements
Qualified Name for Property	dc2ap:nonFunctionalRequirements
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:requirements] DC2AP Element Set http://purl.org/dc2ap/elements/requirements
Source Label	Non-functional Requirements
Label in this DCAP	[n/a]
Source Definition	Responsibilities and restrictions for meet each non-functional requirement of the analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This element refinement is optional because quality attributes, as described by non-functional requirements, may vary by application domain of the analysis pattern. Different non-functional requirements can be registered, preferably using separate iterations of this element refinement. The non-functional requirement must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Dependencies and Contributions [dc2ap:dependenciesAndContributions]

Property URI	http://purl.org/dc2ap/elements/dependenciesAndContributions
Qualified Name for Property	dc2ap:dependenciesAndContributions
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:requirements] DC2AP Element Set http://purl.org/dc2ap/elements/requirements
Source Label	Dependencies and Contributions
Label in this DCAP	[n/a]
Source Definition	Brief explanation about the identified relations of dependency and contributions among the requirements of the documented analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	The dependencies and contributions must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Dependency Graph [dc2ap:dependencyGraph]

Property URI	http://purl.org/dc2ap/elements/dependencyGraph
Qualified Name for Property	dc2ap:dependencyGraph
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:dependenciesAndContributions] DC2AP Element Set http://purl.org/dc2ap/elements/dependenciesAndContributions
Source Label	Dependency Graph
Label in this DCAP	[n/a]
Source Definition	Graph Diagram used to represent the identified relations of dependency among the requirements of the documented analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	The dependency graph can be represented by an URI relative to a XMI file or image.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Optional

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Contribution Graph [dc2ap:contributionGraph]

Property URI	http://purl.org/dc2ap/elements/contributionGraph
Qualified Name for Property	dc2ap:contributionGraph
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:dependenciesAndContributions] DC2AP Element Set http://purl.org/dc2ap/elements/dependenciesAndContributions
Source Label	Contribution Graph
Label in this DCAP	[n/a]
Source Definition	Graph diagram used to represent the identified relations of contribution among the requirements of the documented analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This diagram should to classify each relation of this kind as positive or negative contribution. The contribution graph can be represented by an URI relative to a XMI file or image.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Optional

Obligation	Conditional
Condition	Whenever there are relations of this kind among the requirements of the pattern, the contribution diagram should be registered.
Minimum Occurrences	0
Maximum Occurrences	1

Conflict identification and Guidance to Resolution [dc2ap:conflictAndResolution]

Property URI	http://purl.org/dc2ap/elements/conflictAndResolution
Qualified Name for Property	dc2ap:conflictAndResolution
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:requirements] DC2AP Element Set http://purl.org/dc2ap/elements/requirements
Source Label	Conflict identification and Guidance to Resolution
Label in this DCAP	[n/a]
Source Definition	Brief explanation about the identified conflicts among the requirements of an analysis pattern and possible manners to solve them.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	Normally there are conflicts among requirements of the analysis pattern when the graph diagrams of dependency or contribution presents cycles. Different conflicts and resolutions can be registered, preferably using separate iterations of this element refinement. The conflict identification and guidance to resolution must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Conditional
Condition	If there is at least an identified conflict, is necessary to register this element refinement.
Minimum Occurrences	0
Maximum Occurrences	unbounded

Priorities Diagram [dc2ap:priorities]

Property URI	http://purl.org/dc2ap/elements/priorities
Qualified Name for Property	dc2ap:priorities
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:requirements] DC2AP Element Set http://purl.org/dc2ap/elements/requirements
Source Label	Priorities diagram
Label in this DCAP	[n/a]
Source Definition	The priorities diagram represents the order which requirements of an analysis pattern should be satisfied respecting their dependencies.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	From this diagram it is possible to identify the importance of each requirement of the analysis pattern and thus solve possible conflicts among them, prioritizing a most important requirement over another. The priorities diagram can be represented by an URI relative to a XMI file or image.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Optional

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Participants [dc2ap:participants]

Property URI	http://purl.org/dc2ap/elements/participants
Qualified Name for Property	dc2ap:participants
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:requirements] DC2AP Element Set http://purl.org/dc2ap/elements/requirements
Source Label	Participants
Label in this DCAP	[n/a]
Source Definition	Entities that interact with analysis pattern requirements.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	The participants are the actors of the use case diagram which represents a system that meets the requirements of the analysis pattern. Different participants can be registered, preferably using separate iterations of this element refinement. The participants must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Modelling [dc2ap:modelling]

Property URI	http://purl.org/dc2ap/elements/modelling
Qualified Name for Property	dc2ap:modelling
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Modelling
Label in this DCAP	[n/a]
Source Definition	Agglutinating element of diagrams and descriptions that represents part of the problem solution.
Usage in this DCAP	This element was defined for this DCAP.
Comments for this DCAP	This element is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Not permitted		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Behaviour [dc2ap:behaviour]

Property URI	http://purl.org/dc2ap/elements/behaviour
Qualified Name for Property	dc2ap:behaviour
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:modelling] DC2AP Element Set http://purl.org/dc2ap/elements/modelling
Source Label	Behaviour
Label in this DCAP	[n/a]
Source Definition	Agglutinating element of diagrams that make up the behavioral model of the analysis pattern. The behavioral model is the basis for the structural model of the analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This element refinement is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Use Case Diagram [dc2ap:useCaseDiagram]

Property URI	http://purl.org/dc2ap/elements/useCaseDiagram
Qualified Name for Property	dc2ap:useCaseDiagram
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:behaviour] DC2AP Element Set http://purl.org/dc2ap/elements/behaviour
Source Label	Use Case Diagram
Label in this DCAP	[n/a]
Source Definition	Diagram used to represent a system that meets requirements of an analysis pattern together with entities which interact with them.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	The use case diagram can be represented by an URI relative to a XMI file or image.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Optional

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Collaboration/Sequence Diagrams [dc2ap:collaborationSequenceDiagrams]

Property URI	http://purl.org/dc2ap/elements/collaborationSequenceDiagrams
Qualified Name for Property	dc2ap:collaborationSequenceDiagrams
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:behaviour] DC2AP Element Set http://purl.org/dc2ap/elements/behaviour
Source Label	Collaboration/Sequence Diagrams
Label in this DCAP	[n/a]
Source Definition	Collaboration and Sequence diagrams are used to create scenarios that represent the execution of each use case of the analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	These diagrams have an important role in the problem solution, because from them are identified the base objects for the creation of the structural model of the analysis pattern. Different collaboration and sequence diagrams can be registered, preferably using separate iterations of this element refinement. These diagrams can be represented by an URI relative to a XMI file or image.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Optional

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Activity/State Diagrams [dc2ap:activityStateDiagrams]

Property URI	http://purl.org/dc2ap/elements/activityStateDiagrams
Qualified Name for Property	dc2ap:activityStateDiagrams
Defined By	DC2AP Element Set: http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:behaviour] DC2AP Element Set http://purl.org/dc2ap/elements/behaviour
Source Label	Activity/State Diagrams
Label in this DCAP	[n/a]
Source Definition	Activity and State diagrams are used to represent the general behaviour of the system specified by the analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	These diagrams represent the behaviour of the system more clearly and detailed than the use case diagram, however aren't prerequisite for the creation of the structural model of the analysis pattern. Different activity and state diagrams can be registered, preferably using separate iterations of this element refinement. These diagrams can be represented by an URI relative to a XMI file or image.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Optional

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Structure [dc2ap:structure]

Property URI	http://purl.org/dc2ap/elements/structure
Qualified Name for Property	dc2ap:structure
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:modelling] DC2AP Element Set http://purl.org/dc2ap/elements/modelling
Source Label	Structure
Label in this DCAP	[n/a]
Source Definition	Agglutinating element of the diagram and descriptions that make up the structural model of the analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This element refinement is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Class Diagram [dc2ap:classDiagram]

Property URI	http://purl.org/dc2ap/elements/classDiagram
Qualified Name for Property	dc2ap:classDiagram
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:structure] DC2AP Element Set http://purl.org/dc2ap/elements/structure
Source Label	Class Diagram
Label in this DCAP	[n/a]
Source Definition	Class diagram is the main part of the problem solution treated by the analysis pattern. This diagram should be created according with the objects identified by the behavioral model of the analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This diagram can be represented by an URI relative to a XMI file or image.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Optional

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Class Descriptions [dc2ap:classDescriptions]

Property URI	http://purl.org/dc2ap/elements/classDescriptions
Qualified Name for Property	dc2ap:classDescriptions
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:structure] DC2AP Element Set http://purl.org/dc2ap/elements/structure
Source Label	Class Descriptions
Label in this DCAP	[n/a]
Source Definition	Brief description of each class of the class diagram.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	These descriptions are important to facilitate the understanding of the diagram and consequently of the problem solution proposed by the analysis pattern. Different class descriptions can be registered, preferably using separate iterations of this element refinement. The class description must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Relationship Descriptions [dc2ap:relationshipDescriptions]

Property URI	http://purl.org/dc2ap/elements/relationshipDescriptions
Qualified Name for Property	dc2ap:relationshipDescriptions
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:structure] DC2AP Element Set http://purl.org/dc2ap/elements/structure
Source Label	Relationship Descriptions
Label in this DCAP	[n/a]
Source Definition	Brief description of the main relationships present in the class diagram.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	These descriptions are important to facilitate the understanding of the diagram and consequently of the problem solution proposed by the analysis pattern. Different relationship descriptions can be registered, preferably using separate iterations of this element refinement. The relationship description must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Solution Variants [dc2ap:solutionVariants]

Property URI	http://purl.org/dc2ap/elements/solutionVariants
Qualified Name for Property	dc2ap:solutionVariants
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:modelling] DC2AP Element Set http://purl.org/dc2ap/elements/modelling
Source Label	Solution Variants
Label in this DCAP	[n/a]
Source Definition	This element refinement presents alternative models of behaviour and structure to solve the problem treated by the analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	This element refinement is intended to share experiences of using of the analysis pattern, since after its use, the responsible analyst may have modified the models proposed to better meet small problem variants. Future users of the analysis pattern can be benefit from these alternative models. Different solution variants can be registered, preferably using separate iterations of this element refinement. The solution variants can be represented by URI relative to XMI files or images.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Optional	Mandatory	[dcterms:URI]	Optional

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Resulting Context [dc2ap:resultingContext]

Property URI	http://purl.org/dc2ap/elements/resultingContext
Qualified Name for Property	dc2ap:resultingContext
Defined By	DC2AP Element Set: http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Resulting Context
Label in this DCAP	[n/a]
Source Definition	This element describes adaptations realized in the analysis pattern when it is applied in specific systems.
Usage in this DCAP	This element was defined for this DCAP.
Comments for this DCAP	This element is intended to share experiences of using of the analysis pattern, since after its use, the responsible analyst may have realized adaptations to better meet specificities of a system. Future users of the analysis pattern can be benefit from these use reports of the analysis pattern in specific cases. Different resulting contexts can be registered, preferably using separate iterations of this element. The resulting context must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Design Guidelines [dc2ap:designGuidelines]

Property URI	http://purl.org/dc2ap/elements/designGuidelines
Qualified Name for Property	dc2ap:designGuidelines
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Design Guidelines
Label in this DCAP	[n/a]
Source Definition	This element presents general tips for implementation of the documented analysis pattern.
Usage in this DCAP	This element was defined for this DCAP.
Comments for this DCAP	This element is intended to share experiences of using of the analysis pattern, since after its use, the responsible analyst can report actions taken during the implementation that can benefit future users of the pattern too. These tips should be independent of platform or programming language for thus doesn't limit the benefits to potential users. Different design guidelines can be registered, preferably using separate iterations of this element. The design guideline must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Optional
Condition	[n/a]
Minimum Occurrences	0
Maximum Occurrences	unbounded

Consequences [dc2ap:consequences]

Property URI	http://purl.org/dc2ap/elements/consequences
Qualified Name for Property	dc2ap:consequences
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[n/a]
Source Label	Consequences
Label in this DCAP	[n/a]
Source Definition	Agglutinating element of descriptions of advantages and disadvantages of use the documented analysis pattern.
Usage in this DCAP	This element was defined for this DCAP.
Comments for this DCAP	These positive and negative consequences are related to various aspects of the pattern. This element is not filled, because their data are concentrated in its element refinements.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Not permitted		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	1

Positive [dc2ap:positive]

Property URI	http://purl.org/dc2ap/elements/positive
Qualified Name for Property	dc2ap:positive
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:consequences] DC2AP Element Set http://purl.org/dc2ap/elements/consequences
Source Label	Positive
Label in this DCAP	[n/a]
Source Definition	Positive consequences of use of the documented analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	Different positive consequences can be registered, preferably using separate iterations of this element refinement. The positive consequence must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

Negative [dc2ap:negative]

Property URI	http://purl.org/dc2ap/elements/negative
Qualified Name for Property	dc2ap:negative
Defined By	DC2AP Element Set http://purl.org/dc2ap/elements/
Type of Term	Property
Subproperty Of	[dc2ap:consequences] DC2AP Element Set http://purl.org/dc2ap/elements/consequences
Source Label	Negative
Label in this DCAP	[n/a]
Source Definition	Negative consequences of use of the documented analysis pattern.
Usage in this DCAP	This element refinement was defined for this DCAP.
Comments for this DCAP	Different negative consequences can be registered, preferably using separate iterations of this element refinement. The negative consequence must be a string.
Uses Vocabulary Encoding Scheme	[not specified]

Value URI	Value String	Syntax Encoding Scheme(s)	Rich Represent
Not permitted	Mandatory		Not permitted

Obligation	Mandatory
Condition	[n/a]
Minimum Occurrences	1
Maximum Occurrences	unbounded

5.3. Vocabulary Encoding Schemes Description

DC2APtype [dc2apves:type]

Vocabulary Encoding Scheme URI	http://purl.org/dc2ap/ves/type
Qualified Name	dc2apves:type
Defined By	DC2AP Vocabulary Encoding Schemes http://purl.org/dc2ap/ves/
Type of Term	Vocabulary Encoding Scheme
Label	DC2AP Type Vocabulary
Definition	The set of classes specified by the DC2AP Type Vocabulary, used to categorize the nature or genre of the resource.
Label in this DCAP	[n/a]
See Also	http://purl.org/dc2ap/type/
Used as Vocabulary Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc:type] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/type

DC2APformat [dc2apves:format]

Vocabulary Encoding Scheme URI	http://purl.org/dc2ap/ves/format
Qualified Name	dc2apves:format
Defined By	DC2AP Vocabulary Encoding Schemes http://purl.org/dc2ap/ves/
Type of Term	Vocabulary Encoding Scheme
Label	DC2AP Format Vocabulary
Definition	The set of file formats specified by the DC2AP Format Vocabulary, used to categorize the nature or genre of the files.
Label in this DCAP	[n/a]
See Also	http://purl.org/dc2ap/format/
Used as Vocabulary Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc:format] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/format

IMT [dcterms:IMT]

Vocabulary Encoding Scheme URI	http://purl.org/dc/terms/IMT
Qualified Name	dcterms:IMT
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Vocabulary Encoding Scheme
Label	IMT
Definition	The set of media types specified by the Internet Assigned Numbers Authority.
Label in this DCAP	[n/a]
See Also	http://www.iana.org/assignments/media-types/
Used as Vocabulary Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc:format] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/format

ISO639-3 [dcterms:ISO639-3]

Vocabulary Encoding Scheme URI	http://purl.org/dc/terms/ISO639-3
Qualified Name	dcterms:ISO639-3
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Vocabulary Encoding Scheme
Label	ISO 639-3
Definition	The set of three-letter codes listed in ISO 639-3 for the representation of names of languages.
Label in this DCAP	[n/a]
See Also	http://www.sil.org/iso639-3/
Used as Vocabulary Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc:language] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/language

5.4. Syntax Encoding Schemes Description

Uniform Resource Identifier [dcterms:URI]

Syntax Encoding Scheme URI	http://purl.org/dc/terms/URI
Qualified Name	dcterms:URI
Defined By	Dublin Core Terms: http://purl.org/dc/terms/
Type of Term	Syntax Encoding Scheme
Label	Uniform Resource Identifier
Definition	The set of identifiers constructed according to the generic syntax for Uniform Resource Identifiers as specified by the Internet Engineering Task Force.
Label in this DCAP	[n/a]
See Also	http://www.ietf.org/rfc/rfc3986.txt
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc:identifier] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/identifier
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc:source] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/source
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc:rights] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/rights
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dcterms:isVersionOf] Dublin Core Terms http://purl.org/dc/terms/isVersionOf
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dcterms:isReplacedBy] Dublin Core Terms http://purl.org/dc/terms/isReplacedBy
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dcterms:replaces] Dublin Core Terms http://purl.org/dc/terms/replaces
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dcterms:isPartOf] Dublin Core Terms http://purl.org/dc/terms/isPartOf
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dcterms:hasPart] Dublin Core Terms http://purl.org/dc/terms/hasPart
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:isDesignedWith] DC2AP Element Set http://purl.org/dc2ap/elements/isDesignedWith

Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:shouldAvoid] DC2AP Element Set http://purl.org/dc2ap/elements/shouldAvoid
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:complementedBy] DC2AP Element Set http://purl.org/dc2ap/elements/complementedBy
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:dependencyGraph] DC2AP Element Set http://purl.org/dc2ap/elements/dependencyGraph
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:contributionGraph] DC2AP Element Set http://purl.org/dc2ap/elements/contributionGraph
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:priorities] DC2AP Element Set http://purl.org/dc2ap/elements/priorities
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:useCaseDiagram] DC2AP Element Set http://purl.org/dc2ap/elements/useCaseDiagram
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:collaborationSequenceDiagrams] DC2AP Element Set http://purl.org/dc2ap/elements/collaborationSequenceDiagrams
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:activityStateDiagrams] DC2AP Element Set http://purl.org/dc2ap/elements/activityStateDiagrams
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:classDiagram] DC2AP Element Set http://purl.org/dc2ap/elements/classDiagram
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc2ap:solutionVariants] DC2AP Element Set http://purl.org/dc2ap/elements/solutionVariants

W3C-DTF [dcterms:W3CDTF]

Syntax Encoding Scheme URI	http://purl.org/dc/terms/W3CDTF
Qualified Name	dcterms:W3CDTF
Defined By	Dublin Core Terms http://purl.org/dc/terms/
Type of Term	Syntax Encoding Scheme
Label	W3C-DTF
Definition	The set of dates and times constructed according to the W3C Date and Time Formats Specification.
Label in this DCAP	[n/a]
See Also	http://www.w3.org/TR/NOTE-datetime
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dcterms:created] Dublin Core Terms http://purl.org/dc/terms/created
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dcterms:modified] Dublin Core Terms http://purl.org/dc/terms/modified
Used as Syntax Encoding Scheme For	Analysis Pattern [dc2aptp:analysisPattern] [dc:date] Dublin Core Metadata Element Set, v1.1 http://purl.org/dc/elements/1.1/date

APÊNDICE B

Artigo V: Uma Infraestrutura de Dados Espaciais para o Projeto GeoMINAS

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RESUMO

Este artigo descreve o projeto que teve como objetivo criar uma nova Infraestrutura de Dados Espaciais para o Projeto GeoMINAS, resgatando os seus dados originais e documentando-os por meio de metadados, descritos com base no padrão nacional de metadados (Perfil MGB). Os passos para a implantação da IDE GeoMINAS são descritos detalhadamente.

Palavras-chave: Infraestruturas de Dados Espaciais, Mapa, Minas Gerais, IDE, INDE, CONCAR.

ABSTRACT

This article describes the project which aimed to create a new Spatial Data Infrastructure for the GeoMINAS Project, restoring their original data and documenting them by means of metadata, described based on the national metadata standard (MGB Profile). The steps for the implementation of the SDI GeoMINAS are described in detail.

Keywords: Spatial Data Infrastructure, Map, Minas Gerais, SDI, INDE, CONCAR.

1 INTRODUÇÃO

O termo Sistema de Informação Geográfica (SIG) é usado para denotar sistemas capazes de relacionar dados cadastrais/atributos e dados geográficos (NOGUERAS-ISO; ZARAZAGA-SORIA; MURO-MEDRANO, 2005). Este tipo de sistema possibilita o acesso, através de interfaces amigáveis, a visualização de variáveis sobre feições e fenômenos que ocorrem na superfície terrestre. Os SIG vêm tornando-se cada vez mais sofisticados e o avanço nos dispositivos de captura de dados geoespaciais tornou o processo cada vez mais rápido (RAJABIFARD; WILLIAMSON, 2001). Entretanto, quase todo novo projeto de SIG pode implicar em desenvolvimento a partir do zero, caso não haja suporte a reutilização de base de dados já existentes.

A resposta ao suporte para reutilização de dados espaciais gerados por diversos agentes foi a criação de uma infraestrutura que permitisse seu compartilhamento, ou seja, uma Infraestruturas de Dados Espaciais (IDE). Este termo surgiu em 1993 quando o Conselho de Pesquisa Norte-Americano (*US National Research Council*) estabeleceu a necessidade de acesso padronizado à informação geográfica (MAGUIRE; LONGLEY, 2005). Para isto é fundamental o conhecimento e existência dos dados sobre os dados: os metadados. Os metadados desempenham uma função primordial em uma IDE, pois eles tornam os dados e serviços geoespaciais acessíveis a usuários e softwares-cliente. Estes são agrupados em catálogos com a finalidade de facilitar o conhecimento e recuperação dos dados, bem como a sua utilização, a partir da obtenção (*download*) do dado ou ainda diretamente da IDE, por meio de serviços Web (NOGUERAS-ISO et al., 2005).

No Brasil, grande parte dos dados geoespaciais ainda encontra-se dispersa em diversas instituições públicas e privadas gerando assim um conjunto de problemas que poderiam ser, em grande parte, resolvidos, se as instituições que possuem estes dados utilizassem um sistema integrado de catalogação de metadados.

Com a recente iniciativa da Comissão Nacional de Cartografia (CONCAR), de lançar a INDE – Infraestrutura Nacional de Dados Geográficos (CONCAR, 2010), juntamente com a definição do Perfil MGB – Perfil Brasileiro para Metadados Geográficos (CONCAR, 2009), em consonância com o padrão internacional de metadados (Série ISO TC211), iniciativas de IDE nos diversos níveis de abrangência começam a ser reestruturadas.

Este artigo descreve a iniciativa de reestruturação do portal de dados do Projeto GeoMINAS, ou seja, a criação da IDE estadual GeoMINAS[1], para disponibilizar as coleções de dados espaciais disponíveis no antigo site do GeoMINAS, o qual não adotava nenhum padrão para descrição dos metadados, já que na época de seu lançamento ainda não estavam estabelecidos padrões como o CSDGM (FGDC, 2000) e o ISO19115 (ISO, 2003). Com esta reestruturação os dados passam a ser documentados por metadados elaborados de acordo com o Perfil MGB, da INDE. Esta nova IDE, além de manter os dados do antigo site, visando a possibilidade de execução de operações de análises temporais, está apta a receber novos e atualizados dados de abrangência estadual.

2 UMA IDE PARA O PROJETO GEOMINAS

O site GeoMINAS[2] foi uma iniciativa publicada em 1995, a partir da articulação de um grupo de instituições sediadas no estado de Minas Gerais sendo pioneiro na disponibilização de dados geoespaciais em âmbito estadual. Seus dados foram amplamente utilizados por usuários de todo o Brasil durante seus 15 anos de existência, entretanto devido a falta de apoio político, este site não recebeu atualizações e em abril de 2011 foi retirado do ar.

No primeiro semestre de 2011, como projeto da linha de pesquisa em Bancos de Dados Espaciais, do Programa de Pós-Graduação em Computação da Universidade Federal de Viçosa, foi realizado um trabalho colaborativo que teve como objetivo criar uma nova IDE para o GeoMINAS, resgatando os seus dados originais e documentando-os com base no Perfil MGB. Para tal foi necessário utilizar uma ferramenta capaz de catalogar, recuperar e realizar buscas espaciais nesses metadados.

Para atender essas necessidades foi escolhido o catálogo de metadados GeoNetwork[3]. Nas seções a seguir são apresentadas as etapas da construção da IDE GeoMINAS.

[1] http://www.ide.ufv.br/geominas
[2] http://www.geominas.mg.gov.br
[3] http://geonetwork-opensource.org

2.1. Configuração do GeoNetwork

O GeoNetwork proporciona a catalogação e o acesso ao conteúdo de diversos tipos de dados, inclusive espaciais, através de metadados, tendo como base os padrões de metadados ISO19115, ISO19139, FGDC e Dublin Core. Este sistema é amplamente utilizado em iniciativas de IDE pelo o mundo, por exemplo, a INDE (CONCAR, 2010) e a *Scottish Spatial Data Infrastructure*[4].

Optou-se por utilizar a versão 2.2 do GeoNetwork, disponibilizada no site do IBGE por esta possuir suporte ao Perfil MGB. Devido a necessidade do GeoNetwork ser executado em um servidor de aplicação com suporte a Java Web e Servlets, foi utilizado neste projeto o software livre Apache Tomcat.

Foi preciso aumentar a memória heap e a "PermSize" do Tomcat durante a implantação para não haver sobrecargas e consequentemente a paralisação do servidor hospedeiro. Para isso foi executado o software apache6w.exe e na aba "Java" da interface foi necessário inserir um comando após a última linha do "Java Options" e alterar o valor do campo "Maximum memory pool", como mostrado na Figura 1.

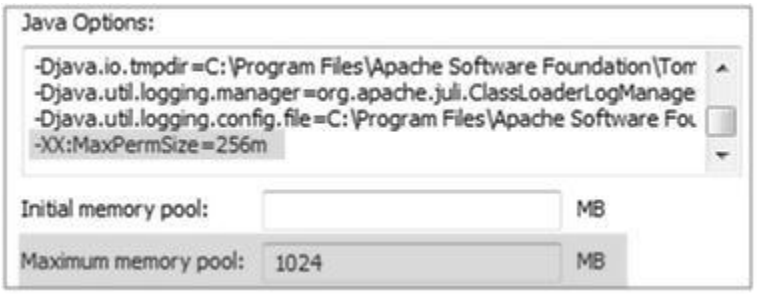

Figura 1 - Configuração de Memória Heap e PermSize no Apache Tomcat

A Figura 2 mostra o local onde o Tomcat localiza os arquivos do GeoNetwork e como fica o endereço dele para acessá-lo via *browser*. O campo "path" da tag "Context" é o endereço Web para chegar ao GeoNetwork. Considerando que o domínio das IDEs hospedadas no servidor utilizado é "`www.ide.ufv.br`", quando o usuário acessa "`www.ide.ufv.br/geominas`" ele entra no ambiente do GeoNetwork. O campo "docBase" é onde se localizam os arquivos do catálogo de metadados dentro do servidor.

[4] `http://scotgovsdi.edina.ac.uk/srv/en/main.home`

```
<Context path="/geominas"
       docBase="D:\Geonetwork\geominas\web\geonetwork"
       crossContext="false"
       debug="0"
      reloadable="false" />
```

Figura 2 - Configuração do GeoMINAS no Servidor de Aplicação Apache Tomcat

Para adequar a interface da IDE GeoMINAS, foram realizadas modificações nas folhas de estilo "geonetwork.css" e "ext-all.css", presentes respectivamente nos diretórios "geonetwork" e "css". Esses arquivos são responsáveis por configurar as cores da interface do GeoNetwork. Além dos parâmetros das folhas de estilo, algumas imagens presentes no diretório "images" foram substituídas para compor a interface.

O GeoNetwork é integrado a outros dois softwares, o Geoserver e o Intermap. Eles auxiliam na realização de buscas espaciais, exibindo um mapa interativo onde o usuário pode selecionar e ampliar uma região de interesse para a busca de dados e um serviço de mapa para Web conhecido por WMS, onde se pode adquirir várias camadas de mapas de outros ambientes na Internet e ter uma melhor noção de localização.

Durante a implantação do GeoNetwork ocorreram problemas com a exibição do mapa interativo, solucionados após a realização de configurações no arquivo "mapServers.xml", como mostra a Figura 3. Para tal, foi necessário alterar os parâmetros "url" explicitando qual o domínio ou IP do serviço WMS do Geoserver.

A Figura 4 mostra um exemplo de interface da IDE GeoMINAS, após as customizações descritas nesta seção.

```
<mapContexts>
<default name="Layers for default map - DUMMY NAME : note used">
      <server url="http://www.ide.ufv.br/geoserver/wms" type="2">
            <layer name="gn:world"></layer>
      </server>
      <server url="http://www.ide.ufv.br/geoserver/wms" type="2">
            <layer name="gn:gboundaries"></layer>
</server>
```

Figura 3 - Configuração do Intermap e Geoserver

Figura 4 - Página dos Metadados da IDE GeoMINAS

2.2. Obtenção dos Dados Geoespaciais do GeoMINAS

Como o antigo site GeoMINAS foi retirado do ar, buscou-se encontrar cópias dos dados originais em fontes alternativas. Considerando que os dados foram publicados e disponibilizados livremente para *download* e uso, e ainda que a Universidade Federal de Viçosa foi uma das parceiras no projeto original, entendeu-se que não haveria problemas legais em disponibilizar os dados do GeoMINAS por meio de uma IDE.

Para a obtenção dos dados foram analisadas e utilizadas quatro fontes distintas, as quais possuíam cópias dos dados originais. O primeiro sítio foi um servidor do INPE - Instituto Nacional de Pesquisas Espaciais, onde se obteve um volume de 13Mb de dados. Estes dados estavam disponíveis para serem utilizados como exemplos no software Spring. A segunda fonte de dados foi um site de uma disciplina de banco de dados espaciais, do Departamento de Computação da Universidade Federal de Minas Gerais, onde os dados estavam armazenados em um SGBD PostGIS. A terceira fonte foi uma empresa de Viçosa-MG, chamada iPlanus, onde obteve-se uma cópia parcial dos dados, com volume na ordem de 70Mb. Um dos proprietários desta empresa havia

participado do projeto original do GeoMINAS. Por fim, uma cópia completa dos dados foi obtida junto ao Departamento de Solos da UFV, cujo contato também havia participado do projeto original.

2.3. Elaboração dos Metadados no Perfil MGB

Logo após a execução do processo de recuperação dos dados do GeoMINAS, iniciou-se o trabalho de análise e elaboração manual dos metadados. Para tal, foi utilizado o editor de metadados do GeoNetwork.

As informações sobre os metadados originais foram primeiramente coletadas do arquivo de descrição dos dados do site do GeoMINAS, cuja cópia foi obtida juntamente com os dados. Este arquivo de descrição segue uma padronização denominada Kit Desktop Mapping 2.0. O trabalho de edição dos metadados iniciou-se na adaptação destas descrições para o Perfil MGB. O documento descritivo obtido não continha as coordenadas limites e nem o sistema de referência. Assim utilizou-se o sistema *freeware* Quantum GIS para a coleta das coordenadas e o sistema de referência para cada arquivo *shape*. Os títulos dos metadados contidos na descrição do Kit Desktop Mapping 2.0 estavam rotulados com uma sigla que não identificava com clareza o dado com o qual estava relacionado. Assim, a descrição do metadado foi alterada para um rótulo mais significativo que expressa melhor a identificação do dado bem como auxilia na recuperação do mesmo. O nome relativo a um dado espacial “MG.TAB”, por exemplo, foi alterado para “Contorno do Estado de Minas Gerais (MG.TAB)”. Para não perder a primeira descrição do metadado, manteve-se o seu antigo nome no final da descrição, entre parênteses.

3 CONSIDERAÇÕES FINAIS

O acesso a dados geoespaciais é um recurso estratégico para as instituições, tanto públicas como privadas. No entanto, o custo para obtenção e produção de dados geoespaciais é muito alto, quando comparado à aquisição de dados em aplicações não espaciais. Desta forma, o compartilhamento de dados geoespaciais é fundamental para que esses também possam ser utilizados por instituições que não possuem recursos para produzi-los.

Uma Infraestrutura de Dados Espaciais é a resposta tecnológica para minimizar esses problemas. O uso de um padrão de metadados, além de permitir a busca e localização de dados existentes, ainda fornece outras informações. O Projeto GeoMINAS original foi um dos pioneiros no Brasil a mobilizar e reunir um grupo de profissionais de diferentes instituições com um interesse comum e era, até recentemente, uma importante fonte de dados geoespaciais. No entanto, sua desativação deixou muitos usuários potenciais sem o acesso a este importante repositório de dados.

A IDE GeoMINAS além de prover acesso aos dados do antigo site, reestruturou a documentação dos dados de acordo com o novo padrão de metadados brasileiro, o Perfil MGB. A opção de utilizar o software GeoNetwork possibilitou adicionar ao GeoMINAS novas funcionalidades, pois além de facilitar a localização e permitir que o usuário adquira os dados para seu computador, possui funcionalidades de WebSIG, ou seja, permite ao usuário consultar e realizar análises espaciais simples usando apenas o *browser*.

Com a IDE GeoMINAS o repositório de dados deixa de ser estático e disponibiliza um ambiente onde os usuários podem facilmente publicar seus dados. Como trabalhos futuros, serão desenvolvidos novos serviços Web e pretende-se integrar a IDE GeoMINAS à INDE, como mais um nó da rede de servidores de dados geoespaciais.

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