Ontological Methodologies – From Open Standards Software Development to Open Standards Organizational Project Governance

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Summary
Ontological methodologies use consistencies in system development and project management work and create consistencies in both system products/services and project knowledge management. They also transform these system development and project management practices into multi-site models where project work and resources are carried in different locations.

This paper examines the ramifications of this discovery in project management by researching an ontological methodology for specifying the domain knowledge and data model of multi-site project management (MSPM), and verifies that the value of the MSPM ontological methodology goes beyond creating consistencies in making MSPM knowledge explicit. The MSPM ontological methodology is a new governance framework of project management across locations, where open standards govern the execution of project management, and in doing so creates and sustains capability consistency in organizational project management, enterprise architecture management and multi-site risks management that includes macroeconomics management.

Key words:
Ontology, ontological system development, multi-site project management, ontological methodology, ontological data model.

1. Introduction

Ontology is a branch of philosophic studies, which together with physiology, cosmology and theology theories form the four disciplines of metaphysics [4]. Ontology studies define the concepts of reality and therefore frame the explicit definition and classification of knowledge that is based on community agreements [4, 21, 29]. As such, Gruber [6-9] redefined ontologies are explicit notional specifications of conceptualized knowledge, a statement that profiles a design philosophy of today's open systems development trend.

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2. Ontological system development

According to Poli [12-17], ontology development is a three tier methodology model that involves knowledge community collaboration in

- Specifying foundation ontologies that are language based specifications agreed by domain knowledge experts
- Conceptualizing the foundation ontologies / domain knowledge into logical data models
- Formalizing the development and enhancement of forms and methods used in developing and continuously maintaining these foundation ontologies and data models, which also include self-evaluation frameworks development for continuously improvement.

As evident by research literature, this traditional view of ontology has strongly influenced the direction of research and development (R&D) of applying ontology principles in system work. The emphasis focuses on specifying and data modeling specialized enterprise functions as the areas of domain knowledge. The R&D effort is often driven by identifying how domain knowledge acquisition and data modeling (often carried out in the context of user requirement specifying and analysis) can be made consistent, and by elaborating and applying the resulting forms and methodological hind-sights into increasing the standardization of next generation (i.e. web service oriented) of system development.

What this is means is that in-house software development, which traditionally uses proprietary and discretionary forms and methods, is out. Instead, transforming the whole software development lifecycle experience and the products/services produced to embrace open standard, is in. This new trend in software system development characterizes the essence of ontological software development.

Underpinning the formalization of ontological forms and development lifecycle methods is a requirement of evaluation for continuously improvement, suggesting that

the ontology development process is self-managing. In the context of software development, it is not presumptuous to expect that developing and maintaining ontological artifacts are governed by a project management discipline, because quality management is a function of project management and because it is common knowledge that project management governs software development work.

3. The Value of Consistency

Therefore ontology software development is a methodology where all process and product/service aspects of *software development lifecycle* and *project management* are aimed to be made consistent by adopting a managed framework of open standards from different disciplines of enterprise professions.

Consistency has many uses:

- From a business perspective, consistency in processes and products/services attributes to cost efficiency and lesser complexity in operations and management that would result in easier and faster change management for internal improvement and strategic reasons. This ultimately translates to lower costs, higher product/service quality and faster speed to service and market.

- From a system perspective, consistency enables system interoperability that:

    - Can lead to lesser ICT components and therefore lower cost and less complex change management ICT resources, and more importantly leads to high efficacious enterprise knowledge provisioning and management. Ultimately, consistency enables and sustains efficient total cost of ICT ownership and effective change management.
    - Can shape the servicing inertia of a firm for strategic advantage. The concept of interoperability goes beyond system integration to a model that combines and shapes the servicing inertia of enterprise people, process and ICT systems together to create core competencies that give competitive advantage [2, 18]. In international strategy studies, core competencies are important strategic advantageous servicing capability that create customer value and give sustaining competitive advantage, is difficult to imitate, and is used in many products in many markets that it become an essential and core service component of markets and organisations [18].

Therefore, in ontological software development methodologies, there must be agreed consistencies in:

- Software development forms and methods of

    - User requirements (domain knowledge) specification and its knowledge modeling
    - System design models and artifacts
    - System testing / verification of functionality

- Integrating system capabilities into development and deployment of strategic servicing inertia, i.e. core competencies

- Project management of the software development lifecycle

These consistencies can be developed and maintained as standards in forms and methods by different disciplinary communities of experts, and brought into coordinating fusion through the ontological methodology frameworks. As such, it is now obvious that the ultimate value of an ontology methodology is that it is also a framework for governing and bringing together the component management of developing system, process and people capabilities towards developing specialized core competencies of the firm.

4. Research Case Development

4.1 Project Background

In 2003/04, Curtin University initiated several research projects to investigate how ontological methodologies can be framed to develop consistency in software development lifecycle and project management in order to help Australian enterprises acquire or improve their competencies in software development and project management across different locations.

This paper shall share insights into one of these research areas, i.e. that of multi-site project management (MSPM), an emerging and fast growing model of project management in practice; and developing its ontological methodology.

From a research discipline perspective:

- The empirical data originated from using the organizational project management standards of the Project Management Institute (PMI) and selected grounded theories of international business studies to expand the risk management frameworks of traditional project management.

- The objective defined was to create a ontological methodology that refers to, builds upon and reflects the open standards of project management and system architecture communities, and selected grounded theories of academic research communities
- The research problem was the lacking cross-location project knowledge consolidation capabilities of Australian enterprises that fundamentally caused the many ills and failures of project management in current practice, and the solution, the MSPM methodology for addressing this identified problem cause, was validated through developing and analyzing the case studies of two Australian organisations wanting to acquire MSPM while still immature in project management proficiencies.

The following sub-sections summarize the key research findings, including the validation conclusions of the MSPM ontological methodology and data model.

4.2 What is MSPM?

In Australia and the USA, more than 50% of enterprise expenditures involved software development [1, 10, 19]. Ironically over the last thirty years, the trend of failing projects is an reoccurring norm unresolved to this day [3, 5, 11, 20, 22-28]. As such, it is not unusual to expect that out of every 100 projects, 70 are still at risk of failing [3] despite higher adoption of project management best practice, more training, and availability of newer system tools.

What was not obvious is that project management has changed to a model of MSPM, where project work and resources are spread across locations, often crossing sovereign and organizational boundaries. The reasons for allocating project resources and activities in different locations are influenced by globalization factors, which drive enterprises to disperse their enterprise functions in locations in order to leverage competitive advantage from local supply chain factors and government incentives. As a result, enterprises choose to spread their project work based on decisions that give them comparative competitive advantage.

While field practice has evolved and changed the nature of project management from single sited or single organization models to multi-site models, we drew from existing literature review and analysis that explicit and formalized industry and research MSPM knowledge is lacking.

Furthermore, our evaluation of current products (i.e. PMI standards, PRINCE2, ISO 1006/1007, Micro Project, a third party (Planpower) methodology and software *Project-In-A-Box*) showed that current methodologies and system tools do not explicitly and therefore do not adequately support multi-site aspects of project management. The evaluation also concluded that the PMI standards and PRINCE2 are regarded as the two global best practices of project management because:

- Of their comprehensive coverage of organizational project management processes,
- They are vendor neutral, and
- They foster global community involvement and agreement in their formalization as best practice methodologies.

While PMI and PRINCE2 standards are both comprehensive in their organizational project management guidelines, PRINCE2 goes two steps further to include standard input and output templates, and integration into a bigger government e-servicing system development lifecycle framework. However, the PMI standards have more global coverage in its community membership and registered users, and PMI encourages volunteer participation in developing and maintaining the PMI standards. As such, the PMI standards are more open and less government administration centric (hence easier to use and more readily multi-purpose in use). However, both explicitly lack reference to multi-site peculiarities in their functions and documentation.

Given that project management has matured into a MSPM practice and lacks explicit multi-site support in current methodology and system products, developing a common and explicit MSPM knowledge framework is most logical first solution because using the knowledge framework would:

- Bring together and coordinate the change management of current project management people, process and system capabilities, including best practices, to build up MSPM capabilities
- Foster community collaboration in developing and maintaining consistent MSPM knowledge for fostering consistency in the lifecycle change management of MSPM capabilities, in both their forms and development methods.

To begin this quest, MSPM is defined. From evaluating best practices in project management, and analyzing the macroeconomic and strategy management aspects of international business theories, we inferred that MSPM:

- Is a model of organizational project management whereby it uses portfolio, program and project control structures to structure, stitch and align the ramifications of strategy management to project management
- Is a model of risk management that not only address aspects of conventional project risks and issues management, but also make additional provisions for:
  - The influences and impact of macroeconomic drivers in different locations that arise from differences in locations' political, economic, social and technological systems, and which conventional project management methodologies and system tools do not support.
  - Including product design governance frameworks that model and control software design and architecture management to be consistent in both forms and methods in order to (a) produce interoperating components and inter systems integration in the most optimized manners, and (b) integrate system servicing with other aspects of business process and people capabilities to create / improve core competencies for competitive advantage. As such, MSPM must integrate enterprise architecture management frameworks for governing software design and architecture to integrate into bigger enterprise contexts of core competency/service design and development work.

This definition frames the functional scope of the MSPM knowledge framework, which the Curtin research aimed to develop its logical data model by using ontology principles. Therefore, the research focus, hence its objective, is directed at developing the MSPM ontological methodology and in the course of doing so, we deliver the MSPM knowledge framework in the form of a data model. In the next two sub-sections, we shall summarize the highlights of these two research achievements to date – the MSPM ontological methodology and data model.

4.3 The MSPM Ontological Methodology

To design an ontological methodology for specifying and modeling MSPM knowledge, we need to identify, refer and build on open standards in organizational project management, enterprise architecture management and multi-site (macroeconomic) risks management to create open standard MSPM knowledge specifications and its logical data model.

Some of the open standards exists in the form of current best practices; some are specific service oriented architecture standards developed and maintained by open standards communities of ICT developers; some do not exist, in which case we used grounded theories of academia to shape their governing design frameworks.

In framing the ontological MSPM methodology, we used:

- The best practice of PMI organizational project management standards (i.e. Project Management Body of Knowledge (PMBOK), Portfolio and Program Management) to describe the processes and structures that constitute the starting basics of MSPM knowledge
- International business theories of macro economic and strategy management as governing frameworks for profiling the multi-risk and product design management functions of multi-site project management. As part of this work, we identified using the open standard - The Open Group Architecture Framework (TOGAF)'s enterprise architecture modeling techniques to govern product design and management in project work.
- Open standard, the Ontological Web Language (OWL) subset - OWL Lite's semantic description standards and grounded Unified Modeling Language (UML) 's entity-relationship conventions to conceptualize the MSPM knowledge specification/s into a logical data model
- Best practice PMI's Organisation Project Management Maturity Model (OPM3) and grounded research theories of qualitative program evaluation to develop evaluation methods for assessing the process and product quality of the MSPM methodology and data model, which also aided in identifying potential improvements in the process and data model design.

The selection criteria of best practices were based on the global coverage of community's membership, comprehensive development lifecycle support and extent of general purposed application.

By prototyping this MSPM ontological methodology through manual execution, we produce the MSPM user requirement specification that followed the formatting guidelines of TOGAF's business scenario modeling technique and a logical MSPM data model that uses UML E-R conventions and OWL Lite's semantic description standards to identify the conceptual entities and relationships of MSPM knowledge.

4.4 The MSPM Data Model

The MSPM data model conceptualized the literature inferred MSPM knowledge into the following concept (data) sets, which we also refer as metadata classes: location, process, service level, risk and role for supporting the knowledge flows of project management resource and activity management.

Each of these metadata classes can refer to, or build upon existing E-R agreements set by communities of specialized industry or functional professions of experts.

We researched and examined emerging and existing E-R models (ontologies) of each of these metadata classes, and customised to define the data entities and relationships that make up each data set.

In evaluating the data model, we used the grounded theories of qualitative program evaluation to devise an evaluation framework in which we compared each of the identified data elements with those of Web Service Architecture (WSA) metadata elements, to qualify degree of cross-reference, hence establishing open standards compatibility (i.e. 72%) and in doing so helps to identify gaps for improving the data model towards 100% open standard compatibility with WSA.

This modeling technique helped to structure a domain ontology of MSPM knowledge into metadata classes, which can refer to and build upon existing metadata sets already developed and maintained by metadata communities. These metadata communities have memberships that are made up of industry experts specializing in certain enterprise and/or ICT functions. Hence, their knowledge contribution and development involvement constitute vital leverage for establishing open standards for creating consistency in the data modeling of MSPM knowledge.

4.5 The Research Case Validation

Developing the MSPM ontological methodology serves the purpose of helping to resolve the many current ills of project management that is caused by lacking explicit MSPM knowledge, methodologies and system tools because project management in Australian practice has matured into a multi-site model.

This also means by executing the MSPM ontological approach, an organisation would be guided to realize, correct or prevent their current issues of project management.

This validation hypothesis was proven in developing and analyzing the case situations of two Australian companies facing many project management challenges and wanting to acquire MSPM competency. We profile the two organisations and their project environments and challenges, and performed a what-if scenario analysis had the two organisations carried out the methodology. The what-if scenarios verified that the MSPM ontological methodology would have given them:

- Higher realization and guided know-how of using existing PMI standards to practice organizational project management,
- Awareness of using TOGAF standards to gain control of their very lacking product design management
- New insights into the issues of intra and inter location macroeconomic risks and issues, and used academia resources to apply grounded theories of macroeconomics and strategy management to frame the governing principles of their multi-site risks and issues management.

The evolving specification of the MSPM data model would have only helped the two enterprises validate their own evolving data models and the underpinning functional scope of their MSPM knowledge management and system support and identify evolving gaps for improving their project knowledge management.

These project management know-how, even in its research and development, would have also helped the two organisations to demarcate project risks from their business risks, so that their project sponsors could have planned business contingency plans to at least minimize containment of the forth coming high risk of project failures as their inexperienced project managers continued to struggle with many and escalating project problems during the research term.

5. Conclusion

Indeed the research findings raise one conclusive awareness that ontological methodology in software development lifecycle phases or whole of model, is a holistic organizational project governance framework that aligns:

- Domain knowledge development inside software development lifecycle management, and
- Software development lifecycle management inside core competency / service development lifecycle management

- Core competency / service development lifecycle management inside business strategy lifecycle management.

In its development, the methodology could have guided the project managers in two Australian cases self improve their proficiencies in organizational project management and enterprise architecture management, which would help to resolve may of their current issues in project management, and take one step further to managing multi-site risks that manifest from macroeconomic differences between location.

In its completion, the MSPM ontological methodology is also a framework that make explicit awareness that conventional project management has matured to a MSPM model, whereby open standards govern the execution of project management, and in doing so creates and sustains consistency in organizational project management, enterprise architecture management and multi-site project risks management.

When these MSPM capabilities are enabled, consistency in knowledge management results and provides a common framework of MSPM knowledge specification and data model that guide organisations to not only complete resolution of current project knowledge management issues in the shorter term, but that also serves as a governing framework for streamlining and integrating longer term lifecycle change planning and management of project management people, process and system capabilities to acquire and sustain MSPM competency.

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