The Relevance of Perspectivism to the Task of Modularisation in Ontology Development

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Abstract

An ontology development methodology seeks to provide developers with established principles, processes, practices, methods and activities for developing ontologies (Gasevic et al., 2009). Diverse methodologies have been published for the development of ontologies, and have evolved, based on the diverse experiences of researchers and practitioners, and the development teams who surveyed the benefits and shortcomings of the available methodologies in order to determine the applicability of methodologies to particular contexts. An evaluation of existing ontology development methodologies has identified that the concept formulation process is not well defined, or based on rigorous processes (Castro et al., 2006; Winters & Tolk, 2009). In order for the validity of the social realism of the actors in a social setting to be captured, the perspectives of each actor needs to be acknowledged and incorporated into the concept formulation process / framework. This paper demonstrates how consideration of perspectivism leads to a meaningful modularisation of the resultant ontology.

Key Words: Perspectivism, ontology development methodology, grounded theory, modularisation of ontologies

INTRODUCTION

The ontology development methodology in this paper adopts a coding process based on grounded theory (Glaser & Strauss, 1967; and Strauss & Corbin, 1997), with term clarification and disambiguation using a reference lexicon, in this case WordNet (Princeton University, 2010). Grounded theory has been proposed as a way of deriving concepts using qualitative analysis, and is applied to the derivation of an ontology using bottom up coding from rich text (Lamp & Milton, 2007; and Urban, 2009, Keen, Milton and Keen, 2012). The objective of the approach is to be informed by appropriate ontological theory, be faithful to the social setting of the target domain, and create a parsimonious ontology. Consequently, we use common-sense realist ontological theory (e.g. Basic Formal Ontology) in identifying and categorizing terms in text that refer to aspects of reality.

This paper demonstrates the relevance of explicit treatment of perspectivism in ontological development that is based on the analysis of natural language. A segment of dialogue is analysed to show the progression from concept identification, through to modularisation, and some form of confirmation of the wellformedness – in terms of clarity and completeness – of the resulting modular ontology.

BACKGROUND

Perspectivism is a fundamental concept in the research and analysis of objects and phenomena. However, it is frequently forgotten, ignored, neglected or not explicitly acknowledged. Nietzsche stated that perspectivity is "the fundamental condition of all life" (Nietzsche, 1886). Nietzsche asserts that interpretation is the application of beliefs about the nature of reality, as viewed through particular perspectives. One of his major contributions to the theory of knowledge can be summarized as:

> Knowledge is always perspectival. Knowledge from no point of view is as incoherent as a notion of seeing from no particular vantage point. The notion of all-inclusive perspective is as incoherent as the concept of seeing an object from every possible vantage point simultaneously. (Nietzsche, 1886).

Confusion can arise in ontological development, due to statements being made from different perspectives without an explicit articulation of the authors' assumptions and point(s) of reference. An example of this predicament is the domain of information and informing. Before discussing this subject, an example of the identification of perspectives will be shown to demonstrate how diverse human observations may be categorised in the development of a domain ontology.

FOUNDATIONS OF CONCEPT FORMULATION

There are five general foundations of the concept formulation method adopted in this research: (1) the use of coding inspired by parts of the grounded theory method, (2) the use of perspectivism to inform the partitioning of reality, as the natural folds in reality, (3) the use of ontological theory to identify ontic terms and to determine top-level category membership, and (4) the use of a lexicon to assist in the disambiguation of terms. (5) cognitive partitioning of reality, based on perspectives, to modularise the resultant ontology. We explore each of these in this section.

GROUNDED THEORY

Developing ontology like "knowledge representation endeavours are always a kind of sociological work" (Ribes & Bowker, 2009). Recognizing this, Kuziemsky (2007) demonstrated the potential of employing grounded theory approaches in ontology development methods. Grounded theory method has been used for ontology development in scientific settings (Lamp & Milton, 2007; and Lamp & Milton, 2008) and earlier in knowledge management (Pidgeon et al., 1991). The grounded theory method assumes a realist stance (Glaser & Strauss, 1967; and Glaser, 1998). However, in social settings some parts of reality (e.g., societal institutions) are often arbitrary, dynamic, and dependent on social recognition (Lomborg & Kirkevold, 2003). The use of grounded theory in ontology development is attractive because of the rigorous way in which codes are linked to, or grounded in, the source text (e.g., interviews). These codes relate directly to concepts, actions and entities in the real world being modelled, and retain a high degree of relevance to the context. The use of Grounded Theory in ontology development methodologies is based on the use of coding families to help identify, interpret and categorise the ontic terms in source text. Ontic terms are those terms that refer to things in reality that are "relating to, of, or having real being" (Webster, 2012). The use of text and its interpretation is consistent with a realist philosophical stance. Specifically, conceptual realism Cocchiarella (2007) links the concepts and terms people use to describe reality with an ontology in a way that is true to a realist stance but is also true to the language used to express concepts and the interpretation that people place on the terms.

Glaser (1998) proposed that data coding in grounded theory be guided by the adoption of coding families of theoretical codes. Further, grounded theory method does not assume that there is only one perspective on reality, but rather recognises that there can be multiple concurrent perspectives. This pluralist approach is useful for conceptualising the world as seen by different individuals and groups of people in a social setting with multiple, diverse perspectives. (Göktürk et al. 2004) support the explicit recognition of perspectives as a means of supporting pluralism, and resolving apparent conflicts between the views of different actors / experts in a domain setting.

PERSPECTIVISM

Perspectivism is the view that all truth is through, from, or within a particular perspective. The perspective may be a general human point of view set by an individual or group of people, which is influenced by culture, history, language (Blackburn, 1996). Multi-perspectivism and concurrent perspectives can also co-exist.

In the emergent process of concept identification and coding and the design of ontological architectures, concepts, relationships and ontological rules can be grouped into modules that reflect different perspectives or interpretations of a social setting. A perspective may be considered to be a limiting awareness of a subset of the real world, which is of specific interest to individuals or sub-groups. The process of modularisation of an (emergent) ontology relies on meaningful selection and definition of modules that are self-consistent, share a common goal or goals, and express the purposes inherent in specific perspectives (Parent & Spaccapietra, 2008). Such modules need to make sense of, and be used by a cohort of users who are/primarily interested in the sub-domain of the specific modules, rather than the whole domain.

Modularisation of an ontology increases its potential for ontological reusability, as these modules would have been accepted as representing distinct, specific functional perspectives. An ontology module represents an agreed conceptualization of a sub-domain of a primary domain (Calvanese et al, 2005). The completeness of ontology modules and the logical relationships between the modules is a common concern of ontology modularisation approaches (Pathak, et al., 2009).

Following the positions of Kant and Nietzsche (Schacht , 1983), perspectivism is relevant to the process of concept formulation, as it is based on the belief that there can be many valid, concurrent ways, or conceptual schemas, through which the world is viewed. While many ontology development methodologies adopt implicit beliefs as to the ontic nature of aspects of the world being modelled, these beliefs are conditioned by the perspectives with which the world is viewed, and by which we construct meaning and communicate about that

world. Indeed, the explicit identification of perspectives taken by participants in the social setting is considered a key contribution of the ontology development methodology in this paper. As such perspectivism is not incompatible with a common-sense realist stance. However, one must be careful to ensure that the various ways in which the world is viewed does not deny or cloud the existence of reality nor deny the existence of social reality.

The researchers adopt a naive realist view (Sayer, 2000), in which the interpretation of real world is conditioned by perspectives of real world objects and phenomena, gained through experience, including language. From this viewpoint objects and phenomena are accepted for what they are, in terms of matter, occupying space, and other physical attributes, and for being generated by social interactions between people. This viewpoint is consistent with the interpretative basis of Ground Theory (Glaser & Strauss, 1967).

Acknowledging multiple perspectives on reality is compatible with common-sense realism which

> draws a systematic distinction between reality and appearance, or in other words between the way the world is and the way the world seems or appears via one or other of the sensory modalities and from the perspective of one or other perceiving subject in one or other context. The thesis that there is only one world towards which natural cognition relates must thus be understood as being compatible with the thesis that there are many different ways in which the world can appear to human subjects in different sorts of circumstances. (Smith, 1995).

Thus, using grounded theory to guide concept formulation is also consistent with the epistemic foundations of common-sense realism (Dancy & Sosa, 1992).

The actors' abilities to adopt multiple perspectives concurrently affects their abilities to employ holistic views of the target domain, to use common/standardised terminology and determine action plans with multiple actors. Recognition of the roles of the actors, perspectives and their pluralistic awareness of the context, the interactions and networks of relationships, are key to the ontology concept formulation process, as presented in this paper. This approach leads to modularisation of ontologies that are aligned with the adopted roles of the actors in the social setting.

The scope of the present study is restricted to a case study of a social setting in the area of community event management. The results may be extended by naturalistic generalisation to a wider range of applications, but such claims are not warranted by the authors.

COGNITIVE PARTITIONING OF REALITY

Perspectivism has been identified as a key to effective cognitive partitioning and concept aggregation, a recognised approach to divide up, sort, or map reality (Smith & Bittner, 2001).

Mereology deals with the nature of part-wholeness in the partitioning of concepts of reality. The partitioning of reality into sets of things, classifications, taxonomies and hierarchies is a fundamental human activity that is based on perceived sameness between individuals (Smith & Bittner, 2001). It is a fundamental process in ontology development in the formulation of classes, abstraction of concepts from consideration of the attributes of individuals, and in the modularisation of ontologies.

We consider notions of wellformedness for classes or partitions of concepts and relationships in ontologies, along the following dimensions, based on Bittner & Smith (2001):
   a) The degree of correspondence between partitioning of concepts and attribution of these concepts to individuals in reality. This reflects the degree of cohesion of the partitioning scheme;
   b) The degree to which a partitioning of concepts reflects the perceived mereological structure of the slice of reality onto which it is projected. This reflects the degree of conformance of the partitioning scheme with mereological perceptions of reality.
   c) The degree of completeness and exhaustiveness of the partitioning. This reflects the degree to which the partitioning scheme is sufficient to cover all relevant concepts and individuals within the application domain.

We hold that that the construction of a valid domain ontology requires a social realism stance (Jureta et al., 2008), in which concepts or cognitive artefacts are grounded in speech acts that accurately represent the intentions and perspectives of each actor in the target social domain and collectively the social processes in which they participate. This requires a rigorous approach in the conceptualisation phase of ontology development, as abstract concepts are clarified, disambiguated and abstracted from natural language sources

Roles of actors do not define the perspectives of the actor, but rather highlight the actor's existing knowledge and their intents underlying their interactions and interpretations, within the context of the meetings, discussions and documents gathered in each case study.

TOURISM EVENT MANAGEMENT

In tourism event management, the identified perspectives are closely related to the dimensions of the management tasks confirmed by Getz (2008). To create an abstract ontological structure from the social process, the use of perspectives and a social realism stance are considered essential.

Across the event management literature there has been recognition from a number of authors that there is need to present the complexity of this domain from multiple perspectives. Getz (1997) model of special events referred to six key perspectives and the inter-relationships associated with special events (Environment, Sponsor and Partner, Community, Customer, Economy, Organiser / Goals). This model prompted Jago (1997) to recognise -the need to refine the perspectives, elements and relationships of service and governance. In (2008) a literature review was conducted on tourism event management and 'A framework for understanding and creating knowledge about event tourism' was developed by (Getz) which highlighted varied interpretations and dimensions of event management. Evaluation of multiple interpretations of event management perspectivism created an awareness of the potential perspectives which may frame the ontological structure of this complex and social process driven domain. Observation of dialogue and interactions gathered in this study also informed and evolved this categorisation.

ILLUSTRATION OF THE METHOD

To illustrate the foundations of the method foundations and to review the application of the dimensions of Bittner & Smith (2001), this section is divided according to the stages of the method, and describes the purpose of each stage, the desired outcome, the procedure of each stage, an illustration of the coding process of the stage and most importantly reflections on the contribution of each stage to achieve a grounded concept formulation process.

This section presents text from recordings of meetings for a voluntary community management committee. The committee is responsible for managing a community cultural festival. The management meetings provide a rich source of text for concept formulation because of the social processes described in the meetings (e.g. the training of volunteers at the festival itself). The committee brings a broad range of skills and knowledge, and there has been a relatively high turn-over of members over the past twelve months, which is a common concern in volunteer association where there is a single focus (Smith, 1994).

Stage 1: Identification and Classification of Ontic Terms and the classification of General Concepts.

Purpose: To identify the ontic terms under discussion in the text, and to classify them into general ontological categories. In this sense the ontological theory is used as a coding family. This stage feeds into the next stage which is close to open coding in grounded theory.

Limited interpretation is adopted in this stage. Ontic terms and related general terms are coded, with concepts clearly presented using argumentation and association derived from the text. No contextual interpretation or social analysis is undertaken.

Outcome: The outcome is a list of candidate terms for further refinement. The outcome of stage 1 is a selection of relevant terms derived from the text, classified as plain facts, so they exist', 'there is,' 'real', and 'nonfictional', as they occur in sentences. No interpretation is performed to identify ontic terms. General concepts are interpreted or disambiguated terms as derived from interpretation or understanding the context of the sentence.

Procedure: Parts of speech that refer to things in the world are identified in the text and are classified according to a general common-sense realist ontology. The categories in the ontology are: event (including process), individuals, substances, and attributes of events and individuals. The ontological coding family helps in disambiguation by clarifying the types of terms in the text, identified as Ontic or General Concept.

Illustration:

The coded terms are illustrated in brackets and are classified as Ontic or General Concepts (GC).

Speaker 1: Ah now this is a question [Ontic: question] that came though on the email [GC: communication], I think I can word [GC: terminology] it to you [GC: collective individuals] from the email [GC: document

reference] from Susie [GC: Non-committee member; GC: Individual] about the middle pub [Ontic: venue].. I think she [GC: individual] is reluctant [GC: Issue] to put sound equipment [Ontic: equipment, GC: Production equipment] in there [Ontic: venue, Ontic: location].

Speaker 2: We've [GC: collective individuals] got to sort this out [resolve issue] because we can't afford [GC: time management concern] to lose a venue [Ontic: venue], it was really hard to fit everything in this year [GC: Past, GC: Program Scheduling, GC: Acts], and we can always shrink [GC: Resource and Experience reduction] the festival again [GC: organisational structure], you know that's the other option [GC: alternative], go back to a smaller festival and have to turn ticket holders away [GC: financial impact].

One of the reasons why I'd be reluctant [GC: Reasoning, GC: Choice of acts] to have it as like a free venue [Ontic: venue, GC: marketing, GC: Strategy], and just put on the new emerging and more amateurish acts [GC: Program mix, GC: act type] there is because part of the whole idea of getting a lot more of those acts in [GC: Program structuring, GC: Strategy] was to bring families down [GC: Marketing, GC: Incentive] to *Town Name* who would then buy tickets to see and [GC: relation GC: financial impact] [Speaker 1: That worked]

Speaker 3: I think it worked [GC: success], we never really know [GC: uncertainty] whether these things work [GC: Success] but I think that was one of the factors [Ontic: Factor, GC: Criteria] that got a lot more people along [GC: Marketing, GC: Attend].

Speaker 4: So we've talked about the organisation [management process] touching, on the venues [Ontic: Venue, GC: Resource], um Green room [Ontic: Venue] at St James [GC: Business Partner], just saying that's where the volunteers will be located [Ontic: Location, Ontic: Volunteer, Ontic: Organisation, GC: HR management, GC: Resource Access, GC: Resource deployment].

Reflection: the terms identified in this stage give a classification of the terms in the dialogue. It is initially believed that three of the four identified perspectives are concurrently represented in this fragment of text.

Stage 2: Reference to the context to clarify terms

Purpose: To abstract from the specific terms identified in Stage 1 to more general interpreted terms. This stage is close to the open coding in grounded theory, in which the coder aims to "generate an emergent set of categories and their properties which fit, work and are relevant for integrating into a theory" (Glaser, 1978). The unit of analysis at this stage is the sentence.

Outcome: Terms that capture interpretations which are reasonable common sense refinements of the initial terms in reference to the context of the text.

Procedure: The coder reflects on the terms, and interprets from the fragment of text at the sentence level.

Illustration:

Speaker 1: Ah now this is a question that came though on the email, I think I can word it to you from the email from Susie about the middle pub, and I think she is reluctant to put sound equipment in there, [GC: Query, Management issue, Production Concern].

Speaker 2: We've got to sort this out because we can't afford to lose a venue, it was really hard to fit everything in this year, and we can always shrink the festival again, you know that's the other option, go back to a smaller festival and have to turn ticket holders away. [GC: Programming and Scheduling, Choice of Act, Customer Experience, Financial Impact, Event]

One of the reasons why I'd be reluctant to have it as like a free venue, and just put on the new emerging and more amateurish acts there, is because part of the whole idea of getting a lot more of those acts in was to bring families down to *Town Name* who would then buy tickets to see and … [GC: Marketing, Act type, Incentive, Customer type, Financial impact] [Speaker 1: That worked]

Speaker 3: I think it worked, we never really know whether these things work but I think that was one of the factors that got a lot more people along, [GC: Marketing, Factor, Success, Unknown]

Speaker 4: So we've talked about the organisation, touching on the venues, um Green room at St James, just saying that's where the volunteers will be located. [GC: Business Partner, Management Process, Human Resources, Resources, Resource Deployment]

Reflection: The coder uses their knowledge of the text and its context to classify the terms under study with the support of a reference lexicon. This stage is common to open coding as the coder abstracts general codes from the text, using a level of interpretation that is based at the unit of analysis. The terms identified in the text are abstracted to determine general interpreted concepts. The interpreted messages are also identified based on an

understanding of the context of the dialogue as presented by the contextual relationships between ontic and general concepts.

Key interpretations have been identified, based on the messages present in each sentence and the key terms identified in stage 1. The coder has identified abstract terms, which represent the contextual ideas addressed by the speakers as represented in a sentence.

Stage 3: Disambiguation with the support of a reference lexicon.

Purpose: To clarify and disambiguate the terms found in stages 1, using the abstract, context appropriate terms interpreted in stage 2, with the appropriate definitions and related terms presented in the lexicon.

Procedure: Terms identified in stage 1 with the interpretation of the text from stage 2 are used in conjunction with the lexicon WordNet in three ways:
1. To define and disambiguate the terms by selecting one more appropriate definitions for each term.
2. To confirm the ontological categories in which the term is located, using the hypernyms structure.
3. To identify ontic relationships, based on the meronymic structure – member of, part of, substance of etc.

Stage 3 is key to the clarification of terms from the text in stage 1, and development of ontological, abstract terms. The benefit of using a lexicon, such as WordNet, is the use of concept definitions and associated hyponyms that are relevant to the context of the language being coded.

Outcome: a list of disambiguated candidate terms, plus hypernym and meronym relationships for these terms.

Illustration:

Speaker 1: Ah now this is a question that came though on the email, I think I can word it to you from the email from Susie about the middle pub, and I think she is reluctant to put sound equipment in there [GC: Query, Management issue, Business Partner, Production Concern].

Speaker 2: We've got to sort this out because we can't afford to lose a venue, it was really hard to fit everything in this year, and we can always shrink the festival again, you know that's the other option, go back to a smaller festival and have to turn ticket holders away. [GC: Programming and Scheduling, Choice of Act, Customer Experience, Financial Impact, Event]

In this example, clarification of "Scheduling" as an event or an individual is important. A relevant definition is:

Scheduling (noun) – setting an order and time for planned events (WordNet reference #101144355).

The hypernym structure is: Event > Act > Activity > Preparation > Planning > Scheduling.

 The act of "Scheduling" could be a process which evaluates and aims to balance, time, resources, customer experience and marketing attraction. Although not in WordNet, the process by which archiving is achieved could be defined as:

Process: A particular cause of action intended to achieve a result (WordNet reference # 101023820) Hypernym structure: Event > Act > Activity > Procedure > Process.

WordNet is relatively weak in recording meronymic (part-whole) relations. For example "We've" in the extract above refers to the individual "Management Committee," with parts comprising each member of the committee.

Reflection: Stage 3 has been identified as key to the disambiguation and interpretation processes from the natural language stage 1 to ontological, abstract terms. The use of the WordNet lexicon expands the coder's awareness of possible relevant definitions, and identifies common hypernym relationships, so that disambiguation is based on the definition of terms and their locations in the hypernym hierarchy.

It is believed that Stage 3 contributes to the process of ontology modularity, as it identities correspondence or logical connection between concepts in reality and the framing of perspectives the bases of cognitive partitioning, (Smith and Bittner, 2001) Objective (a).

Stage 4: Identifying ontological relationships

Purpose: to identify and define ontological relationships emerging from the analysis of the text, refinement and reflection is made by the coder. The meronym relations from Stage 3, considering general ontological theory (e.g., Chisholm's ontology (1996)) are viewed as relations part-whole or sub-class relations, generalizable from natural language. A limited number of whole some relations can be extracted from this text as the natural language context is not absolute.

The association of concepts in relationships assist in the identification and clarification of perspectives adopted by the speaker in the text being analysed. Attributes are identified as contributing to an understanding and modelling of the social process, event or individual.

Outcome: a list of ontological relations, derived from the text, based on Spradley's ethnographic relations (Spradley, 1979). An ontological model which incorporates the ethnographic relationships, provides a visual semantic model, and highlights the concepts that may be absent from the model.

Procedure: the coder reflects and interprets what ontological relations are present in the text, and how to model the structure of ethnographic relationships relevant to the domain.

Illustration: Speaker 1: Ah now this is a question that came though on the email, I think I can word it to you from the email from Susie about the middle pub, and I think she is reluctant to put sound equipment in there [GC: Query, Management issue, Business Partner, Venue, Production Concern].

Speaker 2: We've got to sort this out because we can't afford to lose a venue, it was really hard to fit everything in this year, and we can always shrink the festival again, you know that's the other option, go back to a smaller festival and have to turn ticket holders away. [GC: Programming and Scheduling, Choice of Act, Venue, Customer, Experience, Financial Impact, Event] One of the reasons why I'd be reluctant to have it as like a free venue, and just put on the new emerging and more amateurish acts there, is because part of the whole idea of getting a lot more of those acts in was to bring families down to *Town Name* who would then buy tickets to see and [Speaker 1: That worked] [GC: Marketing, Act type, Incentive, Customer type, Financial impact].

Speaker 3: I think it worked, we never really know whether these things work but I think that was one of the factors that got a lot more people along, [GC: Marketing, Factor, Success, Unknown]

Speaker 4: So we've talked about the organisation, touching on the venues, um Green room at St James, just saying that's where the volunteers will be located. [GC: Business Partner, Management Process, Human Resources, Resources, Resource Deployment].

The above text provides examples of relationships:
• Venue – is located in – Town (ontic relationship)
• Business partners – provide – Venues (general concept relationship).
• Choice of acts – affects – Customer experience (general concept relationship)
• Acts – are scheduled – at Venues, in Time (general concept relationship).

Reflection: Once a list of ontological concepts are identified, the ontic and general concept relationships are identified. This stage captures the semantic richness of the ontological schema.

Stage 4 is believed to define the partitioning and mereological structure by the forming of general and ontological relations of the domain and the projected ontological relationships (Smith and Bitter, 2001) Objective (b).

> Stage 5: Interpreting perspectives from the text

Purpose: to look beyond the text to the context, and seek to interpret the perspectives taken by the speakers. This stage will reduce the number of candidate terms already found and provide insight into the intentional stance of the speaker and occurrences of pluralism of perspectives. Consideration of the context of the text and clarification of perspectives occurs at the paragraph level.

Outcome: assignment of perspectives to the speakers in the fragments of text being analysed.

Procedure: the coder reflects and interprets the perspective(s) the speaker has assumed in the sentence.

Illustration:
Speaker 1: Ah now this is a question that came though on the email, I think I can word it to you from the email from Susie about the middle pub, and I think she is reluctant to put sound equipment in there [Planning / Resource, Management].

Speaker 2: We've got to sort this out because we can't afford to lose a venue, it was really hard to fit everything in this year, and we can always shrink the festival again, you know that's the other option, go back to a smaller festival and have to turn ticket holders away [Service, Experience, Planning / Resource]. One of the reasons why I'd be reluctant to have it as like a free venue, and just put on the new emerging and more amateurish acts there, is because part of the whole idea of getting a lot more of those acts in, was to bring families down to *Town Name* who would then buy tickets to see and [Speaker 1: That worked] [Service, Experience].

Speaker 3: I think it worked, we never really know whether these things work but I think that was one of the factors that got a lot more people along, [Experience]

Speaker 4: So we've talked about the organisation, touching on the venues, um Green room at St James, just saying that's where the volunteers will be located. [Planning / Resource]

Reflection: It is evident in the coding of committee meetings that committee members adopt multiple concurrent perspectives, based on the context, intentions and stances adopted in discussions. The changes in perspectives frequently coincide with topic shifts. The identification of perspectives were not performed by the coder in the initial stages as it may have clouded the coding process, but rather builds on the outcomes of stages 1 to 3. Coding of multiple committee meetings and individual interviews indicate that speakers commonly adopt up to three concurrent perspectives. These perspectives determine social interactions and the forming of sub-groups. Based on individual knowledge and experience, it is common for individuals in a sub-group to adopt a common perspective. Modularity of this domain is proposed to naturally align with identified perspectives and the speakers' interpretations of the domain.

Stage 6: Refining the Ontology

The ontology is achieved by successively refining the list of terms, the definitions of terms, the ontological relations between terms, and the ontological hierarchy of terms up to the most general categories of individual, event, and attribute and to identify the completeness and exhaustiveness of the ontology modules.

The refinement of the ontology, Stage 6, is believed to addresses the objectives of (Bittner and Smith, 2001) partitioning of reality, Objective (b) and (c).

(b) Degree of how well a partition represents the mereological structure of the domain it is projected onto; and (c) degree of completeness and exhaustiveness.

Object (b) is addressed through examination, review and evaluation of the hypernym structures associated with the identified concepts, and considering the questions:
- What mereological, or part-whole structures are apparent in the resulting ontology? This analysis needs to be conducted at the higher levels of abstraction of the hypernym hierarchy in the ontology.
- Does the modular partitioning of the ontology reflect and meaningfully support this merological structuring?

In a similar approach to modular decomposition in software engineering, one would expect a well-formed merological structure to exhibit a high degree of relationship cohesion within partitions, and a low degree of coupling of relationships between partitions.

RELEVANCE OF PERSPECTIVISM IN THE METHODOLOGY

The identification of perspective shifts in the dialogue being analysed is a valuable tool in discerning the mereological structures present in the domain. Participants naturally use language that exhibits high degrees of cohesion within a particular perspective, and relatively low degrees of cohesion between episodes of apparent disjoint perspectives. For example, in the dialogue [resented in Stage 5 above, the speakers are apparently using different perspectives, and there is a low degree of coupling between the concept bases used by Speaker 1 and Speaker 2.

This analysis becomes more difficult when the participants are apparently using multiple perspectives concurrent, or when the perspective(s) being adopted by the participant speaker(s) are not readily apparent from the terms and concepts in their language. In practice, such periods often correspond to transitional phases between distinct perspectives, and phases in which the participants are not clearly addressing topics with which they are obvious familiar. For example, in the dialogue in Phase 5 above, Speaker 2 is ranging across a broad range of topics (Service, Experience, Planning / Resource) using relatively short and definite statements. These statements are intended to be authoritative, rather than analytic.

Object (c) is addressed through seeking to saturate the analysis by exhaustive analysis of the dialogues between the participants, and other sources of documentary language. Consideration of the degree of clustering of concepts present in the emergent ontology also gives a guide as to the extent of coverage of relevant concepts, and leads to re-examination and further analysis of the dialogue and language sources for further evidence of ontological constructs.

Given the grounded nature of this ontology development methodology, the extent of completeness and exhaustiveness of the ontological analysis is dependent on the richness of the sources of the dialogue, and documentary material available for analysis. While, it is believed that measures of completeness and exhaustiveness of emergent ontology are undecidable in an absolute sense, they are meaningful with regard to the analysis of a finite source of material.

Consideration of modular ontologies and their comparison with other existent, reference ontologies also provide a source of information for consideration of the issues of completeness and exhaustiveness. For example, an emergent modular ontology that deals with planning and resource management may be compared with a project management ontology, in order to highlight conceptual areas which may not have been covered by the participants, or were not identified and analysed by the ontology developer. In the latter case, this may lead to a re-examination and analysis of the relevant source material.

DISCUSSON OF METHOD AUTOMATION AND SCALABILITY

This method is performed in an iterative process, which encourages reflection, the use of an iterative or non-sequential coding processes, review of perspectives, and of consistency with the social context. Reference to existing documentation of the social context, and reference to a lexicon facilitates interpretation, clarification and disambiguation of terms. To interpret semantic relationships between terms, Spradley's (1979) ethnographic analysis provides the classes of relationships by which concepts are related, within the identified perspective(s).

Modularization is one of the techniques that bear good premise of effective help towards scalability in ontology design, use, and management. Currently modularization in ontologies is an immature area (Shengda et, al. 2010).

Structure-based ontology module extraction (Seidenberg et. Al, 2009) is usually guided by a particular problem-context that leads to the selection, adaptation, reconciliation, or merging of concepts from multiple extracted ontology modules (Ezunat, et, al 2007). However, the challenge is to ensure that a merged ontology module does not lead to:
  (i)   differences in domain conceptualization,
  (ii) logical contradictions, and
  (iii) inaccurate realizations of the concepts and their roles as per context,

It is important that the extracted ontology modules are semantically consistent.

The approach in this paper has implications for modularization of ontologies by perspectivism. The coding method, when adopting industry perspectives during the axial coding process, has identified the existence of pluralism in the discourse and between perspectives leading to effective modularization. The recognition of perspectives emphasizes the importance of context in the coding and concept formulation processes. The intentional stance of participants is made apparent through documentation of the perspectives and their roles in the concept formulation method. The perspectives form part of the meta-data underpinning the resulting ontology, and suggest potential generalization of this approach to a wider range of ontology development methodologies.

Event management is a complex social process with concurrent interactions and interpretations. As Hois et al., identified in (2009) the challenge of building complex ontologies for such domains requires a modular approach. Such modules need to be meaningful, self-consistent and of relevance to specific cohorts of users. The adoption of perspectives is an approach by which these objectives of modularisation may be achieved, using bottom-up coding approach to ontology formulation. Indeed, the semantic approach (Parent & Spaccapietra, 2008) to ontology modularisation based on identified perspectives, adopted by the speakers would seem to be a promising way forward.

However, the interoperability of modular ontologies built from identified perspectives remains an open issue. While there is considerable work in addressing the technical issues of interoperability of modular onotologies Stuckenschmidt et al., (2009), the issues of semantic and organisational interoperability associated with such modular ontologies need to be addressed. While perspectivism cannot resolve such interoperability, it does provide a formal basis for the definition and dimensionalisation of ontologies.

REVIEW OF METHODOLOGY

The application of this ontology development methodology has demonstrated how the process of concept formulation may be applied in a complex social setting, based on natural language transcripts and other documentary material. Concepts have been identified and relationships developed, using the perspectives of the

speakers and their roles to categorize the concepts and modularise the resulting ontology. Perspectives provide a natural segmentation or "folding" of the slice of reality gained from the dialogue of the participants and the appropriate frame of naturally constructive modularity.

A key warrant of this research is that the segmentation of dialogue, based on perspectival analysis, yields a "natural" modularisation of the resultant ontology, that specifically addresses the objectives (a) and (b), proposed by Bittner & Smith (2001) for meaningfully partitioning reality. The fundamental process in this segmentation is for the analyst to focus on the perspectivism when analysing the source language, so that the perspectives being adopted by the participant speakers becomes apparent. Using this approach, Stages 1-4 yields a partitioning of the source language according to the apparent perspectives adopted by the participant speakers, considering objective (a) Bittner and Smith (2001) while Stage 5 and 6 requires the analyst to specifically consider objectives (b) and (c) of Bittner & Smith (2001) when reviewing the resultant ontology and its modular structure.

FUTURE RESEARCH AND EXTENSIONS

Future work will involve the validation of the ontological outcomes of this case study, with other event management experts within a wider context and across a wider range of case studies. The interoperability of modular domain ontologies, based on the interpretation of perspectives, requires further exploration and refinement.

Comparative analysis of the outcomes of this ontological development methodology with the outcomes of other approaches to ontological modularisation would also yield further insights into the effectiveness and potential for generalisation of the current approach.

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