Advanced Semantic Business Process Analysis: Combining Knowledge Engineering and Complex Event Processing

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Acknowledgements

- Dong Liu, John Domingue and Enrico Motta (OU)
- Ana Karla Alves de Medeiros, Wil van der Aalst (TUE)
- Ivan Markovic (SAP)
- Lucesar Cekov (Ontotext)
- Michael Oppitz, Gernot Zeissler (IBIS)
- SUPER Project
Overview

• Business Process Analysis in Context
• Semantics for Data Integration and Analysis
• Semantics for Generic BPA Components
• Lessons Learnt
• Concluding remarks
Business Process Analysis

- "In which of our food manufacturing machines are we processing meat or raw eggs?"
- "How many inventory management methods are currently in use?"
- "Do we have a cost approval process for items below $200?"

Mining
Monitoring
Reverse-Engineering
Traditional Business Process Analysis

Manual & custom-tailored setup
Requires expensive adaptation for
- Changes on the underlying systems
- Changes on the objectives/goals
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... IMPROVING DATA MANAGEMENT WITH SEMANTIC TECHNOLOGIES ...
Data Integration: Use Semantics

- integrating views over data
- enhanced querying support
- automated derivation of knowledge
COBRA Ontology

- Extensible along specific domains
- Providing a basic upper-level ontology for the development of generic software
Assertion and reasoning about time
Based on Allen’s algebra
Extended with some additional convenient relationships
...AND FURTHER
ONTOLOGIES
Capturing events within BPM systems

...AND FURTHER ONTOLOGIES
Capturing events within BPM systems
Definition and computation of metrics

...AND FURTHER ONTOLOGIES
...AND FURTHER
ONTIOLOGIES

Capturing events within BPM systems
Definition and computation of metrics
Goal-driven metrics
...AND FURTHER ONTOLOGIES

Capturing events within BPM systems
Definition and computation of metrics
Goal-driven metrics
Strategic analysis
Semantic Data Warehouse

Continuously populated
Incremental reasoning and knowledge derivation in generic terms for its analysis and decision making
Traditional Business Process Analysis

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... PROVIDING GENERIC AND SMARTER ANALYSIS ENGINES WITH SEMANTIC TECHNOLOGIES ...
“Problem-solving methods describe [this] control knowledge independently from the application domain thus enabling reuse of this knowledge for different domains and applications. It describes which reasoning steps and which types of knowledge are needed to perform a task”

(Fensel & Benjamins, 1998)
Problem-Solving Methods

- Effort was devoted to covering concrete tasks (configuration, diagnosis, etc)
- Creation of a library of PSMs
- Creation of frameworks and methods for their definition and development, e.g., CommonKADS, UPML, TMDA
Application of PSMs principles
Based on the use of task-specific ontologies
Anchored on COBRA as integration point
Generic SBPA Tooling
Generic SBPA Tooling

Enhanced mining algorithms
Enhanced conformance checking
Generic SBPA Tooling

Enhanced mining algorithms
Enhanced conformance checking
Enhanced reverse business engineering
Generic SBPA Tooling

Enhanced mining algorithms
Enhanced conformance checking
Enhanced reverse business engineering
Enhanced monitoring
... A RETROSPECTIVE VIEW ...
Ontology Engineering

• Integration is based on comprehensive and expensive ontology engineering

• Considerable solutions available (TOVE, SUPER, etc)

• Although many of those solutions disregarded the operational aspect

• Convergence and establishment of some core models is necessary
Knowledge Representation

• The framework and technologies adopted has a fundamental impact
• Expressivity
• Processing Time
• Scalability
• Maturity
Data Integration

- Systems adaptation has to be gradual
- Wrappers over existing formats
- Views over existing DBs
- Knowledge needs to be embedded in the core in many cases
  - Adaptation of engines, e.g., BPEL engine
Lessons Learnt

• Plain RDF(S) (with some bits of OWL) is expressive and scalable enough for enterprise data integration
  ‣ Linked Data principles and technologies are a good option

• Procedural knowledge needs to be captured and this is beyond “just” rules
Lessons Learnt

• Reasoning is expensive
  ‣ Fine tuning when/how it takes place is essential: most of it “at night”

• Efficient queries over distributed datasets is challenging as of now
  ‣ Minimise joins across datasets
  ‣ Tradeoff between localisation and scalability
Monitoring vs Analysis

- Monitoring is a kind of BPA but in reality very different from the rest
- Decisions need to be real-time
- Little reasoning can take place
- Decisions are limited to a time window using background knowledge
Real Time vs Batch Analysis

- Real time and batch processing are complementary and this should be exploited
- Computations done in real-time can be avoided in batch processing
  - Summarisation & incremental processing
  - Results from batch processing should be compiled into actions for real-time
    - Rules, decision trees, etc
CEP AND SBPA

- Monitoring is often approached as CEP
- Objects detected are often of a transient nature
- From a holistic perspective CEP should be approached in an integrated BPA framework as both knowledge acquisition and situation detection
SENTINEL

Semantic Business Process Monitoring tool
Integrating
- PSMs for execution analysis
- CEP for stream processing
SENTINEL

Semantic Business Process Monitoring tool
Integrating
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SENTINEL IN CONTEXT

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Sunday, 29 May 2011
... Conclusions
Conclusions

- Semantic technologies can be highly beneficial within the BPM domain, notably in BPA
- Their exploitation isn’t without challenges and requires combining a number of techniques (ontologies, rules, machine learning, etc)
- Performance is still a limiting factor
Conclusions

• BPM is gradually moving from rigid solutions towards more flexible options where semantics can pay more

• Preexisting idiosyncrasy is however a very strong opposing force
  ‣ See reluctance to Declarative Workflows
Thanks for your attention