Towards the Verification of Business Process Modeling

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Presentation Summary

Management of Business Process has come out as a set of technologies aimed at supporting the execution of the *business logic* by means of modern business best practices [1], which include *Workflow Management Systems* (WFMS) for workflow execution and monitoring. To attain this, any organization should previously obtain, as result of the Business Process Modelling (BPM), the complete definition of the set of its[5] *business processes* (BPs), i.e., the set of 'different ways' by which companies conduct its (business) objectives or *user goals*. Nevertheless, BPM is a "non engineered" activity up to now, since there's still a lack of maturity of current methods and languages in BPTM, especially a lack of soundness and semantics richness. No formal definition of any logics exists up until now to describe the set of activities needed to achieve the user goals [2].

Business Process Modelling Notation (BPMN) [3] has become the "de facto" standard graphical notation for BPM, which describes processes in terms of order dependencies between subprocesses and atomic tasks. In a short time, BPMN has been supported by a variety of BPM tools [3], and thus companies start using it as a standard modeling technique. Existing verification tools cannot be directly applied to BPMN models, in spite of performing verification and validation of BPs is very important to improve their quality. BPMN is a graphical semi-formal notation different from the formal languages required by most existing verification tools, such as *SMV*, *Design/CPN*, *Uppaal*, *Kronos*, *HyTech*, *FDR*2, etc. which operate on models based on Petri nets or Process Algebras.

In the literature we can find different directions regarding the verification and validation of a BP. There are formal methods for verifying BPD (Business Process Diagram) based on Π-calculus [4] or Petri Nets [5], tools which can debug syntactical errors in a BPD by transforming these diagrams into BPEL [6][7], and techniques for showing consistency of BPs written in *Business Process Execution Language for Web Services* (BPEL4WS) [8] based on Model-Checking (MC) [9]. In [8] an extended survey of existing proposals of BPD verification techniques is presented. Nevertheless, none of cited works combine modeling of BPs with analysis/design of BPTMs and verification techniques. Then, and differently from other research work, our approach is aimed at giving a systemic, integrated vision of analysis, design and verification tasks of BPs by promoting the use of MC tools within the BPTM

development cycle. The idea of obtaining a directly executable model from a BP conceptual has led us to propose a software framework, called *Formal Compositional Verification Approach* (FCVA). With our FCVA, the BPTMs *correctness* can be *model-checked* for supporting temporal BP properties analysis and verification. We propose the construction of a BPTM (i.e., a executable model of the BP) with *Timed-Automata* (TA) semantics for modeling BPMN notational elements according to the specification defined in [3]. Behavioural aspects and temporal constraints in a BPTM are specified by using a *Timed-Automata Network* (TAN) as we will show in the through a case study discussion.

This presentation will shortly describe the theoretical background (i.e., Kripke structures and *Clocked Computation Tree Logic* –CCTL-) that supports our approach. Then, we discuss the concepts related with modeling, specifying and verifying BPTMs and we give a brief description of BPMN. Afterwards, we present our definition of the TA semantics for some BPMN notational elements and our proposal in detail. Finally, we apply the scheme to a BPM case study related to the CRM business. The last section gives a conclusion and discusses future work. A brief list of references follows.

References

1. Workflow Management Coallition Standard - Terminology and Glossary Issue 3.0. WfMC (1999), url = {http://www.wfmc.org/standards/docs/TC-1011_term_glossary_v3.pdf.
2. H. Eshuis. Semantics and Verification of UML Activity Diagrams for Workflow Modelling, PhD Thesis (2002), University of Twente, Enschede, The Netherlands.
3. OMG. Business Process Modeling Notation -- version 1.1 (2008). Object Management Group, Mass., USA. url = {http://www.omg.org/spec/BPMN/1.1/PDF}
4. S. Ma and L. Zhang and J. He. Towards Formalization and Verification of Unified Business Process Model Based on Pi Calculus. *Proc. ACIS International Conference on Software Engineering Research, Management and Applications* (2008), **1**, 93-101, IEEE Computer Society, Los Alamitos, USA.
5. W.M.P. Aalst. Making Work Flow: On the Application of Petri Nets to Business Process Management. *Lecture Notes in Computer Science 2360: Application and Theory of Petri Nets* (2002), 1-12, Springer--Verlag, Heidelberg-Berlin.
6. Intalio. *Intalio Designer 5.2*.(2008), http://www.intalio.com/
7. ITP Commerce. Process Modeler for Microsoft Visio (2008). http://www.itp-commerce.com/
8. OASIS. Web Services Business Process Execution Language Version 2.0. *OASIS Open* (2007), Billerica, USA, url={http://docs.oasis-open.org/wsbpel/2.0/wsbpel-v2.0.pdf
9. G. Díaz and J.-J. Pardo and M.-E. Cambronero and V. Valero and F. Cuartero. Automatic Translation of WS--CDL Choreographies to Timed Automata. *Lecture Notes in Computer Science 3670: Formal Techniques for Computer Systems and Business Processes* (2005), 230-242. Springer--Verlag, Heidelberg-Berlin.
10. L. E. Mendoza, M. I. Capel. Automatic Compositional Verification of Business Processes. *Lecture Notes in Business Information Processing. J. Filipe and J. Cordeiro Eds.: ICEIS 2009* , **24**, 479-490, Springer-Verlag, Berlin-Heidelberg.
11. L. E. Mendoza, M. I. Capel, M. Pérez, y K. Benghazi. Compositional Model-Checking Verification of Critical Systems. *Enterprise Information Systems (EIS) X " (Lecture Notes in*

Business Information Processing-ICEIS 2008 revised selected papers)(Eds.:J. Filipe and J. Cordeiro (Eds.J. Filipe and J. Cordeiro).
12. M. I. Capel Tuñón, L. E. Mendoza Morales, and K. Benghazi Akhlaki. Automatic verification of business process integrity. *International Journal Simulation and Process Modelling* (2008)*,* **4 (3/4)**, 167-182, Inderscience ISSN: 1740-2123, Geneve.
13. L. E. Mendoza Morales, M. I. Capel Tuñón y K. Benghazi Akhlaki. Checking Behavioural Consistency of UML-RT Models Through Trace-based Semantics. *9th International Conference on Enterprise Information Systems (ICEIS 2007)*, 205- 211, INSTICC, Portugal.
14. K.Benghazi Ahklaki, M.I. Capel Tuñón, J.A.Holgado Terriza, L.E. Mendoza Morales. A methodological approach to the formal specification of real-time systems by transformation of UML-RT design models. Journal Science Of Computer Programming (2007), 65, 41-56

Brief Biography

Manuel I. Capel-Tuñón is Full Professor of Computer Science at the Universidad de Granada– Granada (Spain) where he teaches Concurrent Programming and Real-time Systems and received the title of Ph.D. in CS in 1992. He leads the research group "Concurrent Systems" that counts with more than 100 publications on Formal Methods (Temporal Logics and Process Algebras) applied to the systematic development of embedded real-time systems.

His research interests are currently focused in the isomorphism between the formal modeling of real-time systems and soft systems, such as social and biological systems. Dr. Capel-Tuñón has recently proposed a new a formal software design method, called MEDISTAM, based on systematic transformation of UML-RT models. Recent results in this field also include an "on-the-fly" Model-Checking algorithm for Future Interval Logic formulae and, most recently, a compositional formal verification method of critical systems. His work appears in "Enterprise Information Systems (EIS)", "Lecture Notes in Business Information Processing" (Springer-Verlag), Journal of "Science Of Computer Programming", "Manufacturing Engineering", "International Journal Simulation and Process Modelling" and the "International Conference on Enterprise Information Systems" (ICEIS). His recent paper entitled "Automatic Compositional Verification of Business Processes"[10] presents the above new Formal Compositional Verification Approach (FCVA), based on the Model–Checking verification technique for social systems modeling, integrated with MEDISTAM–RT.