

Introduction

There is a plethora of studies about Information Systems (IS), Business Process (BP) and various known researchers who have diverse view-points in this domain, the notion of the process has become an essential asset for daily life in enterprises, when a process' objective relates to the company's goals the process will be designated as a BP. Our overall goal in this thesis is to increase knowledge regarding the concept of BP, its modelling, and its management with a deep investigation, especially on the process aspects (static and dynamic).

Questions

Based on expected outcomes and research objectives, the proposed research attempts to answer research questions as follows:

- ▶ **Question 1:** What are the similarities, differences, advantages, and disadvantages between existing BP models?
- ▶ **Question 2:** How can we properly define the dynamic BP concept and its modelling?
- ▶ **Question 3:** What are the factors influencing BP functionalities (during running time)? Moreover, which components could be impacted?
- ▶ **Question 4:** How can BP dynamicity be ensured, and what requirements of dynamic BP must be considered?
- ▶ **Question 5:** In the future, and after learning about the different changes that could impact it, can the organization adapt and control the different changing factors?

Publications

The list of my publications are:

- 1:** Adaptive Case Management and Dynamic Business Process modelling A proposal for document-centric and formal approach. (Molnár Bálint and Bouafia Khawla) (Conference paper: AIS 2017)
- 2:** An FSM Approach for Hypergraph Extraction Based on Business Process modelling. (Bouafia Khawla and Molnár Bálint) (Conference paper: CSA 2018)
- 3:** Dynamic Business Process: Comparative Models and Workflow patterns. (Bouafia Khawla and Molnár Bálint) (Conference paper: CSCS 2018)
- 4:** A Survey on Dynamic Business Processes and Dynamic Business Processes Modelling. (Bouafia Khawla and Molnár Bálint) (Conference paper: ICEIS 2019)
- 5:** Opportunities for Supporting Digital transformation through Modelling Dynamic Processes. (Bouafia Khawla and Molnár Bálint) (Conference paper: ICEIS 2019)

Theses

The thesis contains four sub-thesis:

- ▶ **Thesis 1:** an adequate framework for the analysis of the research domain and understanding the various concepts related to the BP is defined that laid down the foundation of further investigation. We investigated the field in general and collected research details, definitions, terms, standards for IS, BP modelling, BPM and BP technologies such as Enterprise Architecture (EA), Web services, as well as we presented the relation between those all cited notions. Our overall goal in this part is to increase knowledge regarding the concept of BP, its management. All definitions and details help us to know more about the research domain.
- ▶ **Thesis 2:** in this dissertation, a taxonomy is created for comparing the various existing process models. The taxonomy constitutes the theoretical ground of model transformation. A taxonomy for the negative and positive features (advantages and disadvantages) for each existing model was done. A comparative analysis part were summarized in details in tables, a comparison which was based on various criteria (*syntax, structure, and semantic*), these similarities concluded aide us to find syntactical element in the representation codes and helpful in transformations between models. The comparison across models may also lead to mixing and integrating different models to find a way to formally verify ones that might not be verified.
- ▶ **Thesis 3:** we discussed and investigated deeply the dynamic BP aspect definitions using several references in the same domain. Our own definition of dynamic BP is created, which is one of the important goals of our study.
The several factors influencing BP during its functioning were well-defined, later the elements or objects impacted by these changes were explained. The question posed about requirements needed that must take into consideration and how to ensure BP dynamically and how it should be managed. At this thesis, a big part of our investigation was done.
- ▶ **Thesis 4:** introduces the hypergraph that enables the utilization of graph algorithms along with the most recent methods of Data Science. An implementation done of hypergraph was well-explained. An implementation of the hypergraph concept has done in *Python*, this representation using matrices and forms can be used in our future works to use hypergraph and its instances for either other processes and apply several new methods, the implementation aims to represent the hypergraph in different ways to easier the use of it later.
Formal Methods and formal verification objectives are defined with particular attention to model checking, which applied on the representation of the hypergraph based on FSM approach and verify several properties.

Publications

- 6:** Analysis Approach for Enterprise Information Systems Architecture Based on Hypergraph to Aligned Business Process Requirements. (Bouafia Khawla and Molnár Bálint) (Conference paper: CENTERIS 2019)
- 7:** New Functional Approach to Transforming Abstract Specifications of Web Services Based on FSM from BPEL (Journal paper: American Journal of Innovative Research and Applied Sciences. 2020) (Bouafia Khawla, Ali Khebizi and Molnár Bálint)
- 8:** Formal Verification of Analysis Approach for Enterprise Information Systems Architecture Using Hypergraph Representation Based on Finite State Machines for Supporting Business Process Requirements (Journal paper: JABE 2021) (Bouafia Khawla and Molnár Bálint)
- 9:** Business Process Linguistic Modelling–Theory and Practice–Part II: BPLM Business Process Designer Process Requirements (Chapter: IntechOpen 2021) (Jozef Stašák, Jaroslav Kultán, Peter Schmidt and Bouafia Khawla)
- 10:** Hypergraph Application on Business Process Performance. (Journal paper: MDPI: Business Process Management 2021) (Bouafia Khawla and Molnár Bálint)

Conclusion

The work represented the investigation on BP modelling.

The concept of the hypergraph, its representation, and the approach of the hypergraph based on the FSM approach was represented. Formal verification will be applied to verify several properties. The results will be used on BP which is more influenced by environments and the current state of coronavirus, this will be our future work. The goal is to conduct further research that goes under applying of process mining and machine learning approaches in order to verify and align BP using BPMN model.

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