



A Literature Review of Business Process Modeling Techniques

Yasmine Nagm-Aldeen

Researcher of Department
Information system
Faculty of Computer &
Information
Helwan University, Egypt

Manal A. Abdel-Fattah

Lecturer of Department
Information system
Faculty of Computer &
Information
Helwan University, Egypt

Ayman El-Khedr

Assistant Professor of Department
Information system
Faculty of Computer &
Information
Helwan University, Egypt

Abstract— *All Organizations seeking to improve their productivity, quality and efficiency, but without an easy communication and proper understanding of the Business processes both for the developer and the customer, they are doomed to fail. Therefore Business Process Modeling has been developed to help organizations enhancing its Business Processes and achieving a competitive advantage. Many techniques have been created to Model the Business Processes, each with their features and limitations. The aim of this paper is to introduce Business Process Modeling Techniques with different perspectives; focuses on six Business Process Modeling Techniques and highlights the major differences between these techniques.*

Keyword— *Business process modeling, Modeling Techniques, Object Oriented, Modeling Notation, Perspectives of Process Modeling.*

I. INTRODUCTION

Due to the globalization currently organizations operate in instability and intense competition in the business environment. Increasing the competitiveness within an organization requires; reduce time spent to produce same goods and services, improve the quality of the goods or services, minimize the costs and increase the profits. In order to reach these competitive goals many organizations adopted Business Process Model. Business process modeling is a graphically approach that present business activities, events, flow controls, stakeholders, and their relationships. Business process is defined differently in literature e.g. Davenport and Short [3] defined Business Process as a set of logically related tasks performed to achieve a defined business outcome. It defined based on three dimensions:

- 1) Entities: Processes take place between organizational entities. They could be Inter organizational or inter functional or Interpersonal.
- 2) Objects: Processes result in manipulation of objects. These objects could be Physical or Informational
- 3) Activities: Processes could involve two types of activities: Managerial (e.g. develop a budget) and Operational (e.g. fill a customer order).

Where Hammer and Champy [6], defined Business Process as a collection of activities whose final aim is the production of a specific output that is of value to the customer. Business Processes considered as a key instrument for many disciplines and approaches like Business Process Management BPM [5], Business Process Improvement BPI [1], the Design of Service-Oriented Architectures [4], Business Process Reengineering BPR [3], Enterprise Modeling, workflow management and Process Aware Information Systems PAIS [2].

Business Process Modeling has many benefits like:

- Understanding: adopting a well defined set of Business Process Notations among multiple stakeholders.
- Communication: Simplicity and clarity may be the most features of a Business Process Modeling for the communication purpose.
- Modeling: modeling the Business Process enable Decision Makers to simplify the complexity of the real world.
- Managing: manage and store vast amounts data.
- Improvement: analyzing process behavior and performance of the current Business Process to enhancement.
- Reuse: the current model can be reused for other purposes e.g. the same Business Process model can use as an input for another business process.
- Reengineering: modifying the existing model rather than creating it from scratch.

The paper is structured as follows: In section 2 Modeling Techniques: Multi Perspectives are explained. In Section 3 Business Process Modeling techniques are introduced. It divided into two parts: the first part includes an analysis of the six selected techniques and the second part presents a comparison between the six techniques with highlighting the features and limitation of each technique. In Section 4 concluded by a summary and identify the future research.

II. BUSINESS PROCESS MODELING: MULTI_PERSPECTIVE

There are different people involved in the Process Modeling with different Modeling Perspectives in order to support understanding, communication, and coordinate co-work. Process Modeling Techniques usually adopted one or more of these Perspectives which consider as different ways to describe the same thing. Each Perspective gives a partial and incomplete view of the process. Summarizing the main Perspectives of BPM Techniques extracted from:

- A. Curtis' [7] whose divided it into four main Perspectives of Business Process Modeling: the Functional, Behavioral, Organizational, and Informational Perspective as follow:
- 1) The Functional Perspective focuses on what process activities are being performed and what flows of information entities are relevant to these process activities.
 - 2) The Behavioral Perspective focuses on when process activities are performed (sequencing), as well as on the aspects of the manner in which they are performed and how they are performed.
 - 3) The Organizational Perspective focuses on where and by whom the activities are performed in process.
 - 4) The Informational Perspective focuses on what information entities that a process manipulates and their relationships.
- B. J. Krogstie [8] Provides Process Modeling according to eight different Modeling Perspectives: the Functional, Behavioral, Structural, Goal and Rule, Object -Oriented, Communication, Actor and Role and Topological Perspective as follow:
- 1) The Functional Perspective: focuses on transformation (input to output) e.g. Data Flow Diagram.
 - 2) The Behavioral Perspective: focuses on States (of systems, products, entities, processes) and transformations between states e.g. Petri Net model.
 - 3) The Structural Perspective: differs from Functional Modeling, since it focuses on the static aspects, whereas Functional Modeling focuses on dynamics.
 - 4) The Goal and Rule Perspective: focuses on why activities are performed.
 - 5) The Object-Oriented Perspective: focuses on object, which is trace of the events during the existence of the object e.g. UML model.
 - 6) The Communication Perspective: focuses on how people use language for coordinating action and negotiating commitments.
 - 7) The Actor and Role Perspective: focuses on who is responsible for what. The activities performed by a role that grouped together in the diagram e.g. Role Activity Diagram.
 - 8) The Topological Perspective: takes the place into account. It focuses on the typical behavior in a certain setting rather than where this is physically e.g. UML Activity Diagram.

III. PROCESS MODELING TECHNIQUES

In practice several different techniques exist which are suitable for different Business Processes and purposes. Kettinger et al. [9] surveyed 25 methodologies, 72 techniques and 102 tools While, One PhD student started the effort to prepare a list of process Modeling Techniques and stopped at the count of 3,000 [10]. This paper addresses the six most used techniques for Business Process Modeling and reaches a result to their strengths and weaknesses.

A. An Introduction to the Major Business Process Modeling Techniques

This section aims to present the six major Business Process Modeling Techniques; Object Oriented Model (OOM), Data Flow Diagram (DFD), Petri Net (PN), Flow Chart, Role Activity Diagram (RAD) and Integration Definition for Function Modeling (IDEF). Some of these techniques divided into other sub techniques e.g. OOM and IDEF family (see fig.1). The motive for the choice of the six Process Modeling Techniques is that they are widely used in Modeling Business Process.

A.1. Object Oriented Model

Once OOM has been introduced, many OOMs have been developed. Object Oriented Modeling generally based on identifying the objects in a system and their interrelationships. In this paper we will explain only one called Unified Modeling Language (UML), which is considered as the standard graphical notation of OOM. UML divided into 3 categories as follow:

- 1) Behavior Diagrams represent the dynamic behavior features of a system e.g. (activity, state machine, and use case diagrams)
- 2) Interaction Diagrams are a subset of Behavior Diagrams which describe the object interactions e.g. (collaborative, interaction overview, sequence, and timing diagrams)
- 3) Structure Diagrams represent the static structure of the system e.g. (class, composite structure, component, deployment, object, and package diagrams)

While there are 14 UML Diagrams (as shown in fig.1), this paper focus on UML Activity Diagrams (UML_AD), the most important UML diagram for Modeling Business Process [11].

A.2. Definition for Function Modeling

IDEF is a family of Modeling Techniques. There are sixteen independent techniques within the IDEF family extending from IDEF0 to IDEF14 and including IDEF1X (as shown in fig.1). Each technique created to capture a particular type of information within Business Process. The goal of developed IDEF Techniques is to enable experts to comprehend problems from different views and levels of abstraction.

Both IDEF0 and IDEF3 are the most suitable for Business Process Modeling. Both methods are used to describe Business Processes, but from different viewpoints; IDEF0 models Business Functions, while IDEF3 models Business Processes, so IDEF3 is considered the only method of the IDEF family that is used for Business Process Modeling.

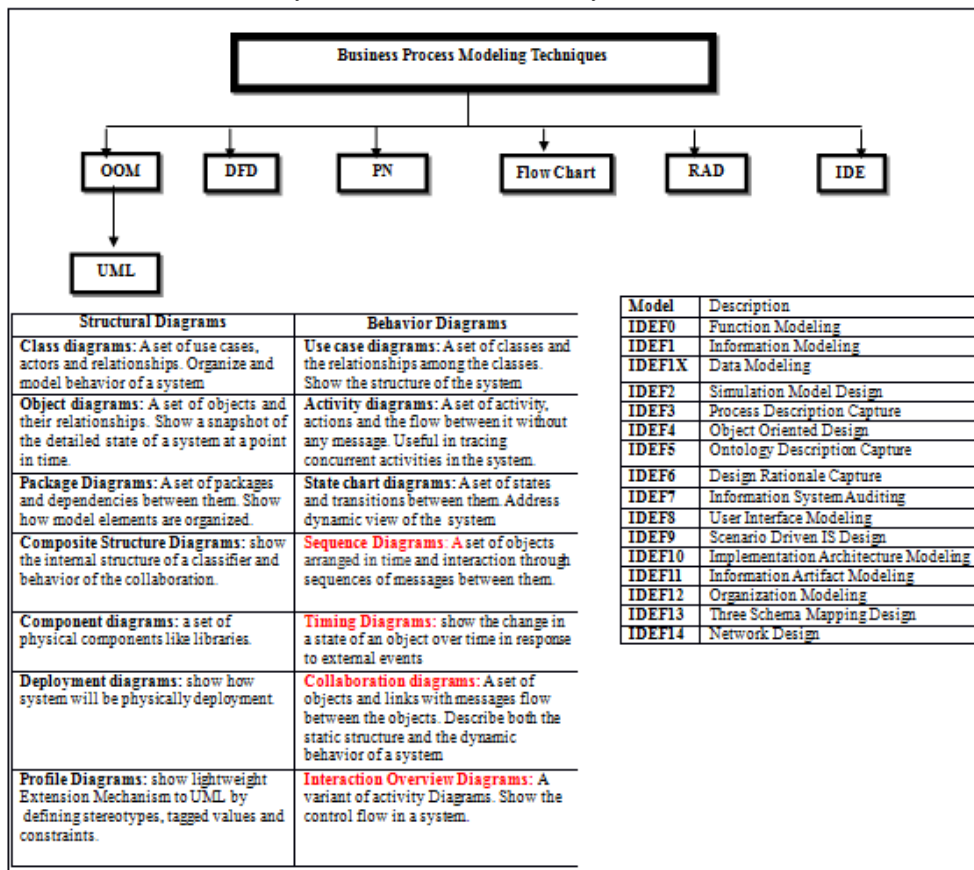


Fig.1 the six main Business Process Modeling Techniques and sub- techniques

B. Comparative Research between the Six major Business Process Modeling Techniques

While the previous section introduces the six techniques, this section provides a comprehensive research between these techniques (as shown in table.1). Aims to help for providing further directions to deciding which Modeling Technique suits the best for certain phases and what are their strengths & weaknesses.

Table.1 Comprehensive between six Business Process Modeling Techniques

| BPM Techniques | Scope | Strength | Limitation | References |
|----------------|--|---|---|--------------------------------------|
| (UML_AD) | Similar to flow chart, Activity Diagram visualize sequences of actions | A major advantage of using activity diagrams is the ability to describe parallel behavior or how behaviors in more than one use case interact. | Activity diagrams do not design to describe how objects behave or how objects collaborate or which objects will perform which actions. | {[12],[13],[14],[15],[16],[17]} |
| (DFD) | DFD simply represents how data flow between external entities, processes and data stores within a system. | -Thanks to functional decomposition (multiple levels of representation)DFD facilitates DFDs redesign of Business Processes and system improvement and also provides a detailed description of the Process for system analysts and users. | DFDs for large systems become hard, difficult to translate and read, be time consuming in their construction and Information flow can be very complex. | {[18],[19],[20],[21],[22],[23]} |
| (PN) | PN is bipartite graphs populated by four types of objects (places, transitions, directed arcs, and tokens) | The main reason for the great success of Petri nets is a combination between a well defined mathematical theory and a graphical representation of the dynamic behavior of systems. | -Models tend to become large. -No support for structuring large models. -Petri Nets are not easily understandable for non-experts. | {[24],[25],[26],[27],[28],[29],[30]} |
| (Flow Chart) | Flow Chart is a diagram that uses graphic symbols to describe the sequential flow of actions in a process. | - Flowchart has few standard symbols which help designer to communicate accurately. - A flowchart is very helpful in detecting, locating, and removing mistakes (bugs) in a program in a systematic manner. | - Flow chart tend to become large in modeling complex processes, it consumes time and slow down process of software development. - Does not support a breakdown of the activities | {[31],[32],[33],[34]} |
| (RAD) | RAD performed by a role are grouped together in a diagram, it is a popular high level visual language for capturing the dynamics and role structure of an organization | -Easy to understand and present a detailed view of the process including sequential, parallel and collaborative processes including scenarios with multiple interactions between roles. -Using role in RAD as a structural concept makes it very clear who is responsible for what. | The process is presented as a sequence of activities not letting a decomposition of the process, and thus it makes an overview difficult | {[33],[35],[36],[37],[38]} |

IV. CONCLUSION

Many BPM techniques are available each with its features and limitation. This paper addressed Business Process Modeling Techniques and discussed six Business Process Modeling Techniques with more details: Object Oriented Model (OOM), Data Flow Diagram (DFD), Petri Net(PN), Flow Chart, Role Activity Diagram (RAD) and Integration Definition for Function Modeling (IDEF). It is also provided a Multi Perspectives in Modeling Techniques and a comprehensive research of six Business Process Techniques. Therefore how process designers select the appropriate Modeling Techniques stills an important research question, so further research is needed to create Framework to evaluate Business Process Modeling Techniques.

REFERENCE

- [1] J. H. Harrington. Business Process Improvement: The Breakthrough Strategy for Total Quality, Productivity, and Competitiveness. McGraw-Hill, 1 edition, April 1991.
- [2] M. Dumas, W. Van der Aalst, and A. ter Hofstede, Process-aware information systems: bridging people and software through process technology. New Jersey: John Wiley & Sons 2005, p. 426.
- [3] Davenport, T.H., Short, J.E.: The New Industrial Engineering: Information Technology and Business Process Redesign. Sloan Management Review 31 (1990) 11-27
- [4] Erl, T: Service-oriented Architecture: Concepts, Technology, and Design. Prentice Hall, Upple Saddle Revier, New Jersey (2005)
- [5] M. Weske. Business Process Management: Concepts, Languages, Architectures. Springer Verlag, Berlin, Heidelberg, 1 edition, November 2007
- [6] M.Hammer , J. Champy ,Reengineering the Corporation: A Manifesto for Business Revolution, Harper Business. (1993).
- [7] Curtis, B., Keller, M., Over, J. Process modeling. Communications of ACM, September 1992, Vol., 35, No.9.
- [8] J.Krogstie, Perspectives to Process Modeling _ A historical overview, Springer . Volume 113, 2012, pp 315-330 2012
- [9] V. Grover, W. J. Kettinger. Business Process Change : Reengineering Concepts, Methods and Technologies. Idea Group Publishing, Apr. 1995.
- [10] J. Recker. Process modeling in the 21st century. BPTrends, 3:1–8, May 2006.
- [11] H.E. Eriksson ,M. Penker, Business Modeling with UML . 2000
- [12] G. Reggio, M.Leotta, et al., What Are the Used Activity Diagram Constructs? A Survey. Proceedings of 2nd International Conference on Model-Driven Engineering and Software Development. 2014
- [13] M. Seidl, M. Scholz The Activity Diagram. Springer. 10 Feb 2015
- [14] N.Ibrahim, R.Ibrahim , et al., Definition of Consistency Rules between UML Use Case and Activity Diagram. Springer. 2011
- [15] P.E. Patel , N.N.Patil Test cases Formation Using UML Activity Diagram. Communication systems and network technologies (CSNT). 8 April 2013.
- [16] H.Bekele, M.Kifle Test Case Generation from UML Activity Diagram: The User Perspective Approach. HiLCoE Journal of Computer Science and Technology, Vol. 1, No. 1.2013
- [17] A.K. Jena, S.K. Swain, et al., D.Kundu , D.Samanta, A Novel Approach to Generate Test Cases from UML Activity Diagrams. Issues and Challenges in Intelligent Computing Techniques (ICICT),IEEE. 2014
- [18] Shuli Yuwen ,K.Wang, A Method of Data Flow Diagram Drawing Based on Word Segmentation Technique. Springer. 6 Dec 2013
- [19] R.Ibrahim, S.Yen yen, Formalization of the data flow diagram rules for consistency check. Cornell university library. 1 Nov 2010
- [20] F.Meng, Transformation from Data Flow Diagram to UML2.0 activity diagram. International Journal of Software Engineering & Applications (IJSEA), Vol.1, No.4, October 2010.
- [21] Jilanic, A.A.A., Formal Representations of the Data Flow Diagram: A Survey. IEEE .2008
- [22] Data Flow Diagram (DFD) Tutorial, Visual Paradigm, 27 Jan 2012
- [23] WHY DFDS? When Swim Lanes are Not Enough A Comparison of Process Modeling Techniques, Advance strategies, inc. 2008.
- [24] F. Lara-Rosano, Petri Net Models of Purposeful Complex Dynamic Systems. Springer International Publishing.2015.
- [25] E W. Mayr, J. Weihmann, A Framework for Classical Petri Net Problems: Conservative Petri Nets as an Application. Springer International Publishing.2014
- [26] A V. Hense, R. Malz, Comparison of the subject-oriented and the Petri net based approach for business process automation.ACM digital library.2015
- [27] W. Reisig, Understanding Petri Nets. Springer. 2013.
- [28] W. Thong, M. A. Ameen, A Survey of Petri Net Tools. Springer. 2014
- [29] B.YILMAZ,APPLICATIONS OF PETRI NETS,2008
- [30] J.Desel, W.Reisig, The concepts of Petri nets. Springer.7 Aug 2014
- [31] Algorithms, Flowcharts & Program Design, INSTITUTE OF DISTANCE & OPEN LEARNING
- [32] T.Wickramasinghe, Business Process Modeling Techniques with Examples. 23 may 2014

- [33] L.Aldin and S. de Cesare, A COMPARATIVE ANALYSIS OF BUSINESS PROCESS MODELLING TECHNIQUES. The United Kingdom Academy for Information Systems.2009
- [34] Nishadha, Ultimate Flowchart Guide (Complete Flowchart Tutorial with Examples).2011
- [35] C. BADICA, A. BADICA. BUSINSS PROCESS MODELLING USING ROLE ACTIVITY DIAGRAMS
- [36] C.Badica, V Litoiu, Role Activity Diagrams as Finite State Processes
- [37] K.phalp. Role Based Models and an Introduction to Role Activity Diagrams (RADs).Bournemouth University (BU).
- [38] N.Shukla· J.E. Keast, Improved workflow modelling using role activity diagram-based modelling with application to a radiology service case study. ELSEVIER. Volume 116,Issue 3 October 2014, P.274–298
- [39] C-H Kim, D-S Yi m, et al., An integrated use of IDEFO, IDEF3 and Petri net methods in support of business process modeling. SAGE Journal. 1 Aug 2009
- [40] Hamzah, M.Hamdi, Modeling the open source software development processes using IDEF3 standard. UTHM university institutional repository. 2013
- [41] C.AVRAM, E.L.AVRAM, MODELING LANGUAGES CLASSIFICATION OF BUSINESS PROCESSES. Academica Science Journal. ISSN: 2285 – 8067.2013
- [42] J.Ping, Z. Peng, et al., Research on business process simulation method of architecture based on IDEF3. IEEE. Jan 2011
- [43] Ezral, M. Fathullah, et al., Application of IDEFO, IDEF3 and UML methodologies in the creation of information models. International Review of Mechanical Engineering. Nov 2011.
- [44] K.Y Jeong, H.Cho, et al., Integration of queuing network and IDEF3 for business process analysis. Business Process Management Journal, vol. 14, no. 4, 2008. p. 471-482.