A Unified Framework for Business Process Intelligence

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Abstract. Enterprises are striving to cut down their cost and the same time maintains an expectable level of quality in service delivery to keep the competitive edge. Integral to that is an analysis of business processes in order to identify inefficiencies in the design as well as execution of processes. Subsequently, based on the analysis improvement actions are taken. The techniques to identify inefficiencies in process are categorized into two types, a-priori (pre-execution) analysis and posterior (post-execution) analysis. This study focuses on posterior analysis, in which the data produced as a result of process execution are used to identify inefficiencies such as execution delay, and resource utilization. The aim of study is to analyze the existing work on business process improvement and build a unified framework for business process intelligence.

Keywords: Business Process Management, Process Improvement, Business Process Improvement, Workflow Management Systems

1 Introduction

Business process improvement is about analyzing the current behavior of process execution in order to identify the process inefficiencies such as agent assignment, resource utilization, and control flow etc. Dissatisfaction from the process execution is the beginning of improvement process. Improvement is a continuous process in determination of causes for inefficiency and finding way to eradicate them. In early 90's Business process reengineering (BPR) is initiated by (Michal Himmer, 1991 and Davenport, 1993) for business processes betterment. Business Process Reengineering (BPR) one way to identify weak point in process design and suggest a radical change method that is to make fundamental changes in process design for its optimal execution. Since then a lot of work has been done to provide radical changes for process improvement. Automation of workflow management systems (WMS) proposed by Georgakopoulos (1995). WMS are combination of technologies that provide methodologies and software support to business process, workflow specifications, optimization of specified processes and workflow automation [4]. Major expected goal in adoption of these technologies is to provide an optimized execution of organizational process and activities. An integrated tool that supports both business user and information technology can only provide flexible way to adopt changes for the improvement process. Automated WMS provide one way to suggest drastic change for process improvement. But a very weak diagnosis mechanism is provided to handle design complexity. Business process Management systems (BPM)

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provide an overall monitoring and management of process. These systems are supposed to be the superset of WFMS [4]. Smith & Fingar (2003) suggest BPM provides a holistic process change management approach to reduce the time and cost of process structure and design change. BPM provides high flexibility in change management. Van der Aalst (2003) defines BPM as "Supporting business processes using techniques, methods and software to design, enact, control and analyze operational processes that are involving humans, organizations, applications, documents and other sources of information". BPM provides process centric approach that is the combination of information technology and business governance methodology [3].

Contribution of this research is to explore and categorized major and common components from improvement methods and organize them into a model. Developed framework is used to facilitate beginner researches to see major components and their order of execution in a single model. Unified model is proposed only for illustration purpose. Model components are gathered from the well known studies conducted in the domain of process improvement and combined with business process intelligence frameworks. Other contribution of this research is to show the research emphasis in using framework components. It is measured from the observation of model description and way of illustration. Research emphasis is noted on three scale that is, highly emphasis, major component and neglected component. Highly emphasized and major component is differentiated like if method is providing detail steps or referring to an establish method in absence of both it is considered as a major component. Which means research considering said sub component in method but its emphases is less. Observation is considered neglected in absence of component. In section 2 gives methodology section 3 presents related work, unified framework is presented in section 4, section 5 presents component usage by BPI researches and Conclusion and discussion is given in section 6.

2 Methodology

Major contribution of this research is to explore studies conducted on business process improvement, especially that are from the domain of business process intelligence. Other propose of this research is to identify most common components in designing a unified BPI framework. Common components are defined as most frequently used. Unified framework is designed to show the improvement process and relationship of components and their order of execution. Two research questions are establishes these are, RQ1: Create unified framework for BPI. Selection of component will do by mutual consciences of all authors. Answer to this question is provided in section 4 that shows the process improvement method with pre and post activates of process warehouse. RQ2: Identification of researches emphasis on identified procedural components of BPI unified framework. Answer to this research question will give you component categories and researchers consideration with highly emphasized, major component and neglected. Articles are selected randomly from online available digital databases that are ISI Thomson, Science direct, IEEE Explore and emerald. Levy and Timothy [7] provided guidelines are used for filtration process. This is followed by an iterative approach. In first iteration 90 articles were

selected after abstract study. In second iteration 31 articles were filtered. Final selection is made by mutual consensus of all authors and finally selection 9 articles. Selected article are either discussing improvement framework components or providing complete framework.

3 Related Work

Business process improvement provides a way to monitor and improve the performance of business processes. Business processes redesign, business process reengineering (BPR), workflow management systems (WFMS), continuous process improvement (CPI), process restructuring and business process intelligence (BPI) are different term used for improvement process[7]. Identification and selection of improvement process is dependent of business user requirements [5]. Process evaluation and performance categorization for all behaviors including resources (i.e agent and resources reassignment) is crucial [4]. Griesberger [8] argue reorganization of process actors for optimistically recovery is equally important. Improvement is required at both stages i.e. before and after task execution [19]. Griesberger [8] in his work emphasized on identification and categorization of process quality dimensions through business key performance indicators. Whole process of improvement is divided into iterative executed steps. These steps provide analysis (finding weakness) through measurement of process log activities [18], change initiative (how to improve weakness) [4], agent and resource performance evaluations [4] and customer/user feedback [14]. A continuous improvement method is proposed by Liang (2012) that provides the incremental way to improve the business process. Lang proposed improvement method consists of four layered steps starts from the creation of workflow models lead to improved process. BPI implication guidelines are provided by Carsten et al. (2010). Based on these guidelines a morphological box for business process intelligence is provided. That shows the relationship of BPI components categorically. Tan et al. (2008) presents BPI model and also demonstrates its implementation with case study. Three steps are suggested for performance and management analysis that are measurement, analysis and response to user. Processes execution quality is measured through efficiency, speed, time, cost and scheduling strategies. Yan Li (2008) designed an intelligent business process system to adhere the process diagnosis, analysis, optimization, and prediction other than previous systems focusing on process definitions and running. Their proposed system is look like cockpit architecture provided by Castellanos (2004).

Dalmaris (2007) proposed a Knowledge intensive business process improvement (KBPI) framework. Which is consists of three parts functional theory of knowledge deduced from Karl Proper's epistemology, ontologies for business process representation and process audit evolution and improvements methods. Mutschler (2005) gives three layers BPI reference model. Process log data is maintained (produced during tasks execution) with special steps. After that clearing operation is performed on extracted log data. Syntactical and syntactically correction operation is performed on extracted data and is integrated with simulation data to process warehouse (PW). Schiefer (2004) gives an idea to merging the workflow produced data with produced activity log data through process information factory (PIF). PIF

consists of these four components, i) Process warehouse (PWH), ii) Process data store (PDS), iii) Event Processing Container (EPC) and iv) PIF Builder. Analyzed and processed information is available to business user via dashboard. An integrated tool that supports both business user and information technology user is proposed by Daniela Grigoria et al ,(2004). Process engine provide multi dimensional view of information to business user through cockpit or dashboard.

4 Unified framework for business process intelligence

Unified framework for process improvement through business process intelligence is an ultimate objective of this research. Major portion of study is conducted through nine B selected PI methods/frameworks [10-18]. Selection is made randomly and by mutual consensus of authors. In development of unified framework first step is to explore the major and common components. Business intelligence based improvement methods and improvement methods without using business intelligence are two main categories. Both domains are considered in an initial study of gathering of all essential comments. Most of important evaluation criteria and established techniques for business process improvement are ignored in business process intelligence domain study [4]. For an instance optimal agent and resource assignment is ignored in BPI methods. Agent is the human resource and resource is the combination of tools or instruments used by the agent to perform process activities. Identified components are classified into four main layers. Functionality of each layer differentiates them from other layer. Unified frame work is generated after combining all selected component with respect to their functionality in each layer. Other part of this research is on the identification of researcher emphasized in using components in selected studies. BPI framework components are categories into four layers or step that are data sources, process warehouse creation process, measurement policies, decision making policies and user interfaces. Data sources defined as the collection sources that contain the process execution information. Process warehouse creation process leads to an integration of all data sources into another repository. Process warehouse differ from data warehouse in a case of having process activity log data and simulation data. Measurement policies are the combination of analytical tasks to perform on PW to extract inform for decision making. Guided way of improvement is required to ease the decision making for business user. Decision making policies are used for facilitation of business user in decision making. Dashboard or user interface is most important component for BPI provide user interaction with system.

Unified framework for business process intelligence provides a way to show clear view of structural flow of improvement process steps and activities. Flow of improvement activities derived from previous work. Provision of pre and post step of process warehouse in a single model is the most furious part of this research. Pre creation steps of process warehouse are already established in literature and have been sufficient investigation. Post step of process warehouse are very rarely investigated. For instance an example of how to use process warehouse an IT developer team developed the process warehouse then it needs to have strong policies to extract required information that provide effective navigation of information. Zellener [20]

claims that no method is developed to provide improvement act. An effective and guided way of improvement is required. It can only be possible when a method have process to identify process weakness efficiently after measuring information from process warehouse. Intension of this research is to add measurement policies and decision making policies as a vital step in BPI framework.

General structure of BPI framework is presented in figure1 that shows complete relationship and step by step execution of all extracted components. General model is dived into three layers first is collection of data sources, second is creation of process warehouse after applying PW creating procedure and policies. Third layer is provision of interface after applying measurement and decision making policies on multi-dimensional data available in PW. Analyzed information is provided as an out put to business user in user friendly manners.

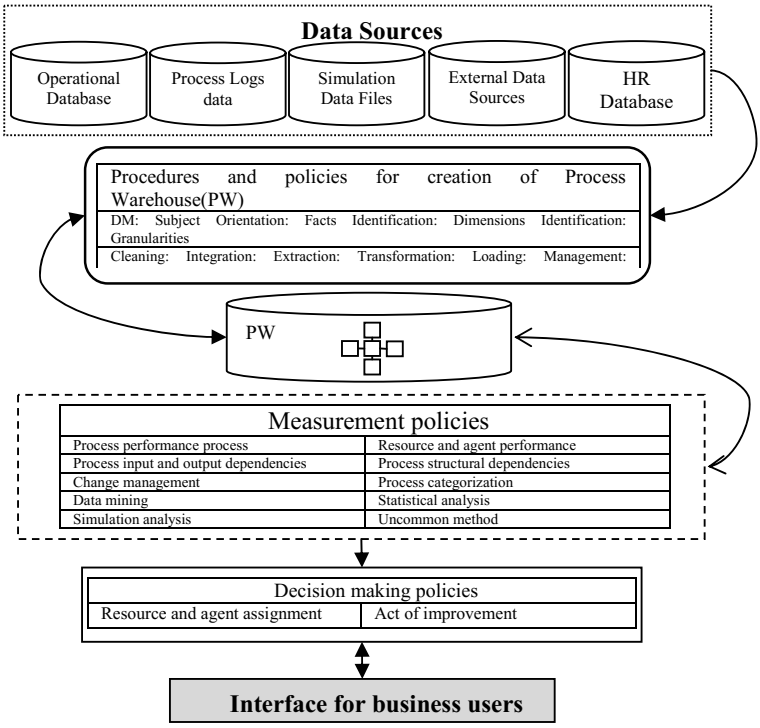

Fig.1 Unified framework for Business Process Intelligence

5 BPI framework components in relation with researcher emphases

Unified framework provides a descriptive framework to show the complete procedural and structural components for improvement process. This framework shows is very helpful for new research in finding all essential components in one model. Business intelligence based framework should have at least framework

components. That are supposed major component and executed in order wise. Once the components are identified and gathered in a framework then our next aim it is to explore the BPI researcher emphasis for each procedural component. Study is made on nine selected method. Identification of emphasis and existence is perceived after studding and discussing with other authors. Finally usage is categorized as following highly emphases, major component and neglected component in studies model. First category is highly emphases, which mean existence of procedural component is highly considered by researchers. Second category is major component which means components are existed in model but focus is very little. Third category is neglected when existence is totally ignored. Table 1 shows the observational presence of procedural components from selected models. For an instance of study [10] we identify from the provided figure 3 "Architecture of the Business Process Intelligence tool suite" operational data sources, simulation data and HR data are neglected the data source components. In some cases complete illustration of method is studied to find response. Highly emphasized and major component is differentiated like if method is providing detail steps or referring to an establish method in absence of both cases it is noted as major component. Researcher considering said sub component in method but it emphases is less so, we categorized it as major component. Absence of component is noted as neglected

Table1. BPI framework components existence with reference to researcher emphasis

Framework components	Procedural components	Highly emphases	Major component	Neglected
Data sources	Operational data	[11,13]	[14,15,16,18]	[10,12,17]
	Process log data	[10-l8]		
	Simulation data	[13,14]	[11,16,17]	[10,12,15,18]
	External source data	[10,11,12,13]	[14,15,16]	[17,18]
	HR data	[11,13]	[14,18]	[10,12,15,16,17]
Process warehouse procedures	Data warehouse perquisites	[13]	[11,14,15,16]	[10,12,17,18]
	Dimensional modeling	[10,11,12,16]	[13,18]	[14,15,17]
	PW repository management	[13]	[10,12,15,16,18]	[11,14,17]
Measurement policies	Process performance evaluation	[16]	[14,17,18]	[10,11,12,13,15]
	Process input and output dependencies		[14,18]	[10,11,12,13,15,16,17]
	Resource and agent performance			[10-18]
	Change management (redesign)		[14,15]	[10,11,12,13,16,17,18]
	Process categorization		[11,13,14,16]	[10,12,15,17,18]
	Process structural dependencies		[13,14,18]	[10,11,12,15,16,17]
	Data mining	[10,12,13,15,16]	[11]	[14,17,18]
	Simulation analysis	[10,12,13,15,16]	[11,17,18]	[14]
	Statistical analysis	[15]	[12,13]	[10,11,14,16-18]
	Uncommon method		[14,16]	[10,11,12,13,15,17,18]
Decision making policies	Resource and agent assignment			[10-18]
	Act of improvement			[10-18]
User interface	Cockpit	[10-18]		

It is observed that most of frameworks are ignoring major procedural components that are supposed to be essential by other improvement studies. Like agent and resource performance evaluation and reassignment, previous methods are also limited

to provide user a guided way of making change i.e. how to make the decision and how to manage the change and reassignment of resources.

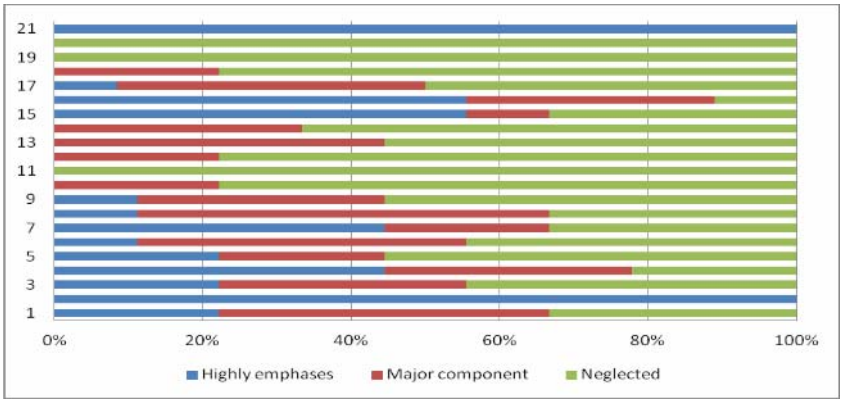

Fig.2. Comparisons of different parameters

6 Conclusions and Future work

This study concluded that measurement and analysis of information from raw data without the presence of PW is very time consuming and need more affords. Procedural components from 1 to 21 are analyzed with selected nine BPI frameworks and results with researcher's choice are shown in figure 2. These 21 components are altogether considering only sub components. Operational data sources, simulation data, process log data, external source data and HR data are the sub components of data sources. Process log data and user interface are considered highly emphasized components. Resource and agent performance assessment and their optimal assignment neglected in all studies. Many studied neglect and ignore existence of important components like how to guide user for decision making, change management and resources evaluation and job reassignment. Future directions from this work are to design a detailed agent and resource assignment method. Not only for agent and resource optimal assignments other neglected sub components also required a detail study.

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