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Decision Enhancement and Improving Business Process Agility

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Abstract
Achieving Business process agility requires organisations to be able to identify change in their business environment and respond promptly. In addition, they should be able to identify internal and external drivers for improvement. Business Process Management (BPM) suites have thus been developed to support the business process lifecycle by enabling timely changes to be made on process models. However, most BPM suites give little attention to the decision process that takes place when analyzing a business process and deciding on how to improve it. This research therefore proposes to develop a platform (Studio) that will provide an interactive environment to enhance the decision process involved in coming up with alternative solutions on how to improve the business process in response to changes, and identified internal and external drivers for improvement. The design science research method that emphasizes the 'utility' of developed artifacts is followed during this research.

Keywords
Decision Enhancement Studio, Business Process Agility, Business Process Management, Design Science

1. Introduction

The ever increasing competition in terms of cost and quality, and the continuously changing business and political environments in the world today [Hill et al. 2006] has increased the demand for Business Process Agility (BPA). Business Process Agility (BPA) is the ability to 'swiftly' and appropriately adjust the set of related activities performed to achieve a given business goal in response to the unpredictable internal and external changes that occur in the business environment, beyond the normal level of 'flexibility' [Oosterhout et al. 2006; Hill et al. 2006; Lin et al. 2006; Sarkis 2001; Sharifi and Zhang 1999]. BPA enables an organisation to (i) have a competitive advantage in an ever changing world and (ii) satisfy its customers at a minimum cost. This competitive advantage is achieved by having the ability to (i) detect and/or predict unexpected changes e.g. new customer requirements, drop in prices for a given product, (ii) identify opportunities to improve business processes, (iii) flexibly modify/adjust business processes at a minimum cost, (iv) easily develop new products whenever there is an opportunity (innovation), and (v) quickly respond to detected/sensed changes in the business environment [Oosterhout et al. 2006; Hill et al. 2006; Lin et al. 2006; Sarkis 2001; Sharifi and Zhang 1999].

The demand for BPA has led to a shift in Business Process Management (BPM) [Hill et al. 2006;] from management theories and practices such as Business Process Re-engineering [BPR] to technologies that have Continuous Process Improvement (CPI) [Neubauer and Stummer 2007; Hill et al. 2006]. CPI a core aspect of BPM enables continuous [Miers 2006; Neubauer and Stummer 2007], and direct improvement of business processes [Hill et al. 2006] thus BPA. In achieving BPA, many approaches have been developed in form of suites to support flexibility and dynamicity of specific business process aspects. This has been done by implementing BPM suites with a number of points of agility [IBM Corporation 2008]. A BPM Suite is defined [by Hill et al. 2006] as "a set of integrated technologies that enable process stakeholders and users to go quickly around the process revision cycle". The BPM suites among others include: BPM Suites [Singh and Thompson 2008; IBM Corporation 2008; BizAgi Limited 2008; Christine 2008; Miers 2006;Hill et al. 2006], Service Oriented Architecture (SOA) enabled BPM Suites usability [Unisys 2009; Dan et al. 2008; Christine 2008; Singh and Thompson 2008; Kuhr and Hamilton 2008; Kamoun 2007; Hill et al. 2006], BPM with Event Driven Architecture (EDA) Suites [Christine, 2008; Lundberg, 2007], and Collaborative BPM [Christine, 2008].

Despite their strength on business rules as a key enabler for flexible and dynamic processes [IBM Corporation 2008; Singh and Thompson 2008; BizAgi Limited 2008], it is observed that these BPM suites have not paid much attention to other points of agility (analytics, events, policies, active content and service selection).

Moreover these suites provide limited usable functionality for analyzing the behavior of a business process from event logs [Aalst 2007]. In addition, BPA requires one to have the ability to (i) detect and/or sense change in the business environment, and respond quickly, and (ii) identify internal and external drivers for business process improvement [Lin et al. 2006; Sharifi and Zhang 1999]. However, most of the BPM suites have very limited support for sense-and-respond patterns thus providing limited support for BPA [Christine 2008]. Last but not least, the decision process involved in exploring possible alternative ways of improving a business process in response to detected change or when an opportunity for improvement has been identified, calls for interaction amongst stakeholders. This interaction has nevertheless received minimal support due to the limited support for collaborative BPM [Christine 2008]. It is thus clear that there is need to provide an interactive environment to enhance the decision process involved in coming up with alternative solutions on how to improve the business process in response to both detected and sensed change, and identified internal and external drivers for improvement. This poses a challenging question: How can the decision process be enhanced in order to improve business process agility (BPA), i.e. exploration of different modifications/ adjustments of a business process?

To this end we propose a decision enhancement studio as means of improving business process agility by providing an interactive environment/platform that comprises a set of tool/techniques that will support the decision making processes involved in exploring alternatives ways of improving business processes in response to change. A studio has been defined by Keen and Sol [2008] as an environment or shared space or forum, which contains a set of integrated tools/technologies (suite) that enable stakeholders (people) to interactively collaborate to generate and analyse 'what-if' scenarios of the possible solutions to a given problem. To address our research question, first we provide an overview of the existing business process management and agility solutions, from which we derive how best the studio approach can be used to strengthen these solutions in order to improve BPA. This is detailed in sections 2 and 3 respectively. To design the decision enhancement studio, we followed the design science research approach as presented in section 4. In section 5, the description of the case used during an exploratory study including the findings and the design of the studio to support the analysis and exploration of business process improvement alternatives are presented.

2. Business Process Agility (BPA)

Business Process Agility (BPA) arose from Business Process Management (BPM) as a result of a need to remain competitive by responding promptly to changes in a dynamic business environment [Oosterhout et al. 2006; Hill et al. 2006; Sarkis 2001;

Sharifi and Zhang 1999]. BPM can be summarized as being both a methodology and a toolset for solving process problems [Christine 2008]. The main aims of BPM are: representation of business processes, activities and execution constraints between the process activities [Weske 2007], and the controlling, monitoring, optimizing and modification of business processes [Hill et al. 2006]. In the quest to achieve agility, organisations sought key enablers in making a process flexible and dynamic. That is, points in a business process that can easily be monitored and modified by a stakeholder or user [IBM Corporation 2008]. Such points are referred to as 'points of agility' [IBM Corporation 2008]. In order to affect the performance of a business process, persons that are knowledgeable about the business process manipulate a given point of agility without having to change the whole process [IBM Corporation 2008]. Six points of agility have been identified by IBM [IBM Corporation 2008]. These are: (i) Events; in cases where the instances of a process originate from multiple sources or users, they appear to be random and non-sequenced. These are correlated into a single actionable instance pattern, (ii) Analytics; this point of agility deals with the analysis of information related to a business processes. This information may be historical data, data from application, generated during execution i.e. event logs, or other sources. Analysis of such data supports decision making and improvement of business processes and business performance in general, (iii) Rules; business rules refer to an arrangement of procedural logic that are applied and followed when making basic decisions e.g. assignments and routing, (iv) Service Selection; this involves selecting an appropriate service or set of services to respond to a given service request. This is a point of agility since a set of services will be selected to respond appropriately to change that may have occurred in the business environment, (v) Active Content; this point of agility refers to information or data that is logically filled and/or automatically changed or personalised. It is a point of agility since each time this information is altered; there are a number of actions that are triggered in a business process and (vi) Policies; these refer to a combination of business level declarations that are used to dynamically form business processes from gather business functionalities of an organisation.

To enhance BPA, many approaches were developed as introduced in the preceding section. BPM Suites: BPM suites consist of tools to support the modeling, configuration, enacting and to support simulation and optimization of business processes [Christine 2008]. It they may have additional components such as a business rules engine or decision services, a content management tool such as a database, collaboration tools, an Enterprise Service Bus (ESB), and industry-specific or application specific frameworks [Christine 2008]. Some examples of BPM suites that have been developed to enable BPA are the IBM Business Process Management (BPM) suite [IBM Corporation 2008], AgilePoint BPM suite [Singh and Thompson

2008], BizAgi Business Process Management (BPM) suite [BizAgi Limited 2008] among others.

Service Oriented Architecture (SOA) enabled BPM Suites. The combination of BPM and SOA leads to an increase/enhancement of BPA through the provision of better flexibility to respond to changes and re-usability [Dan et al. 2008; Christine 2008; Kuhr and Hamilton 2008; Kamoun 2007; Hill et al. 2006]. This is done by enabling the quick assembly of new business processes to meet the changes in the business environment from existing services [Dan et al. 2008; Christine 2008]. However, BPM with SOA suites face a problem of slow speeds experienced when communication between the SOA components which is made up of a combination of pull and scheduled (batch) operations [Ghilic-Micu et al. 2008; Lundberg 2007].
Event Driven Architecture (EDA) enabled BPM Suites. EDA introduces the concept of events into traditional business processes [Christine 2008; Ghilic-Micu et al. 2008]. EDA is defined by Chandy and Shulte [2007] as "a style of application architecture centered on an asynchronous 'push'-based communication model". On EDA architecture, an application detects change and issues a notification that will initiate a reaction in the receiving node [Ghilic-Micu et al. 2008; Lundberg 2007]. The ability to listen and respond to incoming events will lead to improvement in BPA [Christine 2008]. CEP systems have also been run as a parallel platform to a BPM suite to support the sense-and respond patterns [Ammon et al. 2008; Lundberg 2007]. These suites may be enhanced with SOA to enable faster communication [Lundberg 2007]. However, from the survey carried out by Oracle [Christine 2008] very limited support for sense-and-respond patterns by traditional BPM suites or supporting technologies was noted.

Collaborative BPM is a commonly overlooked yet important aspect of BPM with the involvement of people. It has been used in three areas: Exception Handling, Case Management and Research Processes [BizAgi Limited 2008; Christine 2008]. Most BPM suites do not support collaborative interactions that may take place before an action is taken at a given step in the flow of a business process [Christine 2008]
From the above discussion, an improvement in the aspects (weaknesses) mentioned above will improve BPA leading to better operational performance as a result of continuous process improvement. This will also lead to increased profits through making optimum improvements [at a reduced cost] of their business processes which saves money, and quick responses and the satisfaction of customers' requirements. To do this, we propose the development of Decision Enhancement Studio (DES) consisting of suites (set of technologies) to support the decision process involved in achieving business process agility. A studio is an environment or shared space or forum, that contains a set of integrated tools/technologies that enable stakeholders

[people] to interactively collaborate to generate and analyse 'what-if' scenarios of the possible solutions to a given problem [Keen and Sol 2008]. Such a set of integrated tools/technologies is referred to as a Suite [Kol et al. 2008; Hill et al. 2006]. The proposed studio will also provide an interactive environment to support the decision process involved in coming up with alternative solutions on how to improve the business process in response to the detected changes. The DES will lead to the improvement of business process agility by enhancing the decision process involved in making of business process improvements in response to detected and sensed change. Business process agility can therefore be improved through a DES.

3. Decision Enhancement: Studio-based Approach

A studio is an environment or shared space or forum, that contains a set of integrated tools/technologies that enable stakeholders (people) to interactively collaborate to generate and analyse 'what-if' scenarios of the possible solutions to a given problem [Keen and Sol 2008]. Such a set of integrated tools/technologies is referred to as a Suite [Keen and Sol 2008; Hill et al. 2006; Kol et al. 2008]. These suites are deployed in a studio using experimental process methods and recipes on how the stakeholder/users can interactively use the deployed suites [Keen and Sol 2008]. The studio-based approach is therefore useful in solving a problem that requires the input from various knowledgeable people.

The studio approach has been used in several fields such as education [Hundhausen 2002; Bequetter et al. 2001; Bequetter et al. 1999], decision enhancement (DE) [Keen and Sol 2008] and in BPM [Corticon Technologies 2009]. In DE, the studio-based approach is used to enhance the decision-making process in order to achieve decision process agility by enhancing interaction between participating individuals [Keen and Sol 2008]. A studio consists of a suite(s) and recipes on leveraging the suite(s) or a Decision Enhancement Service (DES). The use of the studio approach in BPM has been limited to providing tools that generally support the business life-cycle e.g. the BizAgi BPM suite [BizAgi Limited 2008], and to support a specific point of agility e.g the Corticon Business Rules Management Studio supports the business rules point of agility. The Corticon Business Rules Management Studio provides stakeholders with an environment to author and verify business rules [Corticon Technologies 2009].

The studio approach is used in this research to propose a design of an interactive environment/platform that comprises a set of tool/techniques that will support the decision making processes involved in exploring alternatives ways of improving business processes in response to change. In addition, a set of guidelines on how the set of tools/techniques should be organised and used by stakeholders collaboratively

in an interactive environment/platform, are also provided. The proposed decision enhancement studio design will therefore provide stakeholders with tools/techniques to collaboratively explore business process improvement alternatives in response to identified changes.

4. Research Approach

This research is being done following the Design Science research method. Design Science is a problem-solving paradigm that aims at stressing 'utility of artefacts' that is, producing artefacts that contribute to the body of knowledge and are relevant to the community [Winter 2008; Carlsson 2006; Hevner et al. 2004]. Design Science research consists of three cycles namely, the relevance cycle, the design cycle also known as the 'build-and-evaluate loop', and the rigor cycle [Winter 2008; Hevner 2007; Carlsson 2006; Hevner et al. 2004]. 'Relevance Cycle' deals with identification of a problem, opportunity in a given application domain in terms of business needs. This is an input to the design cycle. The 'Rigour Cycle', involves thorough review of past knowledge in terms of foundations and methodologies to identify applicable knowledge. The rigour cycle also provides input to the design cycle in terms of appropriate theories and methods for construction and evaluation of artefacts. The 'Design Cycle' is the core of design science. It involves the building and evaluating of artefacts following a set of guidelines defined in Hevner et al. [2004]. Following the relevance cycle, the researcher explored a case's business environment to gain an in-depth understanding of the business environment in terms of their goals, operational activities, problems and opportunities with respect to BPA. Interviews were used to gather information on the factors leading to change and those affecting the decision process involved in exploring business process improvement alternatives in response to the identified changes. User requirements were identified from this data and functional requirement for the decision enhancement studio derived from these. In the rigor cycle existing literature was reviewed to identify tools and techniques that will be used in the decision enhancement studio to support the activities and decision process involved in exploration of business process improvement alternatives. In the design cycle, the studio functional requirements from the relevance cycle and the tools and techniques identified in the rigor cycle were used to develop a global design of the studio.

5. Case Study: National Social Security Fund (NSSF) Uganda

The National Social Security Fund (NSSF) is a national saving scheme mandated by the government through the National Social Security Fund Act, Cap 222 (Laws of Uganda) to provide social security services to employees in Uganda. All the organisation's operations are performed within the boundaries of the NSSF Act, directives from the Bank of Uganda (BOU) and the Ministry of Finance. Over the

years, NSSF has had the monopoly of providing these services in Uganda however; the vision of liberalizing the business will bring about more competition on the scene. In order to prepare for this and to remain competitive in the free market there is an increased demand for business process agility. Secondly, with the increase in the number of members (employees contributing to the fund) there is need to improve service delivery especially when it comes to processing benefits. The organisation therefore sought to improve its business processes to meet these needs. The following section presents the challenges business process agility in the organisation particularly the decision making process involved in the exploration of business process improvement alternatives, identified from this case study. These challenges were used to identify user requirements and thereafter to derive studio functional requirements which were used as the basis for the proposed studio design for a decision enhancement studio to improve business process agility.

5.1. Challenges to the Decision Making process: Exploring Alternative business process improvement solutions

To identify the key performance indicators and factors that drive the need for business process improvement and to get a better understanding of the decision process involved in the exploration of different alternative ways of improving a business process, an exploratory study was done at NSSF-Uganda. The study was done to identify the major factors that affect the operations of the organisation and the challenges that stakeholders face during the decision making process involved in business process improvement.

The heads of the Risk, Information Systems, Operations (Customer Care) departments and the Performance Intelligence Unit at NSSF-Uganda were interviewed in face-to-face sessions. The operations department was selected because it is the core department in that it interfaces with the employees and employers delivering the organisation's services to them. The other departments were selected because they are primarily involved in the analysis of the organisation's business processes to monitor it's performance and to seek opportunities of improving it. In addition to these, they also take part in the decision making process of determining how the business process should be improved.

From the data collected, the following problems/challenges were identified as to be affecting the decision making process involved in exploring alternative solutions for improving their business processes. These may be categorized into 2 groups namely internal and external challenges. Internal challenges are those that are caused by factors within the organisation that can be controlled, whereas external challenges are those that are caused by external factors that the organisation has no control over

and yet they affect the decisions made on how to improve the organisation's business processes.

5.1.1 Internal Challenges

i). There is limited stakeholder participation; The limited participation is attributed to a number of factors such as lacking or limited clarity and understanding of an improvement opportunity and failure to clearly envision the benefits associated with a given proposed improvement alternative. These factors minimize the participation of a stakeholder that is to say, failure to clearly envision the need for proposed change or to understand how one will benefit from a given business process improvement alternative, causes stakeholders to participate less in the decision making process and thus inhibits business process agility.

ii). Poor information flow; In cases where decisions have been made on how to improve a business process, failure to pass down information concerning the decisions to concerned users or other stakeholders has hindered or slowed down the implementation of improvements to their business process.

iii). Rigidity in the decision-making process; In some departments, decisions concerning what improvement should be made to a business process have been limited to a small section of the departmental staff for example heads of departments and/or a selected number of other departmental staff. This has been seen to cause a gap between management and junior employees which may later impede implementation of improvements to a business process.

iv). Bureaucracy; The existence of strict organisation structures through which decisions are to be made, has a tendency to slow down or even inhibit responsiveness to changes in the business environment that require improvement or adjustments to be made to business process. Lack of flexibility in the decision-making process may therefore reduce the agility of an organisation.

v). Lack of enough and/or current information; Periodic data is used to analyze the performance of the organisation's business process. Data that has been logged by the workflow management system over a given period of time is collected by a member of staff and filtered to generate reports that are then used to analyze the performance of the business process. This means that decisions will be made based on static information and not real time.

vi). The need to cut costs; this has affected the decision making process since the

stakeholders have resorted to Microsoft applications such as excel for data analysis. As a result complex analytics that are performed by specialized software cannot be performed. This has made the data analysis and later report writing activities within the process such as risk assessment and business process analysis labour intensive.

5.1.2 External Challenges

i). Fluctuating stock prices; NSSF invests the contributions in stock shares. Any drop in the stocks prices means that the anticipated revenue from the sale of the stocks will not be reached. Such a loss means that the interest rate being awarded to customers needs to be lowered for that financial year. However it should be noted, that once an interest rate is set in a given financial year, it can't not be changed until the next financial year. This places a challenge on the business process agility.

ii). Political influence; NSSF's operations are governed by the Ministry of Finance, thus changes in its operations have to be approved by the minister.

iii). NSSF Act and Directives from Bank of Uganda and the Ministry of Finance; these affect the decision making process since all the decisions have to be made in alignment to these directives and Act.

iv). Economic stability (inflation, credit crunch); the stability of the economy determines the interest rates that are comprised within rules used by business process activity that deals with crediting a beneficiary's account.

It was also discovered that the external challenges were factors affecting the decision process however beyond the control of the staff members of the organisation. This is because they are controlled by other national and international parties and therefore only form a boundary as to what kind of improvements can be made to the organisation's business process. External challenges such as economic stability and fluctuating stock prices may be monitored independently and the information used as a basis for improving the organisation's business process. Secondly, the management of NSSF-Uganda can only recommend changes to be made to the NSSF Act but not change it. The organisation is also required to abide by the directives from Bank of Uganda and the Ministry of Finance.

To this end, this research focused on the internal challenges because these can be controlled by staff members of the organization thus leading to the derivation of the following user requirements.

i). There is a need to encourage stakeholder participation. This can be done by providing a way of enhancing stakeholders' ability to identify and understand

improvement opportunities and the benefits associated with a given proposed improvement alternative.

ii). Once business process improvement alternatives have been selected, there is a need to improve and monitor the flow of information between concerned users or stakeholders in order to enhance the implementation of business process improvements.

iii). A flexible way of making decisions is necessary in order to increase responsiveness to changes in a business environment, and bridge/reduce the gap between management and junior employees which may otherwise reduce the agility of an organisation, and impede implementation of improvements to a business process respectively.

iv). There is a need for a way of gathering enough and/or current information for business process analysis in order to make decisions based on real time information.

v). There is need for a cheap and effective way of carrying out complex data analysis within risk assessment and business process analysis activities.

From the findings above, it is clear that there is need for a solution that flexibly enables speedy and efficient analysis of logged data from the workflow management system. The solution should also encourage participation of, communication and collaboration between the concerned stakeholders during the process of analyzing a business process and exploring different ways of improving it in a cost effective manner. It should promote understanding of the benefits and downsides of different alternative solutions in the stakeholders so as to encourage participation from them. Also, the external factors should be considered when proposing business process improvement alternatives. For such a solution, it is important to identify the specific user requirements that will be used to guide in establishing the functionality that should be supported by the solution. This research therefore proposes a decision enhancement studio as a solution that can meet these requirements.

5.2. Decision Enhancement Studio for Improving Business Process Agility in NSSF

The decision enhancement studio concept and it;s components have been defined in section 3. The proposed decision enhancement studio will support the exploration of business process improvement alternatives in response to identified changes in social security schemes' business environment such as the National Social Security Fund (NSSF) in Uganda. The appropriate set of technologies' functions requirements i.e.

the activities or functions that the studio needs to provide the stakeholders with were derived from the identified user requirements. The derived functional requirements are presented in the following section.

5.2.1 Functionality Requirements

The functional requirements include:

i). Enable in-depth workflow analysis giving insight into the performance and behaviour of a business process so as to identify the opportunities for improvement by providing a set of tools/techniques that can be used to analyze different aspects of a business process in a timely manner.

ii). Support risk assessment of an organisation's business process in order to identify the opportunities for improvement by providing a set of tools that support the risk assessment activities. In addition, provide an environment that the concerned stakeholders can work with jointly to identify, analyze and generate recommendations for dealing with the identified risks.

iii). Enable multiple stakeholder participation in the generation and exploration of improvement alternatives, risk assessment and decision making by providing a group support system to support these activities. The group support system would enhance collaboration, interaction as well communication among the stakeholders.

iv). Allow for manipulation through interaction with the business process model.

v). Enable the simulation of the different possible modifications/improvement to a business process. The studio should thus provide simulation tools that can mimic the behaviour of a business process, logging events during its execution. The logged information from the simulation would then be analyzed to provide a better understanding of the proposed business process improvement alternatives.

vi). Provide visualization of the analysis reports/results; different presentation formats of the analysis results should be presented to the decision makers in order to improve their understanding on how beneficial a given improvement alternative is.

vii). In addition enhance the stakeholder's willingness, commitment and motivation to take part in the decision making process involved in exploring and selecting a business process improvement alternative.

viii). Provide a means of disseminating or sharing of information about decisions

made (action points and responsibilities) through the short messaging system and/or email systems to improve the flow of information among concerned stakeholders.
In order to meet the need for a way to gathering enough and/or current information for business process analysis, the decision enhancement studio should provide an environment where various stakeholders can contribute their ideas freely as well as provide a set of tools/techniques (suites) that can perform business process analysis on the collected event logs. Being able to analyze the event logs of an information system supporting the business process automatically or with less human intervention reduces the time spent on business process analysis and thus more analyses can be performed thereby achieving analysis on near to real time information. In addition to this, the set of tools/techniques that provide the above functionalities should be well organized following a defined recipe/method. It is thus hoped that the decision enhancement studio will provide a cheap and effective way of carrying out complex data analysis within risk assessment and business process analysis activities.
In the next section we provide a global design of the proposed decision enhancement studio for improving BPA.

5.3. Studio Design

Looking at the functional requirements mentioned above, we propose a decision enhancement studio consisting of 4 suites to provide the required functionality. These are the (i) Risk Assessment suite (ii) Workflow Analysis suite (iii) Suite for exploring business improvement alternatives and (iv) the Communication suite that is responsible for ensuring that the concerned parties in an organisation(s) receive information on the decisions made. The suite for exploring business improvement alternatives also supports the generation of a method or procedure on how to implement a selected business process improvement alternative. The diagrammatic representation of Studio's global design is given in Fig. 1.

The first step in the process of generating and exploring business process improvement alternatives is the analysis of the business process. Using the Risk Assessment and Workflow Analysis suites in parallel, the business process is analysed to understand the level of risks involved, its behaviour and performance with the aim of identifying opportunities for improving it. Event logs and business process specifications (models) from an organisation's workflow management system (WFMS) are provided as input to the Workflow Analysis suite whereas the business process specifications are provided as input to the Risk Assessment suite.
During the risk assessment activity, the responsible stakeholders collaboratively work together to identify risks; that is, detecting threats and opportunities for improving a business process. The input into the risk assessment activity will be a process specification and additional information gathered from different stakeholders who

interact with the business process. In the risk identification activity, stakeholders collaboratively analyze the business process to identify the events of concern. Business process risks are then formulated from identified events. These are then categorized in terms of importance. The generated list of risks is then reviewed to see if it is complete or not. The steps are repeated till a complete list of risks is achieved. Once risks have been identified, stakeholders collaboratively develop metrics for corresponding risks to act as risk indicators for newly identified risks. Risk indicators are used as a basis for analyzing business process risks. During risk analysis, risk levels are identified and stakeholders collaboratively generate recommendations on how to deal with identified risks by discussing the identified risk levels with the aim of generating mitigation or control measures. The risk indicators are monitored and risk levels controlled using the recommendations. This information is compiled into a risk assessment report that is used during the generation of business process improvement alternatives.

In the workflow analysis activity, the responsible stakeholders evaluate the performance and behaviour of a business process. The workflow analysis will be done using a set of tools such as the process mining (ProM) framework which consists of various process mining and analysis techniques; process verification tools such as Woflan; and simulation tools such as Coloured Petri-Net (CPN) tools. It will involve mining the as-is process model from the log file generated by an organisation's workflow management system during process execution. This will be done using the mining techniques for example the Alpha (α) algorithm, provided in the ProM framework. The performance and behaviour of the mined as-is process model will then be analyzed and a report containing this information generated. This report will be used during the exploration of business process improvement alternatives.

The reports generated from the business process risk assessment and workflow analysis activities are used during the exploration of improvement alternatives and decision making activities. Using the suite for exploring improvement alternatives, the responsible stakeholders collaboratively work together to generate and explore possible improvement alternatives. Using a group support system e.g. Meeting Works, the stakeholders evaluate the risk assessment and workflow analysis reports on the existing business process. During this evaluation, aspects of the business process that need to be improved are identified and a goal defined. The goal definition consists of the process to be improved and the aspect(s) to improve. Stakeholders then work collaboratively to identify a business process improvement alternative by first brainstorming on possible ways or alternatives of improving the business process model. The alternatives are evaluated and the most feasible/suitable are selected. The selected improvement alternatives are then fed into the Workflow

Analysis suite and the Risk Assessment suite so that a risk assessment and workflow analysis of each alternative can be performed. Following the same procedure that was used on the existing business process, each improved business process alternative is assessed for the risks involved. Recommendations on how to deal with them are made. A risk assessment report consisting of this information is then generated. Concurrently, simulation will be used as a means to analyse the proposed business process improvement alternatives. An initial business process simulation model will be mined from the log file generated by an organisation's workflow management system during process execution.

Basing on the improvements suggested by stakeholders, the initial model will then be modified into different simulation models representing each business process improvement alternative. The ProM framework analysis techniques will then be used to analyze the performance and behaviour of the different improvement alternatives. Analysis reports containing this information will generated and used in the decision making process. The reports generated from the risk assessment and workflow analysis of the possible business process improvement alternatives are then fed into the suite for exploring improvement alternatives. The reports will be used by a group of stakeholders to select the most suitable alternative to be implemented. This decision-making task will be carried out using a group support system (GSS). The stakeholders will evaluate the alternative improvement solutions against the desired improvement goal i.e. How does a given alternative improve the identified aspect of the business process? Through a voting session the improvement alternative that best satisfies the defined goal i.e. best improves the identified aspect of the business process is selected.
Once a business process improvement alternative has been selected, stakeholders will discuss and agree on an implementation procedure. The selected business improvement alternative and the agreed implementation procedure are then communicated to the people responsible for implementing the improvement to the workflow system. The communication will be done using a script provided in the communication suite.

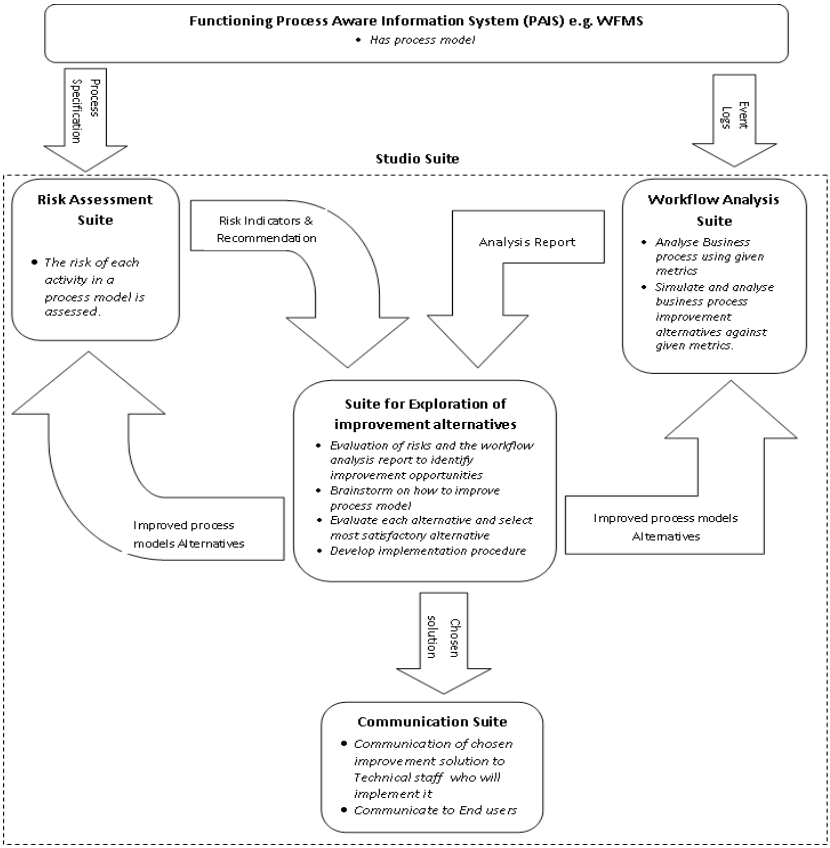

Fig. 1.: Global Design of Decision Enhancement Studio for Improving Business Processes Agility

6. Conclusion and Future research

In this research we have looked at a number of approaches that support enhancing of the business process agility in organizations. Not withstanding their efforts, we observed that these approaches scantily give attention to the decision process involved in the exploration of alternative solutions to improve business processes in response to detected/sensed change [Lundberg 2007; Christine 2008]. More so, the points of agility such as the analytics that would give more insight to the behaviour of business processes, have not received much attention in most BPM suites. Additionally, most of the BPM suites have very limited support for sense-and-respond patterns in terms of implementing EDA in BPM suites [Christine 2008]. Lastly, there is limited support for collaborative BPM [Christine 2008] especially in

the process of exploring possible alternative ways of improving a business process in response to identified changes.

It is on this basis that this research proposes, first, to enhance collaboration and interaction between stakeholders, and secondly enhance the existing BPM suites to support the sense-and-respond patterns. To address this, a decision enhancement studio should eb developed to provide stakeholders with tools/techniques to collaboratively explore business process improvement alternatives in response to identified changes. The developed studio should also provide an interactive environment to support the exploration business process improvement alternatives, and the decision process involved. In addition, a set of guidelines/recipes to coordinate the interactions between people and the technologies and collaboration among people within the studio should be provided. As a step to realizing the above environment, an exploratory study of one case was carried out at National Social Security Fund (NSSF) Uganda. From the study, it was discovered that analysis of a business process in terms of its performance, behaviour, and the risks involved are vital inputs to the process of exploring business process improvement alternatives. In addition to this the internal challenges were used to establish the user requirements and later the studio functional requirements. A studio design consisting of 4 suites to support the analysis and exploration of business process improvement alternatives was then developed. The suites comprise tools/techniques to support risk assessment (Risk Assessment suite), workflow analysis (Workflow Analysis suite), collaborative exploration of business process improvement alternatives (suite for exploring business improvement alternatives), and the communication amongst stakeholders (communication suite).
The next step is to implement and test the studio design using case studies in order to develop a refined validate design with the aim of enhancing Business Process Agility that is, the sensing or detection of changes in the business environment, and the identification of business process improvement opportunities. The designed DES once validated will therefore provide an approach to achieving collaborative BPM by enabling stakeholders to make effective decisions on how to improve a business process.

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