A Serious Game based Method for Business Process Management

Doctoral Paper

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Abstract—Nowadays, organizations have to be flexible enough to allow adjustments to new circumstances and to be able to align their processes in a short time according to the users requirements, respecting environmental constraints and technological evolution. The challenges are then to improve process efficiency and quality, to introduce a continuous process evolution and to improve the stakeholder’s satisfaction. This article proposes a Serious Game-based Method for Business Process Management equipped with a game tool. This approach is particularly useful for existing business processes and allows the representation, amelioration and evolution of changing business processes. We take as case study the university processes and conduct experiments to measure the acceptability and feasibility of our method and identify, develop and validate the specifications of the simulation game tool. Finally we present our first prototype of the game as part of a virtual 3D world.

Business process; modeling; serious games; participative process; process improvement; BPM.

I. INTRODUCTION

Under the impact of globalization, organizations have to be flexible in a way that they are capable of responding in a short time to meet the ever changing and unpredictable demands of the surrounding environment. Organizations have to adapt quickly to the strategical, organizational and technical evolutions, they have to be able to identify, model, simulate, execute, optimize and evolve their process in real time. Thus, process management challenges are to improve process efficiency and quality, introduce a continuous process evolution and improve the stakeholder’s satisfaction.

Business process management (BPM) technologies are considered by analysts as the key to create a flexible organization and recognized as organizational best practices [20]. Certainly the business process approach is a trend and the process modeling (Business Process Modeling Notation BPMN) is a complex but necessary goal. Monitoring in real time (Business activity monitoring BAM) the information emanating from the business process implementation and integrating a robust engine platform for executing process (Business Process Management Systems BPMS), provides the base that enables to adapt, optimize and evolve the business process. Simultaneously, the information systems have to be more flexible and granular to expose their core services to their process customers.

The problem we address in this article is that all the actors of an organization recognize the importance of creating, sharing, collaborating and maintaining process maps, but no one seems to be ready to imply and to invest a lot of time and effort.

Moreover, the multidisciplinary team of actors involve several professionals who use different vocabularies and their lack of a common language result in communication problems. In relation with these problems, the research issues we try to answer in our works are the followings: How to motivate stakeholders to create, share, collaborate and maintain process maps? How to assess the benefits of their job? How to find a common collaborative language? How to simplify the collaborative work? How to reduce modeling time? How to demystify the process modeling? How to simplify the business process evolution?

In order to answer these questions, we propose a serious game based approach, which specifically incorporates a simulation game into a process modeling method. Indeed, we take advantages of the serious game to introduce hedonic properties [14] (stimulation, beauty, etc.) in our approach in order to create positive emotions from the actors playing with the serious game. Based on psychological theories, such properties allow the user to have more pleasure, to be more motivated, more concentrated and so more creative.

Moreover, using serious games in such a method allows addressing to different types of users: from functional actors with no experience on business process modeling to experienced designers without consideration of age, position or socioeconomic status. Such a diversity of actors will in the contrary bring more creativity and richness in the design process.

The remainder of this paper is structured as follows. Section II presents a general state of the art relevant to the construction of our method, particularly life cycle processes
and serious games. Section III presents our serious game-based method. Section IV describes the simulation phase and the validation experiments performed to create our method support tool. These experiments were done using quality management tools with the support of MarveLIG Team, a hotbed platform for scientific experiments of the Grenoble Informatics Laboratory (LIG). Section V shows the specifications of our first prototype game. Section VI concludes the paper and describes the future works.

II. STATE OF THE ART

Our method is inspired of four domains: a) approaches to business process management, b) approaches to process improvement, c) simulating and improving processes and quality management approaches for process improvement, d) serious game domain adapted for modeling. The first two domains are the main center of interest of our method, and the last two domains describe some of the tools and techniques used to support our method.

Next, we present as preamble to our method the state of the art of the four domains.

A. Approaches to Business Process Management

Many approaches and methods to business process management have been proposed in the literature [12]. In order to compare them, we take as reference the process approach adopted by ISO 9001 (2000) [13]. The Deming cycle, or PDCA cycle, is a continuous quality process improvement model consisting of a logical sequence of four repetitive steps for continuous improvement: Plan (Establish the process to achieve the goals), Do (Implement the process), Check (Measure the process and compare the results) and Act (Take action to improve the process). The PDCA cycle is also known as the Deming cycle, the Deming wheel or the continuous improvement spiral.

1) Gillot’s BPM approach

According to [11], the BPM approach is structured by an iterative cycle with four phases oriented to the continuous process improvement.

- The conception phase uses graphical tools for the process design.
- The execution phase integrates the models with the BPM solution to be executed.
- The control phase enables the deployment process in a real execution environment to be managed and supervised.
- The analysis and optimization phase has the purpose, after a certain time of operation, to analyze the collected data to identify possible areas of improvement.

There is an exact equivalence between these phases and the phases of Deming cycle. In the same way, several works such as for example Gillot base their process approaches on the traditional Deming cycle.

2) Crusson’s Approach

Some approaches have changed the Deming process life cycle. For example [6] and the company INTALIO offer a solution for managing business processes based on the life cycle presented in Fig. 1.

Thus, the modeling phase is supported by Intalio|Designer tool whose goal is to represent graphically the activity sequence of a business process. The deployment and execution phases are supported by Intalio|Server which allows the process execution without passing through an implementation phase. Finally, the interaction phase implemented by Intalio|Workflow supports the interaction of the process with the final users in order to identify the changes to carry out and optimize.

Taking into account these changes generates another modeling phase and the cycle repeats.

3) The Process Approach of Debauche and Megard

According to [7], the life cycle presented in the Fig. 2 consists of three phases: Business Process Analysis (BPA) which in a global manner corresponds to the first two phases of the Deming cycle, Business Process Implementation (BPI) whose objective is the integration, deployment and implementation of the process, Business Activity Monitoring (BAM), which is used to measure and analyze the performance indicators of the collected data during the process execution.

Each phase is itself composed of a sub-cycle. This sub-cycle particularly complex and created by several steps, aims to achieve a continuous process improvement and enables the process evolution.

Figure 1. Crusson’s Life Cycle

Figure 2. The Process Approach of Debauche and Megarde
Synthesis

The process management approaches cycles proposed in the literature are equivalent and composed of a life cycle with three main steps: modeling, execution and optimization. The life cycle of Debauche and Megard presents these three phases, each one is itself composed of a sub-cycle.

Nevertheless, none of these cycles describes how is carried out the functional requirements collection process (roles, activities performed, flows...). This essential phase (traditionally called user requirements identification) is usually hard, complex and exhausting.

Moreover, these life cycles lodge an optimization phase after the implementation, however many improvements are organizational and do not necessary require an execution. This is accepted too by Croassin's life cycle highlighting that it is not necessary to go through the implementation phase to provide an optimization process.

B. Approaches to process improvement

Many approaches to process improvement exist and are emerging as a complement of existing methods in process management whose objective is to ensure that they conform to the individual user's needs. Next, we present some of these approaches.

1) Method for Process Improvement of Cattan, Idrisi and Knockaert

This method [5] is suitable for treating recognized process dysfunctions. It is divided into four stages.

- First step: define a process as it exists by answering ten questions such as name, business purpose, stakeholders, etc.
- Second step: identify malfunctions and failures experienced in the process. Brainstorming is used to gather the ideas.
- Third step: a rebuild process takes place to overcome the malfunctions observed in the process using a conventional flowchart.
- Fourth step: suggest improvements by a comparison between existing process and the rebuilt version

The main objective of this method is to obtain a consensual result in a specified limited time (two or three months according to the authors).

2) Method for business process management and improvement of Brandenburg and Wojtyna

This method offers a solution for managing business processes and seeks improvement solutions [4]. It is structured by an iterative cycle with four phases:

- Identify (map) and formalize (document) processes. Create process maps and identify their characteristics.
- Measure and evaluate existing processes. Identify all the critical business processes and evaluate their capability to achieve goals in order to improve them if it is necessary.
- Analyze critical processes obtained and identify improvement solutions. During this step, a failure analysis process has to be developed for identifying problems within the process.
- Implement and validate solutions. It aims to implement and evaluate the improvement plan and measure the result.

These steps constitute a continuous improvement cycle. It represents the control process in compliance with ISO 9001:2000. The authors propose to make use of an index card and eventually a logigram to describe the process.

3) Participative approach to process improvement of Noyé

A participative approach to process improvement is proposed by [19]. It is structured by seven phases and associated tools.

- Project launch. Select the process that needs to be improved. Proposed tool: identification diagram for existing processes.
- Identifying the needs of customers. Establish the level of satisfaction of the stakeholder in relation to their expectations. Proposed tool: Tracking problems diagram.
- Analyze the current process. Analyze and describe the current process to understand problems and their causes. Proposed tool: A critical analysis of the process.
- Set the target process. Analyze processes and find improvement solutions. Proposed tool: Diagram for identification of target process.
- Implementation. Specify actions to be executed. Proposed tool: Description diagram of the target process.
- Evaluate and consolidate. Evaluate the effectiveness of the new process. Proposed tool: Entire process diagram.

Synthesis

Each process improvement approach has a different way of conducting the different phases and uses different types of tools like questionnaires, interviews, flowcharts, process maps, diagrams, brainstorming...

Cattan, Idrisi and Knockaert propose an approach to introduce process changes for treating recognized process dysfunctions. This approach is supported by traditional modeling tools like flow charts, and diagrams.
The Method for business process management and improvement of Brandenburg and Wojtyna proposes a solution not only for improving process, but also for managing process. It is structured by an iterative cycle and has as its primary goal to obtain a consensual result in a specified limited time. One of its interests is the prioritization of critical processes and also the used tools like maps, diagrams, and formal documents.

The Participative approach to process improvement of Noyé is characterized by a user orientation. It employs quality improvement tools to simplify the user participation.

In general, these approaches and the ones presented in section A prioritize the results, they are formal but do not provide the resources that stimulate collaboration between different actors in the process.

Nevertheless, important results need to be retained:

- A process improvement phase before execution in order to obtain early process amelioration.
- The concept of sub-cycle for a particular phase in order to integrate a continuous improvement technique into a traditional management process method.
- The use of quality improvement tools which stimulate people to propose creative solutions.

In conclusion, in this article we propose a new process improvement approach that aims to motivate stakeholders to create, share, collaborate and maintain process maps in an orderly and simple way.

Our work does not replace a traditional Business process analysis tools, our main contribution is to simplify the early phases of the traditional process life cycles and provide an early process improvement phase.

Our work can be considered in the context of Business Process Management and Social Software (BPMS) [21], we try to explore how business process management may profit from social techniques.

In the next sections, we describe the tools and techniques used to support our method: quality process improvement tools and Serious Games.

C. Quality Process Improvement Tools and Techniques

One of the permanent objectives of an organization should be the continuous process improvement. Process models should be able to anticipate and to follow the evolution of processes. Models need to be reviewed and updated to ensure that it reflects the real state of processes and to be closer aligned to organizational needs.

Many tools exist to identify process improvement opportunities and a number of quality improvement tools have been proposed [22], [23], [10], from individual problem solving, rapid team problem solving, and systematic team problem solving to process improvement and redesign.

There are different tools for different kinds of problem solving; it is important to know what sort of problem we are attacking to apply the appropriate sort of tools [22].

These tools provide important methods for self-reflection and analysis. They are simple to use, require no special training and help to collaboratively find innovative solutions to complex problems. For example, quality tools have proven useful in requirements elicitation, Neil Maiden presents in [15] positive experimental results in this domain.

Shiba presents in [22] a compilation of practical tools for assessing, measuring, promoting, and improving the quality of process. Some of them are cited below.

- **Brainstorming** is a group creativity technique designed to generate a large number of ideas for the solution of a problem. Each person on the team is asked to think creatively and write down as many ideas as possible. The ideas are not discussed or reviewed until after the brainstorming session.

- **The Focus Group** A focus group is a group of individuals brought together for a discussion about an issue. In these groups, an objective moderator can encourage participants to freely discuss their feelings and concerns about a topic.

- **The five W's (Who, What, Where, Why, When)** – Collecting precise data through the use of constructive criticism and questioning methods.

- **Cause & Effect (Ishikawa Diagram)** – A simple tool to identify possible causes, hence determining better resolution methods.

- **Histogram** – Graph to display quantitative data related to subject matter. Aid3s in maintaining focus on major causes of problem.

- **Control charts** – Graphs used to study how a process changes over time.

- **Pareto chart** – A simple method for classifying phenomena in order of importance.

- **Scatter diagram** – Graphs pairs of numerical data, one variable on each axis, to look for a relationship.

- **Flowchart** – A technique that separates data gathered from a variety of sources so that patterns can be seen.

Roger Ernoul in [10], introduces total quality management concept and principles accompanied by innovative tools and techniques.

- **Affinity diagram (Jiro Kawakita Diagram)** The affinity diagram is used to organize ideas and data. It is commonly used within project management and allows large numbers of ideas stemming from brainstorming to be sorted into groups for review and analysis.

This is a creative rather than logical process that encourages true participation because everyone's ideas find their way into the exercise.
The main purpose of PDCA cycle application is in process improvement. Process improvement planning generates corrective and preventive actions supported by appropriate quality tools. Application of quality tools in correlation with four steps of PDCA cycle is shown in Table 1.

### TABLE I. QUALITY TOOLS IN CORRELATION WITH FOUR STEPS OF PDCA CYCLE

<table>
<thead>
<tr>
<th>PDCA</th>
<th>Problem solving approach</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>Identify and formulate the problem or the issue.</td>
<td>Brainstorming, The five W's, Affinity diagram</td>
</tr>
<tr>
<td></td>
<td>Finding the real cause of the problem.</td>
<td>Focus Group, Pareto chart, Cause and effect diagram, Relations diagram, Tree diagram, Matrix diagram</td>
</tr>
<tr>
<td>Do</td>
<td>Ask for ideas and solutions and choose one.</td>
<td>Control charts, Arrow diagram</td>
</tr>
<tr>
<td></td>
<td>Plan and implement solutions</td>
<td>Gantt, Pert</td>
</tr>
<tr>
<td>Check</td>
<td>Evaluate the results</td>
<td>Control charts, Pareto chart, The five W's, Process decision program chart</td>
</tr>
<tr>
<td>Act</td>
<td>Establish rules of work.</td>
<td>Focus Group, The five W's, Tree diagram</td>
</tr>
<tr>
<td></td>
<td>Again</td>
<td>Categorization, Affinity diagram</td>
</tr>
</tbody>
</table>

**Relations diagram** Relations diagrams are drawn to show all the different relationships between processes. They are an effective, widely used method for clarifying which causes are most responsible for the problem.

A relations diagram can clarify the cause and effect relationships and facilitate discussion about the principal causes.

**Tree diagram** – breaks down broad categories into finer and finer levels of detail, helping to think step by step from generalities to specifics.

**Matrix diagram** – Decision-making tool to help decide between several viable solutions by basing choices on established criteria.

**Matrix data analysis** – One of the most rigorous, careful and time-consuming of decision-making tools, a prioritization matrix used to make comparisons of a list of options to a set of criteria in order to choose the best option(s).

**Arrow diagram** – shows the required order of tasks in a project or process.

**Process decision program chart (PDPC)** – Systematically identifies what might go wrong in a plan under development.

Process improvement fundamentally is a way of solving problems. If there is a problem, processes need to be improved to deal with the problem [23].

The main purpose of PDCA cycle application is in process improvement. Process improvement planning generates corrective and preventive actions supported by appropriate quality tools. Application of quality tools in correlation with four steps of PDCA cycle is shown in Table 1.

### Synthesis

We have described the tools and techniques used to support our method: quality process improvement tools and Serious Games. In our approach we implemented several of them.

A **Focus Group** is used to represent the role game. Stakeholders are invited to discuss about the process. Questions are asked in the interactive group setting where participants are free to talk with other group members.

Stakeholders are asked about their perceptions, opinions, difficulties and potential improvement actions to the problems within the process.

**Brainstorming** has helped us encourage creative thinking and generate enthusiasm, encourage participation and building on the ideas of others. We have used a silent brainstorming session to identify improvement actions to the problems within the process. Participants are encouraged to write down any new ideas that occur when listening to others.

The **relations diagram**'s objective in our method is to prioritize the amelioration actions. It explains why the relationship is between them.

Our method and more specifically the evaluation and process amelioration we propose will be supported by quality process improvement tools which stimulate people to propose potential, but often creative solutions.

### D. Serious Games

One of our goals is to find the way to involve and motivate the functional actors. The domain of serious games seems to provide the answer; it concerns to apply the video games principles, not for entertaining but for simulating processes with the look and feel of a game.

Serious games are computer or video games designed primarily for a purpose other than entertainment. The use of games within an educational context is fully demonstrated [24], a great number of innovative projects are happening in schools, colleges and universities around the globe. Indeed, serious games encourage collaboration, healthy competition, detailed learning discussions and are helping to transform routine activities and daily work into vibrant, energetic and learning activities. Serious games and active pedagogy encourage users individually and collectively to participate in concrete projects and involve them in the acquisition of disciplinary reflex generally more difficult to apprehend in theoretical terms [1].

Michael Zyda and Ben Sawyer [26] are the precursors of serious games. Based on their works, Julian Alvarez [2] defines a Serious Game as "A computer application, whose initial intention is to combine coherently the serious aspects (Serious) in a neither exhaustive nor exclusive manner, with instruction, learning, communication or further on information, assorted with the playing aspect of Video Games (Game)".

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The playing aspects of video games (history, rules, etc) are preserved, but the goal is to move away from the simple entertainment to find a specific objective. The scope of serious games is wide: Military, Marketing, Education & Training, Simulation, Information, Medical … Although serious games can be entertaining, their main purpose is to make a serious point and stay faithful to the philosophy "serious".

We are particularly interested in the domains of training and simulation [9] by means of role-playing games where participants interact with each other through avatars. The origin of role-playing games comes from about 1921 when Jacob Levy Moreno [17] creates a "spontaneous theater" precursor of psychodrama. Using experimental methods, role theory and group dynamics, psychodrama provides a safe, supportive environment in which to practice new and more effective roles and behaviors.

Later, [8] defines the role playing game as “an improvised scene between two or more members of a group, from a subject (professional, social, family, current or future) sufficiently general to allow each actor to play the role in his own manner...”.

Role-playing is a very useful technique used in many fields such as psychology and pedagogy. It involves participants actively in the learning process by enabling them to act as stakeholders in an imagined or real scenario.

The method and the tool we propose will be supported by the role-playing games and simulation games principles, therefore we adopt the simulation game definition proposed by [18]: “A simulation game is a concrete situation, built on a structural model whose characteristics are to replicate the common essential conditions for a set of real situations”.

**Synthesis**

Our approach pursues two main objectives.

- Simplify the hard and laborious task of gathering information through a serious game approach. The information gathering therefore will be performed "playing" to involve and motivate the different stakeholders.

- Anticipate and simulate the potential improvements actions before executing the real process, again using a serious game approach. Thus the potential improvements actions could be "replayed" as many times as necessary.

For a long time, research into process modeling has been concentrated in their quality par example J. Cardoso, A. Reijers, J. Mendling present a better insight into the factors that make process models understandable for humans [16]. We also focus on improving process modeling but in terms of time.

The originality of our approach relies on the early amelioration process phase, the use of quality process improvement tools which stimulate people to propose potential, but often creative solutions, the use of role-playing games and their implementation in a collaborative way.

In the next section, we present our approach consisting in a serious role-playing simulation game allowing the business process representation with the support of a serious role-playing simulation tool.

### III. ISEA Method

ISEA Method is based on the traditional BPM life cycle, but introduces four original phases: Identification, Simulation, Evaluation, Amelioration (see Fig. 3). This method is particularly useful for existing business processes and allows the representation, amelioration and evolution of changing business processes.

Three phases (Simulation, Evaluation and Amelioration) are based on a serious role-playing game [9]. Additionally, the evaluation and amelioration phases are supported by quality process improvement tools [22].

The ISEA method was defined and designed using user experiments. The purpose of these experiments was to measure the acceptability and feasibility of our method from a qualitative point of view.

It also allowed us to identify, develop and validate the specifications of the simulation game tool.

![Figure 3. The ISEA method](image)

**Identification phase** aims to collect the information necessary to model a process. This phase is generally not highlighted in the traditional business process life cycles in spite of the fact that it's usually hard, complex and exhausting, especially if the organization does not have formal and clear process description documents or if the stakeholders execute mechanically without real conscience of the task.

This phase is generally executed by business analysts who through interviews with the stakeholders gradually elicit the requirements. We have tested this traditional phase through interviews with the stakeholders. A specific process was selected: the schedule management at Grenoble University [3].
We have conducted five interviews and we have seen how this phase has been hard and costly: almost two months between the stakeholder’s identification, the interviews preparation, the interviews conduct and their posterior exploitation.

Noting obviously that these delays were not reasonable, we concluded that the identification phase needs to be sufficiently alleviated and his objective reduced to the minimum necessary for the simulation phase: the identification of all the functional actors in a process.

This identification is made by contacting the first person in the process (often the initiator of the process) who will quickly identify the people with whom he interacts and so on (this identification generally takes two hours). These actors will participate in the simulation phase. This is the approach we have followed for a second process of the Grenoble Informatics Laboratory: the travel expense reimbursement process management, where the stakeholder’s identification took less than two hours (see Fig. 4).

![Figure 4. Map of actors in the travel expense reimbursement process management](image)

**Simulation phase** is the most important and innovative phase of our approach. It is supported by a role-playing game that we call serious role-playing simulation tool. In this phase, all functional actors of a process use the serious role-playing simulation tool in order to collectively elaborate the description of the activities conducted and of the documents exchanged during a business process. The information gathering in this phase is playful and interactive in order to involve and motivate the different stakeholders, thus the role-playing game allows better involving and motivating the participants. We will see more details in Section 4.

**Evaluation phase** aims, always through the role-playing game, to continue “playing” so that the process functional actors detect the difficulties during the process simulation and thus propose potential improvement actions. This phase also called in traditional approaches “phase of control” is usually performed once the phases of modeling and execution have been made, in order to measure and monitor the current performance gaps between current and desired performance of the process.

We propose an early evaluation phase to detect difficulties encountered by the actors during the process simulation in order to make possible a process improvement before the implementation.

We have tested this evaluation phase during an experimental session once the representation of "the travel expense reimbursement process management of the LIG" is obtained in the simulation phase.

This phase is supported by quality tools; a Focus group and a silent brainstorming are proposed. Participants use a silent brainstorming to identify the problems within the process and they were asked to exchange ideas, to discuss the difficulties associated with the process being analyzed and to identify and prioritize opportunities for improvement (called improvement actions).

This experimental session showed that evaluation phase took place under the expected conditions.

Our role-playing game was an effective conflict manager. Participants found it simple and easy to use in a collaborative way. They felt free to communicate openly, take risks and exchange ideas, they imagined creative solutions and they found this experimentation productive in terms of time.

The results of the experiment were surprising in many ways: twenty-three difficulties were identified! Moreover, participants did not have problems in expressing these difficulties, but it was very difficult for them to identify potential improvement actions to the problem, probably due to the fact that difficulties affect their own work, while the improvement actions are more global and involve several actors.

**Amelioration phase** The next step is called amelioration or improvement phase; its objective is to "replay" the process according to the proposed improvement actions. Many improvements are indeed organizational improvements and it is not necessarily required in this case to execute the process if the objective is to highlight the need for improvement.

Amelioration phase is supported by quality process amelioration tools. Brainstorming, affinity diagram and relation diagrams are used by the participant to identify, organize and prioritize the amelioration actions respectively.

A silent brainstorming session allows identifying improvement actions to the problems within the process.

After, participants sort the solutions obtained by brainstorming. They organize the post-it notes into groups that make sense to them and then name each group. Thus they get potential improvement actions.

Finally a relations diagram is used to prioritize the potential improvement actions. Participants answers a "Why" question; it explains why the conditions uncovered by the Affinity Diagram exist and what are the relationships between them.

Thus, once the improvement actions are identified and organized, the process is replayed as many times as necessary to quantitatively identify the impact of improvement measures on the process.
Several iterations simulation - evaluation - amelioration may be needed. This improvement, of course, does not eliminate the "classic" phase of control and optimization, but can significantly reduce it.

We also aim to integrate continuous improvement techniques in our approach in order to simplify the process amelioration. Therefore, the evaluation and amelioration phases are supported by quality management tools, which stimulate people to propose potential, but often creative solutions [22].

**Modeling phase** The objective of the modeling phase, as usual, is to document the organizational practices using a business process modeling language such as BPMN [25]. These BPMN models are partially deducted from the results of the amelioration phase.

**Execution and optimization phases** Once obtained the BPMN models, the execution and optimization phases are the same as in traditional life cycles of BPM approaches.

We are currently working on the development of our method and the simulation game tool, support of the phases of simulation, evaluation and amelioration. Next section focuses on the simulation phase and describes experiments that we have conducted with the functional actors of a specific business process.

### IV. SIMULATION PHASE

The simulation phase is supported by a software role-playing game that we called "serious role-playing simulation game". This phase aims to get a description of the activities conducted and the documents exchanged during a business process in a collaborative and playing way. The different functional actors involved in the business process establish together the description of the process as it currently works.

**Experiment** We followed a quality improvement approach to conduct user experiments for the construction and validation of our method. These experiments allowed us to construct a method suited to the functional actors needs, and make our method both more simple to follow and more robust.

The experiment that we have conducted for the simulation phase was based on a focus group and consisted in a “manual simulation” of our future game with the objective of identify and validate its specifications. The case study was the travel expense reimbursement process management of the LIG laboratory.

All the functional actors of the process identified during the identification phase have been asked to work together to establish the description of the current process. Therefore, a missionary, a team assistant, a team leader, a financial manager, and a laboratory director participated in the simulation phase. The travel agency and the accounting department were considered as external actors in the process. Indeed, the travel agency is not part of the information system and we are not able to take into account the accounting activities (the laboratory interacts with the accounting services of several universities).

**Hypothesis and objectives** Our research hypothesis was that actors would be able to reconstruct the process in a fun, fast and simple way using the resources provided for the experiment. The goal for us was to identify, develop and validate the appropriate specifications of our future simulation game tool. Therefore, we “manually” simulated the game using very simple tools: a large sheet of white paper on a table, color markers, color post-it notes, color-coding labels …

<table>
<thead>
<tr>
<th>Phases</th>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception</td>
<td>Situate the general context of the experiment through electronic slides.</td>
<td>5 min</td>
</tr>
<tr>
<td>Roundtable and role assignment</td>
<td>Role assignment for the participants of the experiment. During this phase, we can realize that some roles have not been identified. In this case, the facilitator can play this role or a new session will be necessary. The facilitator represents the external actors (he receives and transmits information).</td>
<td>10 min</td>
</tr>
<tr>
<td>Scenario proposal</td>
<td>We have played the following scenario: “A new missionary has been recruited by the laboratory. He has a conference in France and he has to travel”.</td>
<td></td>
</tr>
<tr>
<td>Presentation of the game rules</td>
<td>The basic principles of the game are presented in order to know the rules of the role-playing game.</td>
<td>5 min</td>
</tr>
<tr>
<td>Playing</td>
<td>See paragraph “playing”</td>
<td>80 min</td>
</tr>
</tbody>
</table>

**Experimental Protocol** The experiment was carried out in a two hour experimental session with the objective to trace the process in terms of activities; exchanges of documents, etc (see Table II).

**Playing** We have conducted this experiment with the help of post-it notes that represent activities and color markers to differentiate the roles. Participants are put in situation. Each player takes its turn after the other depending on the situation, as would occur in real life. For example, this experiment begins with the missionary, who needs to establish a mission request.
Each participant plays its own role, takes notes on a yellow post-it of the actions performed during the real life. Each one has a color marker which identifies him. The participant places the post-it on the paper board and makes one or more arrows indicating the actor to whom he passes the turn (see Fig. 5).

The actions consist of a verb conjugated in the first person of the singular (e.g. “I ask”), a medium (e.g. “by email”) and a document if needed (e.g. “a quote”).

The verbs and mediums are available to actors in the form of pre-filled sheets. During the game, it is possible to enrich this common vocabulary. The documents are written on a paper-board when they arise.

The document creation is a specific action. In this case, the participant completes a short description (document name, restriction on use, type of document like electronic or paper), places a color-coding label on the sheet (a single color to identify each document) and another on the post-it (the same color). If a participant needs a document previously created, he places the respective color coding label on his post-it (see Fig. 6).

If the intervention of an external actor is necessary, the facilitator plays this role by placing a pink post-it (different from the internal actors). No action is noted on this post-it; only documents may move or appear on it.

During the game, a participant can “place a joker” to denote a possible variant in the scenario, or the fact that different scenarios can be possible. For example, it is the case when the missionary has to ask to his team leader a “mission order”. A possible variant is “the team leader is not available”. For each post-it, the alternatives are carefully noted by the facilitator.

At the end of the scenario, we have proposed to consider two jokers. “The team leader is not available” and “the missionary takes his car”. These variants have been carried out using a portion of the sheet not yet used, to separate it from the regular scenario.

**Experimentation results** The simulation phase is adequate, was correctly planned and executed: no role has been forgotten, which is normal for a relatively common process.

Participants were quickly involved in the game, helping each other to search the action, the medium, reminding if he had forgotten something, etc.

The time (two hours) was enough, but a second meeting would be necessary to play all possible variants. Having a common vocabulary is to be retained. It will be important to formalize and represent this vocabulary, for example with ontologies.

**Simulation phase result** The result is very similar to a BPMN "basic" process (see Fig. 7). The paper sheet represents the workspace, the post-its are the activities, the lines between the post-it are the flow objects and it is easy to find the swimlanes through the different color markers.

It remains to add complex modeling elements such as start events, intermediate events, end events, looping activities, etc. New experimental sessions will allow us to test "how far" is the limit for introducing these elements without losing the playful side.

**V. ASSOCIATED SERIOUS GAME**

Experiments presented in Section 4 allowed us to specify our "process modeling simulation game" which we called ISEASimuLator.

The following diagrams show the actors and the expected features of the tool. Two main actors are involved: the facilitator and the game participant.

The main functionalities were grouped into several packages. The role management package (see Fig. 8) presents the declaration, assignment and validation of the roles, the participants register and their validation.
The simulation package (see Fig. 9) is dedicated to the participants interaction, allowing them to place activities, create documents, link activities, ... Moreover, the facilitator can create scenarios, initialize the process, play as an external actor, replay and register a scenario, etc.

The evaluation package (see Fig. 10) includes the use cases for difficulties identification and classification. The amelioration package (not presented here), has two main use cases: “choose improvement action” and “rank improvement action” and reuses the most use cases of the simulation package.

From the specifications obtained in the experimental process concerning both the method and the associated tool, we have implemented a first prototype of the role playing simulation game. It is part of a virtual 3D world called Second Life created by Linden Labs. Thus, all the modeling elements were represented as 3D virtual objects.

Fig. 11 shows a screenshot of the simulation game and a screenshot of an avatar in the 3D world.

Fig. 12 shows an avatar taking the role of a participant playing with the virtual objects. The panel represents the workspace, the colored swimlanes indicate who is performing an activity and the trolley (see Fig. 13) represents an activity.
VI. Method and Tool Summary

We have examined the acceptability and feasibility of our method. The ensemble of experiments conducted shows that our method works effectively, it is particularly useful for existing business processes and ISEA method has proved to be easy and enjoyable to use.

ISEA has been used successfully on a large variety of university processes: the travel expense reimbursement process management of the Grenoble Informatics Laboratory (LIG), the management of overtime pay process at ENSIMAG School of engineering Grenoble-INP, the application and admission process in MIAGE at Joseph Fourier University.

Additional future experiments to evaluate the prototype of the game are planned for next month of January. The directions of the Grenoble Informatics Laboratory and the Vice-presidency of Pierre Mendès France University have asked us to participate in the formal representation and risk evaluation of their internal processes.

We have also experimented with goal-based approaches in the evaluation and amelioration phases of our current method.

The results of goal-based approaches experiments allow us to derive useful information for further optimization of our method. This experiment has been a complete failure, probably due to the fact that when people are familiarized with a process, it is easier for them to think in terms of difficulties and ways to improve them rather than in terms of objectives and strategies. Nevertheless, using goal-based approaches for new or not well-defined processes will probably get more sense.

Our role playing simulation game prototype has been tested by different users who gave us positive feedbacks.

In general, results show that our prototype is equipped with the correct functionality described for the simulation and evaluation phases. Nevertheless, results show that users face problems of data visualization that lead us to implement substantial changes in the user interface.

VII. Conclusion and Future Works

This paper proposes a Serious Game-based Method for Business Process Management through the incorporation of a role-playing simulation game. This approach is particularly useful for process mapping establishment and for the continuous improvement of existing business processes.

The method is based on seven phases: Identification, Simulation, Evaluation, Amelioration, Modeling, Execution, and Optimization. The first four phases are particularly original: the identification phase is reduced to the identification of all the functional actors of the process whereas simulation, evaluation and amelioration phases are based on role-playing and quality management tools which allow the process improvement before to model and execute them.

We have conducted qualitative experiments in order to examine the acceptability and feasibility of the method and to develop the specifications of our role-playing simulation tool. We have implemented our first game prototype as part of a virtual 3D world and we have created a virtual representation of the modeling elements.

Our current works are to study how it can be adapted for the presentation of new or not well defined processes, such as the processes of virtual organizations. Virtual organizations are composed of several organizations which group together around a new business process in order to follow the evolution of the market or to be more competitive. In such cases, it will be necessary to think in terms of strategies, goals and ways to reach these goals.

Our future works aim to strengthen the method and complete the simulation tool. In particular we will include a chat to allow the facilitator to initiate discussions around the difficulties and improvement actions in order to build a consensus.

We plan to implement further extension to our serious game tool. With our approach, we aim at creating generic, reusable representations of process, we are therefore planning to examine options for providing conversion rules from ISEA method models to BPMN models, and maybe automate this conversion.

Future experiments are planned to examine the feasibility of the game-based tool with the participants playing together in the beginning, but finally playing independently (each player in his office) in order to find the ideal configuration. Indeed, the conducted experiments allowed us to validate the method on its manual version, but, although video games are nowadays part of everyday people life (young people and men in particular), we must now study if using a serious game will not have a negative impact on the collaborative and relational aspects of the ISEA method.

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