Getting users involved in aligning their needs with business processes models and systems

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Abstract

Purpose – This paper aims to present a case study of the application of a methodology that represents an innovative strategy that integrates researches on interaction design and business process management with practical implications. This methodology is devoted to aligning the needs of enterprise system users with business processes (BPs).

Design/methodology/approach – This approach establishes an unbroken network of links between BPs, task models and abstract representations of user interfaces. Once the models are linked, it is possible to identify the impact that any change on these models may produce in other models. The main challenge is to organize the linked models according to the organizational context and manage those links with consistency in order to support improving process efficiency and user productivity. This approach has been applied in a large telecommunications organization during four months with its application in two different projects and validated with a cost-benefit analysis.

Findings – Applying this approach in large organizations has demonstrated that: every involved stakeholder is capable of understanding the whole approach in one working day; creating the models and linking them with the corresponding business process models takes around three men/day per core business process; and applying this approach brings up to 60 per cent of return on investment related to process improvement and user experience.

Originality/value – The main differentials of this methodology include using simple models; considering light actions; preserving the independence of technology; and adopting a human-oriented approach assuring that every managed information impacts people and not only systems, thus enabling fast adaptation to the business dynamism.

Keywords Business process management, User interfaces, Model-driven engineering, Enterprise systems, Interaction design, Process planning

Paper type Case study

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1. Introduction

Business processes (BPs) represent a set of activities that produce a specific output for the organization and its customers (Davenport, 2006). They are usually presented in a graphical format to enable better readability so that professionals can learn and repeat certain steps every time they need to do specific procedures. For instance, in the context of large organizations with several heterogeneous systems, fusions with other organizations or within departments are common. When there are fusions, these systems, including legacy applications, must be integrated. In such a context, BPs play a fundamental role to preserve their corporate knowledge with transparency and dynamism. This aimed dynamism is obtained with the execution of BPs through the use of enterprise systems (i.e. information systems that support BPs of organizations). However, it is common to find organizations that cannot realize which systems to use to perform some BPs. They consequently lose track of what is strategically specified and what is actually done. The alignment of BP with information technology (IT) has proven to promote growth, profitability, and innovation in organizations worldwide (IBM, 2009).

In cases of lack of alignment between business and IT, large organizations normally face severe problems. For instance, when employees are not aware of procedures, they consequently do not follow certain established policies and laws because these procedures might have been just managed just in BP models, but not highlighted nor transferred to enterprise systems. Organizations also face problems when the evolution of enterprise systems is faster than the evolution of the BPs supporting them. Organizations that face these kinds of issues have not employed any alignment strategy or they apply simplistic strategies that do not cover different organizational contexts.

Several recent strategies on IT-business alignment and model-driven user-interface development (MD-UID) (Vanderdonckt, 2005) address impacts from BPs on IT infrastructure and on the functional core with solutions that automate the generation of systems to provide alignment. However, such strategies are usually technology-dependent and assume the organization wants to start developing their systems from scratch. In addition, the links between BPs and the systems that are supposed to support them are far too simplistic. Thus, they ignore multiple links between several business activities and several screens, even in different systems, whether for legacy or recent systems.

Aligning BPs with enterprise systems enables organizations to execute changes with flexibility. However, it is no longer only system processing time that is pivotal for large organizations to change and improve their services for customers. Therefore, we have innovated by aligning IT with BPs through user interfaces (UIs) by defining the UI-business alignment methodology. This methodology analyzes the impact of changes independent of the way BPs are structured and modeled, and how UIs are designed and developed. Here, the concept of alignment (Henderson and Venkatraman, 1999) addresses the fit between the external business arena (i.e. business process models) and the internal structure (i.e. UIs of enterprise systems) and the integration of these structures (i.e. link between BP with UIs).

This methodology uses task models to bridge these distinct domains in a level that is abstract enough to be technology-independent. Task models represent users' tasks while interacting with systems and they have been extensively used so far for model-driven UI generation, usability tests, UI simulation, as a source to improve

UI design through different techniques, etc. However, the UI-business alignment methodology is the first one to use task model as a source of traceability, one of its main differentials. This methodology also covers different kinds of applications because there are several organizations that already have their BPs and systems and cannot afford to re-develop their solutions with new technologies, but need to analyze the impact of changes on their BPs and systems.

This methodology is aimed for enterprise systems in organizations with extensive BPs and hundreds of users using thousands of UIs. The main goal of this methodology is to keep enterprise systems aligned with BPs from the point of view of process performers and process designers, offering a complementary approach to existing solutions for IT-business alignment. These existing solutions are more concerned with requirements and implementations, understood only by specialized professionals (e.g. system analysts, software architects). While our proposed solution focuses on UIs, the part effectively in use by business process performers, who are also enterprise system users (e.g. bank employees using the system at a bank agency). Consequently, the alignment of business with UI brings several benefits, as the ones listed as follows:

(1) Operation managers become aware of who is responsible for what, not only the user roles.

(2) Users can report bugs, suggest improvements and report occurrences during the process execution. This valuable information will then be instantly linked with the corresponding process elements, thus helping business analysts to make decisions that may effectively improve process performance.

(3) System maintenance requests by business analysts are sent in a well-contextualized manner to system analysts. These requests then come with the needed information about which parts of the processes are impacted by those changes, which users will interact with the changes when the new version is released, and which UI design decisions were not well accepted by end-users.

The experience in a large bank-insurance company presented in Sousa *et al.* (2008c) served as foundation to identify the gap in IT-business alignment strategies and to propose a solution to align BPs and UIs of their enterprise systems. From the case study with this company and further contacts with other companies in the banking, automobile and pharmaceutical businesses, it was possible to confirm that this is a major issue in this company as well as in many others large companies in the competitive business world. The bank case study was the first application of the methodology, which focused on how to manage the links between the models. This first application was fundamental to give a solid foundation to the methodology, but there was still the need to apply it with end-users of enterprise systems, not only with specialized IT and UI professionals. This reality encouraged us to validate this approach in another organization with a different business profile aiming at analyzing their interest on the strategy and their openness to change. Such application of the methodology is the focus of this paper.

The remainder of this work presents and compares some existing works on IT-business alignment and MD-UID concerning predefined requirements for the integration of these domains (Section 2). The UI-business alignment methodology is then presented, in which models are at the core of the solution, how they are managed to provide alignment, and how professionals can understand and use the solution (Section 3). A detailed application of the methodology is done in a large telecommunications company (Section 4) in order to analyze the validity of the methodology in the context of a large organization with the participation of end-users of enterprise systems. The main contributions are demonstrated through the proposed solution for certain issues faced by the organization, which leads to some recommendations for future works (Section 5).

2. Related works

In order to analyze works about the alignment of BPs with IT, including how UIs are handled in this context, we have selected works from two different lines of research. First, works from IT-business alignment are presented since they focus on aligning BPs with enterprise systems. Second, we selected works on MD-UID that are concerned with UIs of enterprise systems.

Concerning IT-business alignment

Recent works suggested different types of traceability support between BPs and their supporting software systems. In this research line, a framework was defined to do the traceability between business strategy, BPs and information systems using UML stereotypes (Vasconcelos *et al.*, 2004). This framework proposes a diagram called goal/process/system (GPS) diagram, which represents the association between these three areas and allows identifying dependencies when changes are performed in any of these areas so as to propagate them where it is appropriate. Despite providing support for traceability between strategy, BPs and information systems, it does not address any aspect of user interaction because it focuses on information system architecture.

The Center of Organizational Engineering (CEO) framework represents an enterprise architecture (EA) that aligns the organization's strategy with its BPs, people and IT software and hardware (Sousa *et al.*, 2006; Zacarias *et al.*, 2007). This framework is adaptable with the possibility to redefine the rules that associate enterprise concepts and it includes a human perspective by relating actions of individuals with organizational activities and resources. However, it has no concept related to user interaction. Activities performed by people using a system are represented as automated services that are directly associated with technological components.

Artifact-centered operational modeling (ACOM) is an approach to capture business operational knowledge that is distinguished from other approaches by identifying one information structure, the artifact, which travels from end to end in a process (Bhattacharya *et al.*, 2007). They have defined a framework for IT-enabled business transformation using ACOM as the central foundation. This approach is strong on traceability because it uses a model-driven business transformation (MDBT) approach that maps organizational goals with IT implementations. To support that, they have developed a MDBT toolkit to assist in modeling and semi-automatic model transformations into running applications. On the other hand, it does not provide any support for user interaction because it is focused on system implementations and how IT components are linked to operational tasks and artifacts. Further, it is not adaptable to different organizational contexts because it assumes the adoption of service-oriented architecture for IT solutions, not applicable in all scenarios.

The end-user business process modeling (Stoitsev *et al.*, 2008) is an approach in which business users are active participants in business process modeling using the collaborative task manager (CTM), which provides end-user development capabilities. In their approach, formal process flows are created based on tasks that different process participants are performing. CTM tracks to-do lists of different process participants and integrates them in task delegation graphs, which provide a workflow-like overview of collaborative tasks. This strategy is user-centered because formal process flows are created based on actual tasks users are performing and it is, in a way, human-centered because business users are active participants in business process modeling. However, they participate as creators of process models. This kind of participation does not necessarily get the most useful information from them using their existing know-how. It actually requires them to learn certain techniques in order to be able to give any suggestion. Their solution is useful for situations where organizations do not have their processes formally modeled neither enterprise systems that automate their processes. In this case, they need to create a workflow system from scratch to guarantee that the sequence of activities is done by the respective participants. This strategy is, therefore, not adaptable to different organizational contexts.

Concerning UI and user interaction

Since most of the works from IT-business alignment have little or no concerns with end-users and on how they perceive and handle this alignment, we have expended our literature review to the analysis of some works from MD-UID. This analysis verifies how this line of research considers UIs of enterprise systems and their alignment with their BPs. MD-UID provides a more systematic approach to UI construction, by relating the interface developed to the underlying abstract models. It comes as a solution to improve efficiency by reusing UI models (Barclay *et al.*, 2003). As a result, it enables changing the mindset from only functionality or technology towards user interaction. The works on this line of research are quite broad, where much effort has been focused on model-based design and development of UIs, creating UIs from user tasks (Calvary *et al.*, 2003; Costa *et al.*, 2006; Eisenstein *et al.*, 2001; Paterno and Santoro, 2002; Wolff *et al.*, 2005) with a focus on automatic generation of UIs. However, the focus of this investigation in this line of research is on model-driven (as opposed to merely model-based) and user-centered (as opposed to merely system-centered) design and development of enterprise systems with a focus on the alignment of UIs with BPs models.

In MD-UID, the interest for enterprise systems has been growing in the past years, but it has not been widely researched. Among few solutions, a research on the enhancement of the UI design practice with business process modeling (Sukaviriya *et al.*, 2009) leverages business process models as a starting point of the UI design process. To support this approach, they have developed a UI environment called model-driven human interaction (MDHI), which enables designers to connect UI design with business domain model elements. This approach is very compatible with our solution by providing a user-centered solution for the traceability issue. However, it is not adaptable to any organizational context because it assumes the organization already adopts or intends to adopt artifact-oriented business process modeling. In addition, it is not human-centered because the key people who participate in their approach are business analysts, data modeler, user experience designer and UI modeler; not including end-users.

The recent work of Traetteberg (2008) on model-based UI design structures the modeling method into five steps: first, it starts with BP modeling using business process modeling notation (BPMN) Object Management Group (OMG, 2009) combined with domain modeling using class diagrams. Since this version of the BP model is considered as system-centric, the second step is to separate users' tasks from the system in a refactored process model, still using BPMN. The third step is to create the dialog model to describe the software behavior using the dialog modeling language DIAMODL. The forth step is to generate the graphical UI prototype from the dialog model. The last step is the deployment of the system. Performing these steps provides the traceability between the BP models and the generated UIs, in addition to the adoption of task analysis that makes this method user-centered. However, it is oriented to UI and IT professionals, not considering end-users. In addition, it is not adaptable to any organizational context because it assumes the adoption of service-oriented architecture for IT solutions, ignoring how to handle legacy systems.

From the detailed analysis of these works, we have identified a list of shortcomings that must be addressed in this domain. These shortcomings were considered an inspiration to define the main requirements to be fulfilled in our research, listed as follows:

(1) *User-centered*. Designing systems focused on users and their tasks.

(2) *Adaptable*. The ability to be adapted and applied in different organizations, independent of their adopted business process structure, UI design or IT solution.

(3) *Human-centered*. Make business process performers active agents in the methodology by considering their viewpoints.

(4) *Traceable*. Support organizations in maintaining their systems aligned with business process models, where it is possible to identify the impact that changes on a particular model has on other models and on the system as a whole.

(5) *Software support*. Supply software integrating different models into one source in order to provide traceability.

These requirements were also used as evaluation criteria to analyze and compare these existing approaches. Table I depicts how the investigated approaches were evaluated considering the requirements, which represents an overview of this analysis.

More specifically, we report this analysis by summarizing how these approaches adhere or not to these requirements.

Not all of the analyzed works have a vision for UIs and the ones that do have a user-centered approach (i.e. CTM, MDHI, DIAMODL) propose aligning BPs with UIs with direct links between process activities with UI elements. However, such strategies leave aside the consideration of the user interaction, which is much richer than what is specified in BPs.

	GPS	CEO	ACOM	CTM	MDHI	DIAMODL
User-centered				x	x	x
Adaptable		x				
Human-centered		x		x		
Traceable	x	x	x	x	x	x
Software support			x	x	x	x

Table I. Global comparison of approaches for all requirements

Most of the investigated approaches are not adaptable to different organizational contexts because they are defined based on specific IT solutions. They usually assume organizations will adopt a specific technology (e.g. service-oriented architecture) or that organizations do not have their processes formally modeled, or do not have their enterprise systems developed and deployed. Thus, they impose that the organization should create their systems from scratch. Only the CEO approach is adaptable with the possibility to redefine the rules that associate enterprise concepts.

Most of the investigated approaches do not follow a human-centered approach because they are highly technical by focusing only on business and IT. They mostly adopt semi-automatic generation of systems or focus on UI and IT professionals, not on business performers. For the ones that are human-centered (i.e. CEO, CTM), they have not explored how end-users can produce valuable information for business process improvement.

Traceability is a characteristic that is present in all investigated approaches because they create links between BP and IT or UI, each using their own concepts and technology.

Most approaches are also supported by tools from the development of environments that are integrated with well-known business process notations, such as JBoss Business Process Management (jBPM), BPMN, and with well-known human-computer interaction (HCI) models –, e.g. dialog model, UI model. The only ones without a tool to support the inherent traceability (i.e. GPS and CEO) are mainly methodological proposals.

We have acknowledged the importance of the alignment between BPs and their supporting enterprise systems in the literature. But, we have not seen how to manage such alignment by considering how users interact with those systems and the impact of the user interaction on the business performance. That has been an important concern that motivated us to analyze how to align BPs with UIs and how user interaction and end-user participation can have an impact on business process improvement.

3. UI-business alignment methodology

The UI-business alignment methodology has the goal to support organizations with a strategy to know that what is specified regarding organizational procedures is reflected in the systems that people constantly use to follow these procedures. One aspect that makes the UI-business alignment methodology innovative is that it considers the needs of end-users of enterprise systems to maintain the alignment of BPs with the UIs of these systems.

In order to support traceability and impact analysis when changes are requested, the UI-business alignment methodology establishes an unbroken network of links between a set of models (Sousa *et al.*, 2009b). These models are outlined, followed by the specification of how they can be mapped and managed.

3.1 Models used in the alignment methodology

The three main models used in the methodology are: business process model, task model and UI model.

According to BPMN (OMG, 2009), a business process is defined as a set of activities that are performed within an organization or across organizations. The usefulness of BPs is directly related to the formalization of the sequence of work and the decomposition of the organizational complexity. Once formalized, it can guide the employees and facilitate identification of improvements in the processes.

The BPMN used in the application of this methodology is BPMN (OMG, 2009) because it is a worldwide OMG recognized standard. It is readily understandable by all business users with its standard visualization mechanisms, following the tradition of flowcharting notations for readability; among other benefits that make it the next generation notation that combines readability, flexibility, and expandability. In addition, it is implemented in several tools with proprietary or open source code. However, other notations can be easily used since the main requirement to select a business process notation for this methodology is that it is able to decompose activities in smaller parts. For instance, as a sub-process in BPMN that can be decomposed in as many levels as needed to specify a complex activity.

Task model is used to specify tasks that users perform while interacting with systems in order to achieve their goals (Vanderdonckt, 2005). With this perspective towards users who interact with UIs, we call these tasks, UI Tasks, differentiating them from BP tasks.

The task model's hierarchical structure has the same purpose of the business process structure, which is to specify operations from high level until a detailed description. The symmetry of both structures represents a clear bridge between BPs and UIs. Without the task model, linking processes directly with UIs is not optimal because processes with high-level description do not express how activities are performed. Other researchers in the literature have already come to agree that the "visualization of connected boxes as usually diagrammed in a BP model has limitations; they do not give people a good grasp of a more tangible understanding of the process" (Sukaviriya *et al.*, 2007). We argue that UIs are a concrete way to show the flow of activities of a BP. But if UIs are to consider BP flows and also be productive for users, that is a good reason for having the task model as a bridge between the BP and UIs.

A UI is a means by which users interact with the system. The UI model structure is comprised of UI components, which are components used for user interaction that start in an atomic level and are further composed in broader levels:

- "Screen element" is any UI widget that serves as input and/or output for a UI task, it is the most atomic component (e.g. button, combo box, list box, label, radio button).
- "Screen fragment" is a portion of the UI that is semantically related to other components (e.g. tab, menu).
- "Screen" is a state of the UI when executing a UI task or part of a UI task (e.g. page, dialog box).
- "Screen group" is a group of closely related screens.

One example of a UI where we identify UI components to extract the UI model is shown in Figure 1. This UI is later used in the case study to present how the models are mapped and analyzed when changes are made on them.

The broadest components are composable in nature, unlike the most atomic components. Table II depicts the composition and constraints of the UI components. Screen elements are mandatory atomic components. Screen fragments are optional

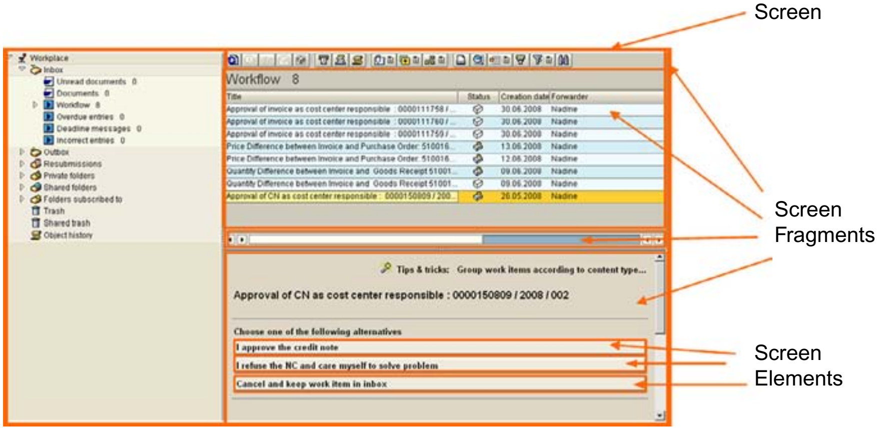


Figure 1.
Extraction of the UI model

Table II.
Decomposition of UI components

UI component	Composed of	Constraint
Screen element	–	Mandatory
Screen fragment	Screen fragment	Optional
	Screen element	At least one screen element
Screen	Screen fragment	Mandatory
	Screen element	At least one screen element
Screen group	Screen group	Optional
	Screen	At least one screen

components, they may contain screen fragments and it must contain at least one screen element. Screens are mandatory components, they may contain screen fragments and it must contain at least one screen element. Screen groups are optional components, they may contain other screen groups and it must contain at least one screen.

Screens, screen fragments and screen elements have their specific UI component types. Screens can be presented as pop-ups, dialog boxes, pages, among others. Screen fragments can be represented as panels, menus, tabs, etc. Screen elements can be depicted as fields, labels, buttons, links, etc. The organization of the UI model in these UI components makes it comprehensive enough to consider most types of UIs, even those with elements poorly specified or even ignored by UI representations in general, such as video, music player, 3D rendering, etc. For any new type of UI element, it is enough just to identify it as a new type in the existing set.

The task and UI models are founded on task and concrete UI meta-models for user-interface eXtensible Markup Language (UsiXML) – www.usixml.org) (Limbourg and Vanderdonckt, 2004) because it provides the necessary support to represent models in a formal and structured manner. It is a reliable reference that is candidate to a W3C standardization process for model-driven UI. It supports the flexibility necessary for defining model-driven UI development. It covers a wide range of UI interaction modalities (e.g. graphical, vocal, tactile, multimodal), which creates more possibilities of integration with different types of systems. It follows a transformational approach that allows flexibility in defining traceability links. In addition, it has been in constant evolution, being the subject of exploitation by several companies and universities under the umbrella of a long-term European project.

Different from other approaches, the UI-business alignment methodology considers UIs as a source for process improvement since user interaction is seen as the concrete execution of process activities. With this perspective, the methodology considers users as active agents who open a new channel for business improvement by informing any sort of problem they face when interacting with the UIs. The identified issues may lead to changes on the processes, on users' tasks, on UIs or on all of them.

UIs can be useful as a means to communicate the way activities are executed in a concrete manner. Using the UIs as a way to communicate BPs is one of the innovations in this methodology. This methodology has been defined to specify how UIs can be mapped to business process to cause a more significant involvement of end-users.

3.2 Alignment methodology approaches

These models can be managed differently depending on the context of the organization where it is applied. This methodology is more suitable for companies that:

- are large because they usually have plenty of systems in production. These systems are running in different platforms and there are hundreds of UIs being used every day;
- adopt BPs, which are the foundation for their enterprise systems and are all in constant evolution; and/or
- have extensive enterprise systems that automate the corporate operations, but have not yet designed their BPs, but are interested in adopting a business process-oriented strategy.

These cases represent situations in which the organization needs to maintain their systems in accordance with the BPs in order to have systems that evolve according to the business strategy. But such alignment is not easy to achieve throughout different departments within the organization. In addition, each department often works separately and has serious difficulties in understanding the work of other departments, such as business and IT departments.

Because of these different realities encountered in companies, the methodology can start from the BP or from the UI. Therefore, the methodology has been organized in core actions that can be applied in two main approaches: forward and backward. Each of these approaches follows a sequence of disciplines related to business process management methodologies and user-centered design methodologies. These disciplines structure the methodology (shown in Figure 2) and are described as follows:

- Business analysis is the set of tasks, knowledge, and techniques required to identify business needs and determine solutions to business problems. Solutions often include a systems development component, but may also consist of process improvement or organizational change (IIBA, 2006).
- Task analysis is used to analyze the underlying rationale and purpose of what people are doing (Sharp *et al.*, 2007).
- Conceptual design means high-level UI design regarding the presentation structure that maps to interactive tasks (Mayhew, 1999).

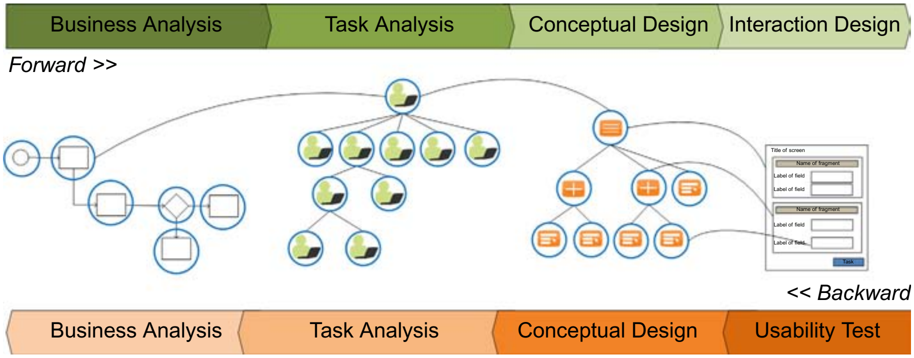


Figure 2.
Alignment approaches

- Interaction design means designing interactive products to support the way people communicate and interact in their everyday and working lives, aimed for all kinds of technologies, systems and products (Sharp *et al.*, 2007).
- Usability test means testing with real users to obtain direct information about how people use computers and what their exact problems are with the concrete interface being tested (Nielsen, 1993).

These disciplines guide stakeholders to link the models and create a network of links applying different approaches, as it is adequate for their corporate scenario. There are two approaches to create a network of links: starting from their processes (forward) or starting from the UIs (backward). We do not use a middle-out approach to create the network of links since task models are not largely adopted. On the other hand, since task models can be derived from BPs or UIs, a middle-out approach is then used in the impact analysis. These approaches are explained as follows:

Forward approach. Applicable in situations where there is a process and there is no system. The forward approach can simulate what could be the future user interaction to execute the process.

The core activities of the methodology to guarantee the UI-business alignment are listed as follows for a scenario application of the forward approach:

(1) Business analysis:
  1.1 select representative and critical processes of the organization;
  1.2 model BPs; and
  1.3 identify systems related with those processes, if existent.
(2) Task analysis:
  2.1 model UI tasks; and
  2.2 map process activities with UI tasks.
(3) Conceptual design:
  3.1 model UIs; and
  3.2 map UI tasks with UIs.
(4) Interaction design:
  4.1 design UIs.

Backward approach. Applicable in situations where there is a system and there is no process. The backward approach uses navigation patterns in the system as a source of data to exploit BPs.

For a scenario application of the backward approach, the core actions are the following:

(1) Usability test:

1.1 select representative and critical systems of the organization; and

1.2 observe users working with those systems to identify their tasks.

(2) Conceptual design:

2.1 model UIs.

(3) Task analysis:

3.1 model UI tasks; and

3.2 map UIs with UI tasks.

(4) Business analysis:

4.1 model BPs; and

4.2 map UI tasks with process activities.

After the mappings are created in any of these approaches, the impact analysis can be performed in three different approaches:

In the forward approach, when changes are made on BP models, they may impact UIs. Such changes can be done from a variety of reasons, including new or alternative ways of doing things, new business opportunities, organizational changes, new regulations, etc. It can verify the alignment of the processes with existing interaction; and identify what impact the optimization of processes has on the user interaction.

In the middle-out approach, changes are made on task models as suggestions from usability experts and UI designers. When changes are made first on task models, the impact is on BP models and UIs with possible updates. Reasons for such changes include new ways to perform tasks that improve the user experience. It can analyze how improved user experience impacts business process specification and performance.

In the backward approach, changes are made on UIs as suggestions from systems users (e.g. customers, employees). When changes are made first on UIs, the impact is on BP models with possible updates. Reasons for such changes include defects to be fixed, better user understanding of the systems' features, new technology, etc. It helps identifying how the improved usability of UIs impacts BPs.

The result of the impact analysis on the forward and middle-out approaches represent advices of possible changes to be done on UIs by UI designers/usability experts. We emphasize that the methodology does not aim to automatically generate UIs. We argue that the work of UI designers is primordial to achieve user satisfaction. UI designers with a human interpretation of their knowledge about user experience, user needs, and design ideas can create UIs that are suitable to the constraints imposed by specific projects.

The methodology can be applied in organizations with minor changes on the way they work, highlighting that the core actions are mandatory to guarantee UI-business alignment. It can be incorporated in the normal practice of corporate initiatives, subject further explored during the explanation of the case study.

The methodology is flexible enough to enable stakeholders to specify at which level of granularity they will map the elements, depending on the complexity of the processes and systems, on the information available and other aspects that directly influence the impact analysis.

A fine-grained granularity level adopted when mapping the models expresses more details in the results of the impact analysis. Each level of BPs can be mapped with the different levels of task models and the task model can be mapped with composable or atomic UI components. For instance, if one chooses to map tasks only to composable UI components, the resulting impact analysis will be presented in terms of screen groups and screens. When tasks are also mapped to screen fragments and screen elements, stakeholders are able to know which fields or buttons on the affected systems are required to change when certain tasks have been updated. This is increasingly relevant for scenarios of several heterogeneous systems, where there is a significant amount of impacted systems and screens.

In summary, this methodology contributes with a stronger relationship between BP and UIs; predicting impact analysis when changes are made on BPs, task models or UIs. The detailed specification of UI tasks represents a strong source of analytical data extracted by monitoring users' interaction aiming at optimizing the user experience and consequently the processes they execute.

Contributing with a cross-organizational engagement, the participation of end-users from different domains creates a proactive approach towards process optimization. It thus makes this methodology less obtrusive and enables "social creativity" as they create, design, develop or perform business activities. Social creativity is a solution for complex problems in which all stakeholders contribute with their different points of view and knowledge resulting in new ideas (Fischer *et al.*, 2004).

In order to increase this research, we have applied this methodology in a scenario where we could have an active participation of end-users. This scenario was obtained in a large telecommunications company. In such a scenario, changes in business may impact several systems and multiple sets of UIs used by different end-users. In this case, it is no longer possible to rely only on analysts or developers' knowledge. Therefore, traceability between the BPs and the UIs becomes a major concern in order to identify the impact of changes and support decision making. This case study is presented in the following section.

4. Case study

The methodology has been empirically validated by applying a qualitative approach since this case study involves the analysis of people, settings and situations as intimately interconnected (Taylor and Bogdan, 1984). The research results presented in this work are validated following the taxonomy that classifies empirical validation methods (Zelkowitz, 2009). From that taxonomy, the selected validation methods are:

- literature search to evaluate published studies that analyze the behavior of similar researches;
- case study to collect detailed project data to determine the results of the application of the proposal; and
- lessons learned to perform a qualitative analysis on completed projects to see if the proposal had an impact on the project.

The theoretical validation was presented in Section 2 with the comparison of the approaches found in a literature search, where related works were compared using a set of relevant requirements.

The empirical validation is done with case study and lessons learned. Case study is distinctively advantageous for this research because we analyze a contemporary set of events in a real-life context, over which the researcher has little or no control (Yin, 2003). This case study is interactive and participative in nature and it holds the following properties: the degree of "participation" of stakeholders from the company is high through interviews and participant observations. The degree of "revealedness" is high since the participants are fully aware of the study that is going on. The "intensiveness" is established in one-hour interviewing sessions, one-hour observation sessions in the professional's setting and the "extensiveness" is established at first in a three- to four-month period, in which sessions can happen once or twice a week in order not to disturb their ongoing works. The "focus" of the study concerns a specific research problem of maintaining alignment between BPs and UIs of its enterprise systems.

The sources of evidence most common in collecting data in case studies, as described by Yin (2003) and Decrop (1999), were applied in this research. Using different sources enables addressing a broader range of issues and provides triangulation by corroborating findings from different sources of information. The sources of information used in the case studies were:

- *Documentation.* Analysis of business process models and UI design.
- *Interviews.* Semi-directive interview (with interview guide) and non-directive interview (informal conversational interview).
- *Observations.* Participant observation in which the researcher becomes immersed in the real settings.
- *Discussions in group.* The researcher participates in meetings where stakeholders discuss topics relevant to the research.

The unit of analysis in this research is the alignment of BPs with UIs of its enterprise systems. The site selected to be studied focuses on a specific setting: large organizations that use BPs and/or have extensive enterprise systems, in this case, a telecommunications company. It also focuses on particular populations: business analysts, UI designers, usability experts, operation managers and end-users of enterprise systems.

The methodology is explained through its application in a large organization, which illustrates the applicability of this methodology in complex scenarios. Therefore, presenting the organizational context and specific scenarios of this case study is primordial to understanding the methodology and the examples illustrated with cases experienced in this organization.

A corporate-level analysis is presented as follows to provide the reader with an organizational context and an overview of the projects.

4.1 Organizational context

The organization selected for this case study is in the telecommunications industry. For confidentiality reasons, the characteristics of this organization are presented in general terms. This organization is a reference in providing integrated communication services, including fixed line voice, mobile voice, broadband, and television services.

The link with the existing businesses lies in the technology; this way, customers can access any of these four products with their existing infra-structure. It thus makes the diversification strategy conglomerate and offers simplicity to the customer. Enhancing its marketing strategy, it has promoted diversification and expanded the scope of its services to include voice over IP (VoIP), which offers phone communications via the IP network.

The high-level management has stated that the organization will give more attention to its BPs. In 2007, they have started to use the enhanced Telecoms Operations Map framework (www.tmforum.org/BestPracticesStandards/BusinessProcessFramework/6637/Home.html) as a foundation for modeling its BPs. This standard is used worldwide as a guidebook for the telecommunication sector to provide companies with a general description of processes. In addition to this framework, the rule is to use Microsoft Visio for operational business flows and Aris for IT core system-related flows. In practice, however, many documents exist to document the BPs, which are not centrally available and not in a common format. In other words, there is no centralized tool for BP modeling. The company owns 40 licenses of Aris; some licenses are used in human resources, the others are spread in the IT unit. However, only three to four professionals are using the licenses regularly, and these professionals are not the process managers. In addition to the cost of such licenses, there is a resistance to use a modeling tool because most professionals are used to Microsoft tools (e.g. Visio, Word and PowerPoint), even though such tools have not been created for such a purpose.

The organization has defined four levels of BP design (independent of the tool used). Level 1 broadly describes who does what in the process; it contains the major entities and actors, but does not involve any decisions or systems. Level 2 complements the previous level by detailing the systems as well as the decisions which have to be made. Level 3 concretely represents the process flow and its description; this level is optional for small processes. Finally, level 4 explains how the user has to interact with the UIs of systems. This documentation is often composed of screen-shots with some annotations for end-users. In addition, the BP models are just used as documentation and are rarely updated.

Besides the greater importance given to modeling BPs, they are also concerned with managing these processes. Hence, one of its main goals for the next five years is to fuse its sales processes so that the different sales channels can provide services to their customers uniformly. However, their current situation at the time of the case study is represented by the lack of consistency and traceability in the documentation. A business process engineer stated that depending on the needs, business analysts produce documentation from scratch and once the project is finished, they discard it. In addition, there is no link between the documentation existing in the different departments, and different stakeholders may use the modeling tool of their choice. With this reality, it becomes increasingly difficult to predict the impact of changes and to be aligned across departments. This problem is frequent and relevant as knowledge represents the organization's ability to determine how it will deliver results, how it will differentiate from competitors and how it will cope with changes. All of these characteristics make this organization an appropriate context to apply the UI-business alignment methodology.

4.2 Projects

The units involved in this case study are: an IT and networks support unit responsible for delivering IT solutions and a professional customer-unit responsible for business-to-business transactions. The case study consisted of two projects that took four months with visits twice a week to the company, organized in the following manner.

The first month was devoted to understanding the organization as a whole, specific departments and professionals in order to select the BPs and involve committed professionals in the application of the methodology. This initial analysis was supported by a survey prepared before the case study in order to guide the semi-structured interviews and direct the questions. In addition, the organizational documentation available in the intranet was also considered in the organizational analysis.

The second and third months involved:

- for the first project: meetings with business analysts to understand the business process and system, and modeling the business process;
- for the second project: attending weekly meetings with the process core team (process manager, IT specialist, project managers and tester) who defined and modeled the business process; using the system under analysis in the test environment; and observing user acceptance tests of the system for this process; and
- for both projects: weekly follow-up meetings to debrief the progress of the work.

A total of 23 professionals have been interviewed, working in 21 different departments out of four different business units.

The fourth month included the application of the methodology on the selected BPs and systems in both forward and backward approaches. The application was followed by the integration of this methodology with the organization's software development process and process improvement methodology. The application and integration were further validated by the stakeholders. The project finalized with two main decisions: to include a suggestion that resulted from applying the methodology in their next release and the continuation of this project to gather further data to support the cost-benefit analysis of the methodology.

Two types of BPs were selected for this case study: first, a supporting business process: the accounts payable (AP) business process that controls invoices. Second, the provisioning business process of integrated telephony solution (ITS) products, which are specific products of the enterprise VoIP (eVoIP) solution. Each of the BPs is described and the methodology is applied to perform the impact analysis in different scenarios. First, the AP business process is used to illustrate the creation of the links in the backward approach and the impact analysis using the forward approach. The creation of the links is demonstrated starting from the UIs because they had their enterprise systems, but had not yet defined their BPs. Since the telecommunications company had many departments in the same situation, the backward approach was useful to build the network of links starting from the UIs of their systems. Then, the provisioning business process is used to illustrate the impact analysis using the middle-out and backward approaches, presented as follows.

4.2.1 Accounts payable. The first project takes place in the department in charge of the IT support for the finance department. The selected business process is the AP that controls invoices. An analyst in charge of the finance IT support explained the process by demonstrating the use of the enterprise system.

From his explanation, it was possible to draft an outline of how they worked and graphically represent it in a business process model (Figure 3).

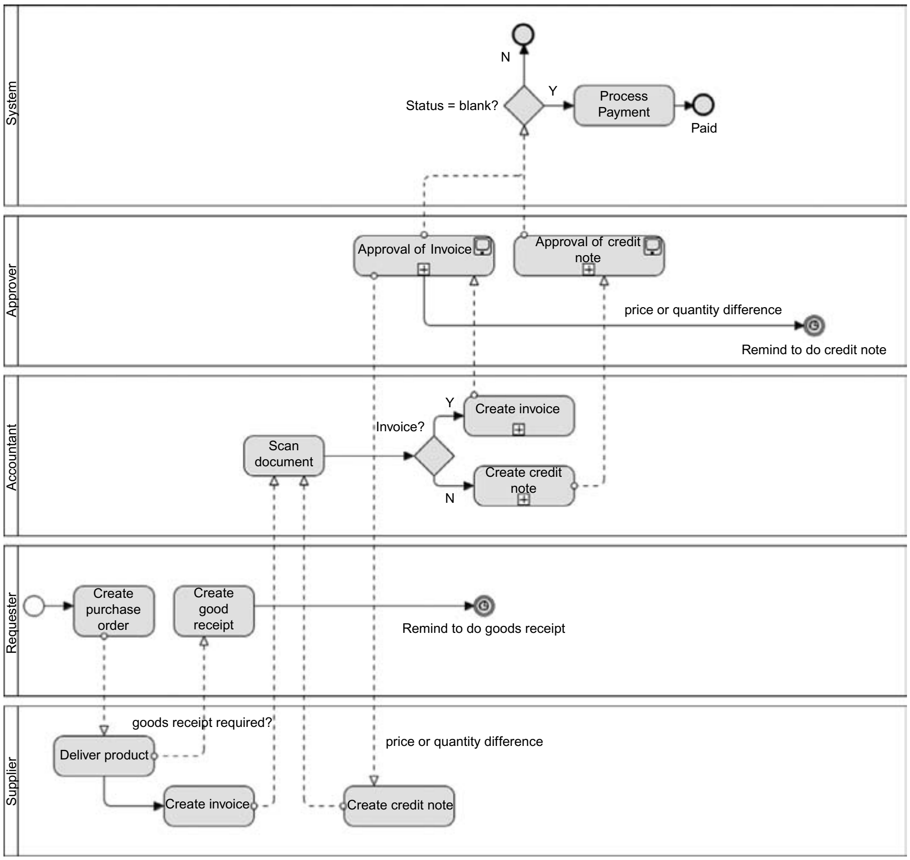


Figure 3.
Business process model for AP

It starts with the creation of purchase orders to request products or services. Once the product is delivered, a goods receipt is created, when required, with a list of the goods ordered that have been effectively delivered. When the supplier sends the invoices for the ordered and delivered products, the accountants scan the invoices and introduce them in the AP system. The scanned invoice and its related data are sent to the approver to ensure that the price and quantity informed on the invoice are correct. The approver analyzes the data and may accept the invoice, refuse the invoice or request a credit note to correct the data in the invoice that is different from the purchase order, either with price or quantity difference ("approval of invoice"). If the approver requests a credit note, the credit note is created and sent to the accountant who scans it and introduces it in the AP system so it can be analyzed by the approver. The approver can accept or refuse the credit note and the related invoice ("approval of credit note"). To guarantee that the process flows smoothly, there are sub-processes devoted to remind the stakeholders involved to create credit notes ("remind to do credit note") and to create goods receipts ("remind to do goods receipt").

The part of the system presented here to exemplify building the network of links starts when a credit note is requested to correct the data in the invoice sent by the supplier that is different from the purchase order, either with price or quantity differences. If the approver requests a credit note, the credit note is created and sent to the requester who analyzes it for approval.

Figure 4 shows the UI where approvers see the list of documents open for approval. When they select a credit note, the approver is able to approve, reject or cancel.

Based on the existing UI of the AP enterprise system, we have specified the UI model. Figure 5 shows the UI model for the current screen group for approval of credit notes, composed of one screen for credit notes without purchase order and another screen for credit notes with purchase order.

Once the UIs were understood and the UI models created, we specified the UI tasks in task models. An extract of the task model for the UI of approval of credit notes is shown in Figure 6, which details interactive tasks.

With the details of UI tasks, it was possible to specify the high level activities of the business process for the approval of credit notes, shown in Figure 7. In this process,

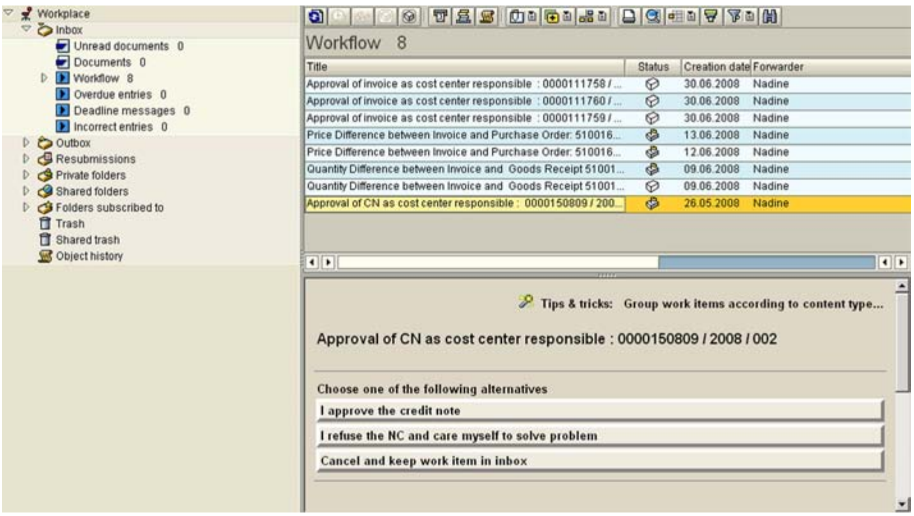


Figure 4.
Screen for approval of credit notes

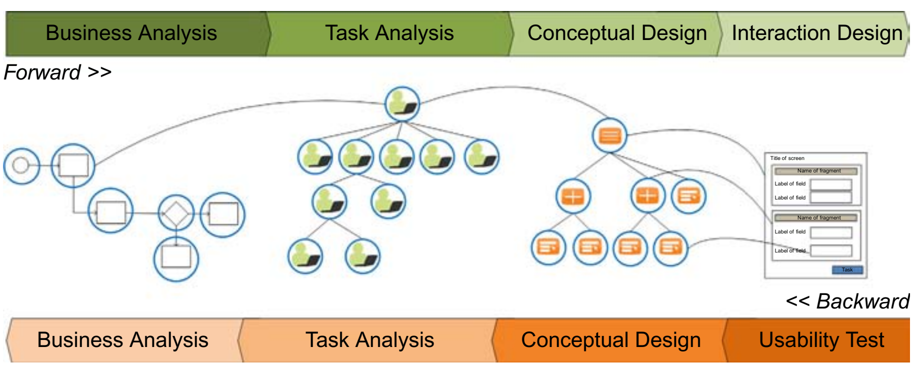


Figure 5.
UI model for approval of credit notes

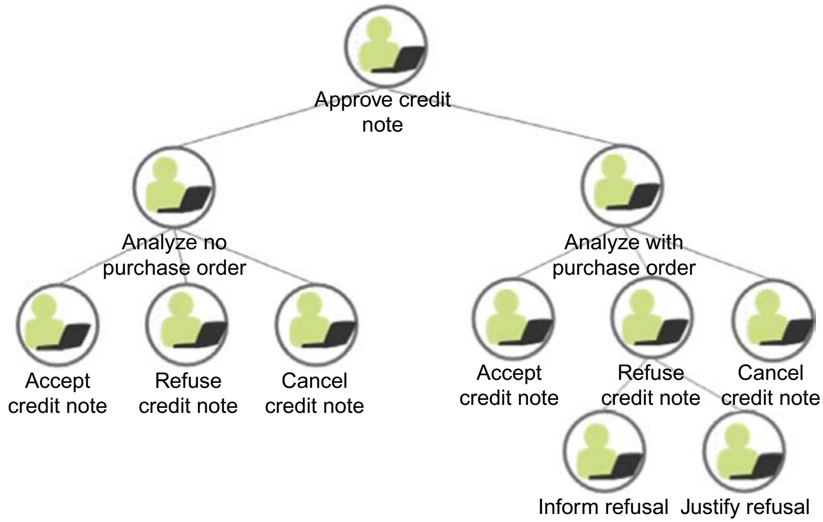


Figure 6.
Task model for approval of credit notes

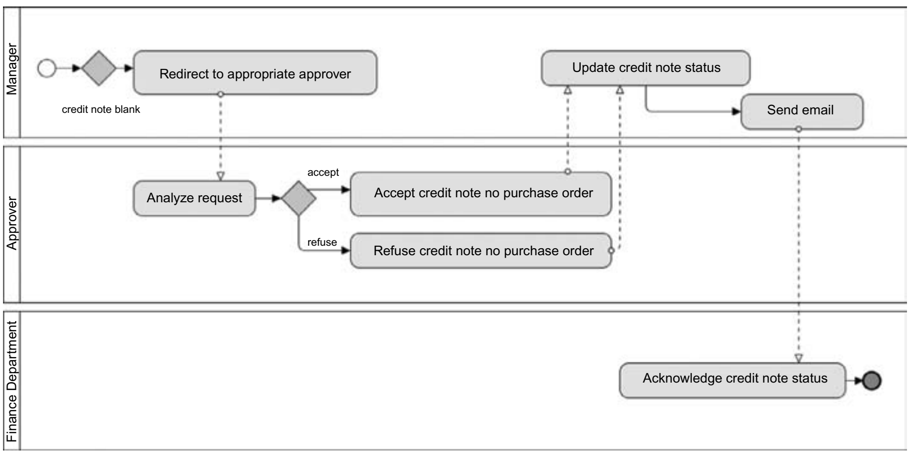


Figure 7.
Business process model for approval of credit notes

when a credit note is open for approval, it is redirected to an approver, who can accept or refuse it. Once an action is chosen, the status of the credit note changes and an e-mail is sent to the finance department that acknowledges the invoice with the latest status of the invoice and related credit note.

With the models created, it was possible to map UIs with UI tasks and then map UI tasks with process activities. For instance, the screen "Approval of credit note with purchase order" inside the screen group "Approval of credit note" was linked to the UI task "Analyze credit note with purchase order" and it was linked to the sub-process "Analyze credit note with purchase order", as shown in Figure 8. The semantics of the mappings between models is defined by analysts with knowledge of both the software and the system. The work of Sousa *et al.* (2009a) presents further analysis of these

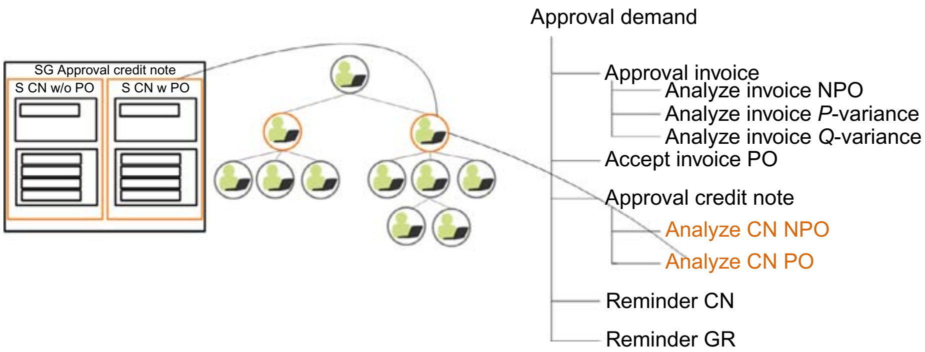


Figure 8.
Scenario: support for approvers of credit notes

mappings and how they are kept consistent. In general terms, rules have been defined to keep the consistency between the mappings. This way, when changes are made in a model, rules are executed to replicate these changes on the related models at design time to maintain the alignment.

This example illustrates how the models are created and how the associations between business process models, task models and UIs is done, which builds a network of links. With this network built, it is possible to navigate in the network in any direction, which aids in identifying the impact of changes, which are explained as follows.

We have identified five scenarios of changes proposed by business analysts and end-users in forward and backward approaches in which the alignment methodology has been applied. Each of these five scenarios demonstrates several possibilities of changes that include updating existing activities, creating new activities, creating an entirely new sub-process in a forward approach and creating new UI components in the backward approach. From these scenarios, we have selected one scenario that depicts a representative example of change starting from the business process using the forward approach. The other scenarios have not been selected because they represent the forward approach, already presented here or the backward approach, illustrated in the provisioning project.

Scenario: managing goods receipt. Business analyst suggests supporting approvers in the creation of goods receipts. A business analyst in charge of the finance IT support requested a split between two cases when there is a quantity difference between the invoice and the purchase order. The variance in quantity can come from an error in the goods receipt or can result from an approver forgetting to do the goods receipt. Therefore, approvers need support to analyze the need to create goods receipts and avoid forgetting to create them, when needed.

This scenario triggers changes in the "Approval of invoice" and "Remind to do goods receipt" sub-processes (Figure 9). In these sub-processes, a new set of activities has been included to support the analysis of the forgotten goods receipt, creating new tasks for the user to execute. To execute these tasks, new screen elements are necessary to enable the user to create the goods receipt or ask the finance department to create the goods receipt.

Results. The results of the impact analysis have been presented and validated by two SAP solution managers, one IT senior developer and a group of IT developers in the finance department in this project. The middle-out and backward approaches have been analyzed in more details in the provisioning project.

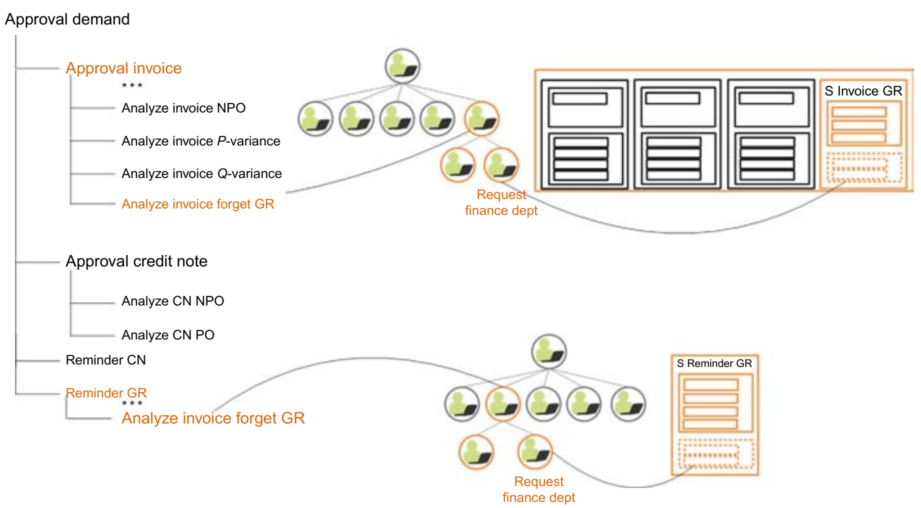


Figure 9.
Scenario: managing goods receipt

4.2.2 Provisioning. This project takes place in the team in charge of the enterprise business department. The selected business process is the provisioning of the ITS products of the eVoIP solution for professional customers who want to integrate their data and voice traffics on the same data network. There are two categories of products that are determined by customer's needs. One is determined by the quantity of dialing numbers that the customer requires. The other one is determined by the number of sites (location of customer's installation addresses) that can be provisioned. The ITS products provide different ranges of dialing numbers, starting at one dialing number, going to ranges of ten and/or ranges of 100 dialing numbers. Each number may be associated to a package that represents voice services, such as call center, auto-attendant, receptionist, etc.

This provisioning business process (extract shown in Figure 10) starts with the accountant filling out the form with the information of the customer's request and creating the order file. Then, the project coordinator starts controlling the flow that drives the provisioning process. The team in charge of the project setup checks if the customer is new, if positive, this task can be directly closed. Otherwise, the team has to

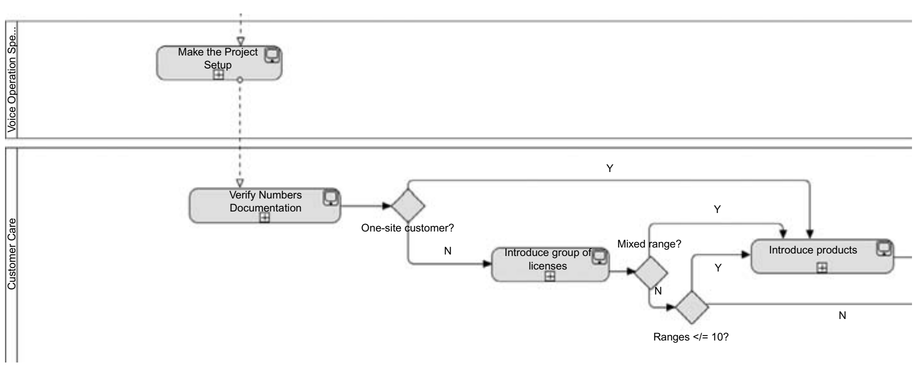


Figure 10.
Business process for provisioning

make a series of tests with the order file. When the file is ready, the customer care department analyzes the order file to understand what the customer has requested:

- If the customer has only one-site, the customer care department orders the requested products ("Introduce products"). The association between the product and the connectivity has to be made.
- If the customer has multi-sites, the customer care department creates a group for the related licenses ("Introduce group of licenses").
- If the customer requests has multi-sites and has ranges less than ten, the customer care department orders the requested products and associates them with the previously created group ("Introduce products"). The association between the product and the connectivity has to be made.

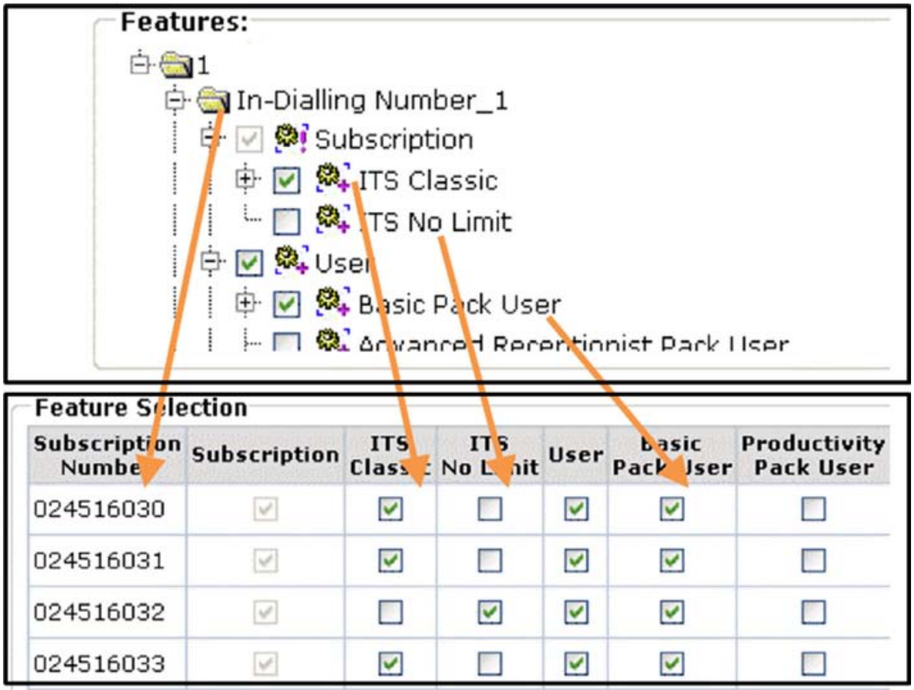
The next step is the pre-activation of the product, where the lines and numbers are ready but not yet activated; only voice tests are possible. Afterwards, the technician plans an installation with the customer. Once installed, the technicians validate the installed products. The numbers are finally activated and the site can be closed by the project coordinator.

We have identified four scenarios of changes proposed by business analysts and end-users in forward, middle-out and backward approaches in which the alignment methodology has been applied. Each of these scenarios demonstrates several possibilities of changes that include creating a new sub-process in the forward approach, updating UI tasks in the middle-out approach, deleting UI components and creating new UI components in the backward approach. From these scenarios, we have selected one scenario that depicts an example of change starting from the task model using the middle-out approach and two scenarios with changes starting from the UIs using the backward approach. We have selected two scenarios in the backward approach because they are differentiated by the extent of the impact analysis. This difference illustrates that not all changes on UIs have direct impact on UIs and presents how they can be considered. The fourth scenario has not been selected because it represents the forward approach, already illustrated in the previous project.

Scenario 1: configure numbers. Users suggest being able to select voice service packages in only one screen. In this scenario, we consider two categories of products that are determined by the quantity of dialing numbers (number of the physical phones) that the customer requires and by the number of sites (location of customer's installation addresses) that can be provisioned. Each number may be associated to a package that represents voice service packages, such as call center, auto-attendant, receptionist, etc.

During tests sessions, users complained about doing twice the same thing on different UIs (Figure 11). On the first screen (on top of the figure), they have to choose the voice service packages for each dialing number. On the other screen (at the bottom of the figure), they have to check if the service packages previously chosen remain the same after the attribution of real numbers to the selected products. The change proposed is to merge these two UIs in one that is more productive to users.

The UIs that are similar are called "Negotiate features" and the "Update features". Merging these UIs is done by selecting the most relevant UI components. This will decrease the number of UI tasks, which have to be deleted from the task model, and to be consistent, the related activities in the BP will be deleted as well (Figure 12).



Subscription Number	Subscription	ITS Classic	ITS No Limit	User	Basic Pack User	Productivity Pack User
024516030	✓	✓	☐	✓	✓	☐
024516031	✓	✓	☐	✓	✓	☐
024516032	✓	☐	✓	✓	✓	☐
024516033	✓	✓	☐	✓	✓	☐

Figure 11.
Repeated UIs to configure numbers

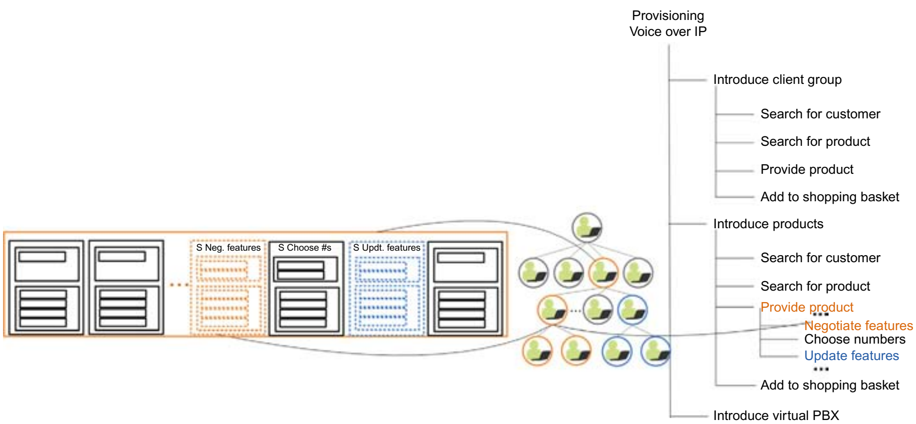


Figure 12.
Scenario: configure numbers

Scenario 2: licenses overview. Users suggest being able to see the overview of available licenses for the customer as they request the customer product. When negotiating the features of products for customers with multiple sites, the information of licenses available for that customer does not appear on the screen. Consequently, users have to remember the types of licenses and the quantities they have previously introduced in the group of licenses. As a result, it is necessary to first check (and update) the group of licenses before provisioning the products. Most users forget and end up with an error message that they do not understand (for instance, the error message does not explain that more licenses are required for that specific group of licenses), which stops the process. Some users remember that they have to check the licenses; then, they navigate through five UIs, select each type of license to see the quantity ordered and write the information on a piece of paper. This process is error-prone as well as a loss of time and efficiency. Introducing a product lasts, on average, 20 minutes; therefore, taking into account such a scenario would decrease the time and increase the efficiency of users.

The proposed change consists of adding information in the UI to "Negotiate features" in order to support the user with relevant information about the licenses. To achieve that, a new screen fragment is added on the screen and new UI tasks are created to support it. Adding a new screen fragment will create new UI tasks to view licenses information, but will not impact the BP (Figure 13). In this case, the change is done just in the task model because it is only persistent to user interaction; thus it is described at a detailed level that is not modeled in the BP.

The resulting UI to "Negotiate features" including the proposed change supports the user with relevant information about the licenses. To achieve that, a new screen fragment is added on the bottom left of the screen and new UI tasks are created to support it (Figure 14).

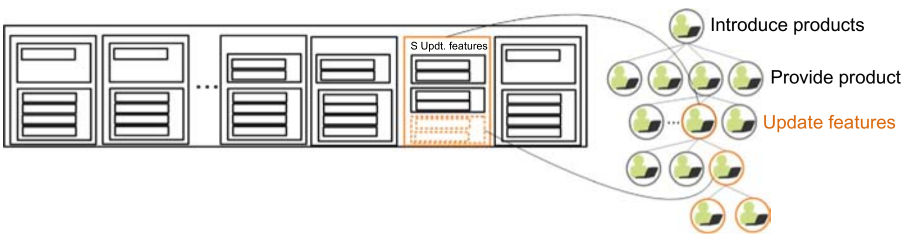


Figure 13.
Scenario: licenses overview

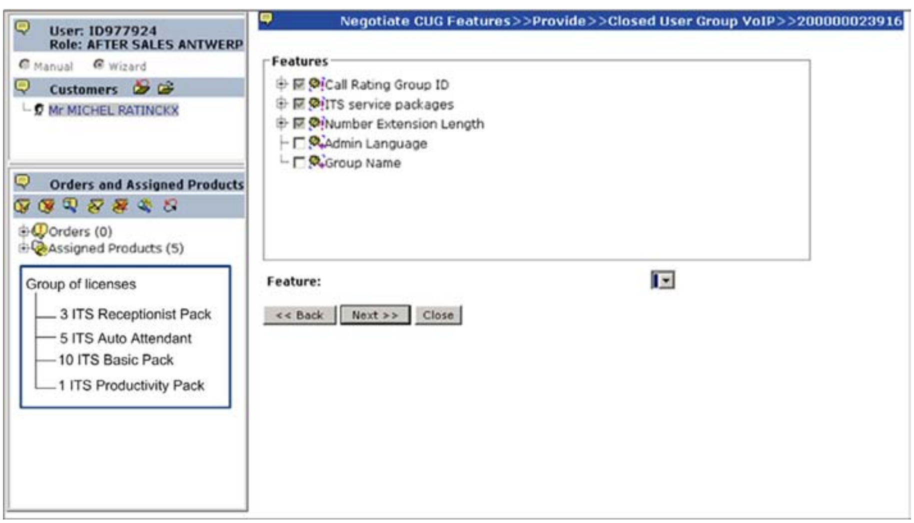


Figure 14.
Suggested UI for licenses overview

Scenario 3: products with multiple sites. Usability experts suggest that users could group licenses of customers with multiple sites to better see where the product is installed. This scenario treats the category of products that are determined by the number of sites (location of customer's installation addresses) that can be provisioned. In this case, products installed in enterprise customers with multiple sites were previously associated with a one-way connection. However, it was not possible from a specific customer site to determine neither the main customer site nor the other sites that belong to the same customer. Therefore, the usability experts proposed users first to create a group of licenses before ordering the requested products. This group of licenses creates a two-way connection between the group and the customer sites that facilitates identifying in which sites the customer has the product installed.

This scenario requires splitting the UI task "Provision eVoIP" in two UI tasks: "Introduce client group" and "Introduce products" (Figure 15). This change leads to splitting the screens in two different screen groups and the sub-process in two sub-processes.

Splitting UI tasks, new UI tasks are created to reorganize the split sub-tasks. For the new UI tasks that are created, it is necessary to create new screen groups for these new UI tasks and associate them with the screens related to the existing UI sub-tasks.

Once the UI components have been updated, the BPs are also updated accordingly. For each added UI task in the task model, it is necessary to add the equivalent BP activities.

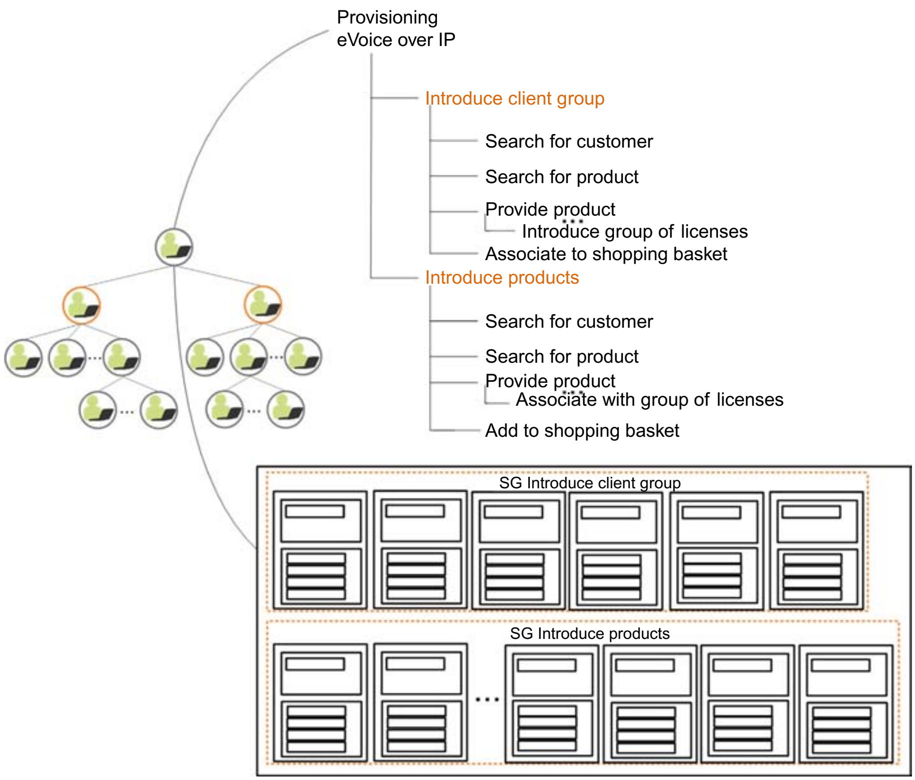


Figure 15.
Scenario: products with multiple sites

Results. The results of the impact analysis have been presented and validated by a process owner, a project architect, and by representatives of both the business transformation and methodology departments in this project.

The impact analyses and changes performed in this case study through the methodology represent a step towards addressing their strategic goals that envision improved customer experience. It further represents future improvements on their provisioning processes throughout the organization.

The application of the methodology in a large telecommunications company enabled its qualitative and quantitative analyses. The qualitative analysis was made in terms of feasibility of integration with their corporate initiatives, such as software development process and process improvement methodology. The quantitative analysis was done through the return on investment (ROI) forecast in terms of the gains achieved relative to the investment on the methodology.

4.3 Qualitative analysis

The goal of this qualitative analysis was to verify the possible integration of the proposed methodology with existing corporate initiatives. Therefore, we have analyzed the software development process that the organization applies in its projects and identified how it can be integrated with the methodology. Their software development process is organized in nine phases following an iterative approach. These phases are similar to the rational unified process (RUP) disciplines that range from requirements, business modeling, analysis and design, implementation, deployment, test, project management, change management, and environment (Kruchten, 2000).

Matching their process with RUP to facilitate explaining the integration with the methodology, we present it in phases.

In the inception phase, first, a project plan lists requests that are documented with a high level estimate of the domains impacted. Then, a project description is prepared with the core project requirements, constraints and key features. To aid in adequately creating these deliverables, the methodology provides for the project plan: a list of organizational units and systems impacted from the requests; and for the project description: a detailed list of organizational units, systems, processes and users impacted from the requests.

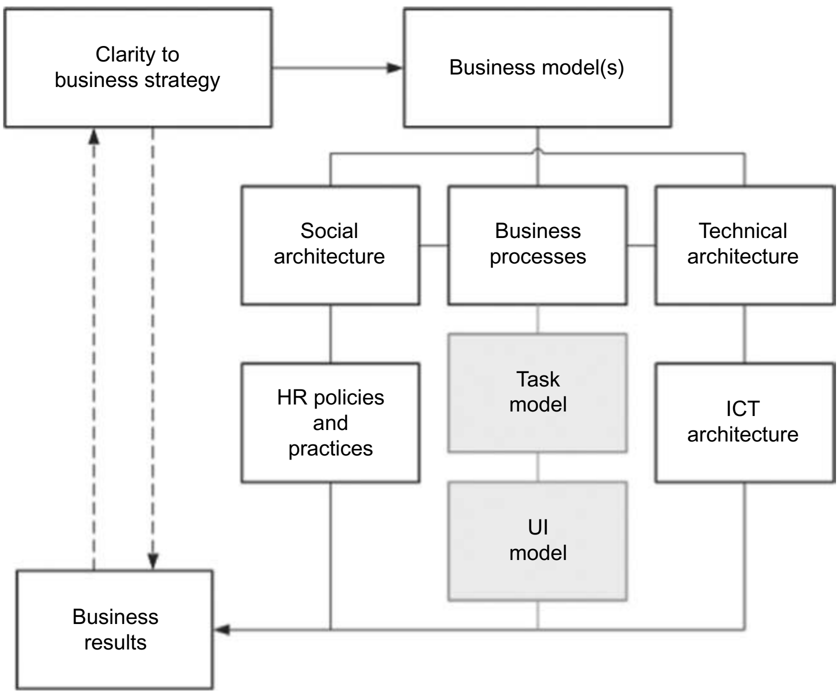
In the elaboration phase, a development plan for the overall project is described with solution architecture definition and domain analysis. For the development plan, the methodology provides a list of UIs and users impacted from the requirements in order to better identify which kind of training users will need.

In the construction phase, the main goal is to build the software and the primary deliverables are resulting from coding, such as components, classes, services, etc. The methodology supports this phase when change requests are created and the impact analysis aids in creating a list of impacted organizational units, systems, processes, UIs and users.

In the transition phase, the goal is to launch the system in production where the system is validated with users. The methodology supports this phase when change requests are created from users' requests and the impact analysis aids in creating a list of impacted organizational units, systems, processes, UIs and users.

The integration of the methodology with a software development process enables the association of software engineering artifacts with BPs. Guaranteeing the alignment of BPs with requirements is primordial for major systems because requirements represent the foundation for the definition of such systems. Therefore, linking requirements directly with activities of BPs represents an important aspect to be considered in the traceability of enterprise systems (Sousa *et al.*, 2008b). This way, when changes are proposed on BPs, it is possible to verify if they are in accordance with predefined requirements.

The methodology is also integrated with EA approaches, such as the framework for capability building (Prahalad and Krishnan, 2008), which manages business strategy, business model, BPs, technical and social structures, human resource policies and practices, ICT architecture and tools, and business results. The methodology complements this strategy framework by adding the task model and the UI model (Figure 16). This integration bridges the gap between EA and HCI, which aids in acquiring a sustainable competitive advantage with end-users and customers. Viewing EA in its broader context of business optimization, the company's process improvement methodology is also aided by the methodology. This kind of integration enables a link between business strategy and BPs. This link is useful to check if the proposed changes on BPs conform to business goals specified as a corporate strategy. For the top-management, it is crucial for the organization to have enterprise systems supporting their business strategies that are translated into activities in the processes. Once systems are aligned with the defined processes, it is easier to verify the alignment to their strategic goals.



Source: Adapted from (Prahalad and Krishnan, 2008), original figure copyrighted to the McGraw-Hill Companies, Inc

Figure 16.
Framework for capability building integrated with the UI-business alignment methodology

The company's process improvement methodology is similar to a typical process improvement methodology, e.g. PDCA (Meisenheimer, 1997). It is an iterative problem-solving process to optimize its BPs and achieve more efficiency. The result from applying a process improvement methodology is a list of processes that need to be changed in order to achieve the organization's objectives. To implement the proposed changes, a typical solution (Vasconcelos *et al.*, 2004) consists of new/updated functions, services, applications that have to be managed in order to solve the identified problems. The methodology proposed here extends the solution given by typical business process improvement methodologies by listing the impacted UIs and going further by listing impacted organizational units and end-users of impacted enterprise systems.

4.4 Quantitative analysis

In our analysis, we aimed to acknowledge the longer term and temporal aspect of decisions, which enabled us to consider risk and uncertainty and how the organization regards these aspects. This analysis is tightly related to operations strategy (OS), which is concerned with developing resources and configuring processes so that the resulting competencies best deliver the proposed corporate value (Van Mieghem, 2008).

In this line, the purpose of resources is to work and generate value; one type of resource is represented by tangible real assets, which are human resources. In our case, they are business performers and simultaneously system end-users. They apply their intangible assets (their "know-how") to do their work. The purpose of processes is to specify how resources perform their activities and add value to the business. In our case, the BPs are the AP and eVoIP processes. The purpose of competencies is to specify what organizations can and cannot do and how well they provide their outputs and differentiate in the competitive market. In our case, the main competency is the ability to do impact analysis from both a business and user perspective.

To contribute to OS and deliver corporate value with improved processes and user experience, we went further the qualitative analysis and have worked on quantifying the results through a cost-benefit analysis of the methodology.

We have analyzed the methodology under three cases that consider optimistic, pessimistic and probable visions of the future using sensitivity analysis. Sensitivity analysis is a technique for systematically changing parameters in a model to determine the effects of such change (Krajewski *et al.*, 2007). We selected the sensitivity analysis to obtain information from the system with a minimum of numerical experiments since we have observed eight users interacting with the ordering system to provision eVoIP products.

The steps we took to evaluate the cost-benefit analysis were:

(1) calculate the time and cost to apply the methodology;

(2) observe users interacting with the system;

(3) identify issues as candidates for a change scenario;

(4) count interaction time for a specific scenario;

(5) calculate the time and cost to develop and deploy the change; and

(6) calculate the cost-benefit analysis.

The calculations of the time and cost to apply the methodology were made based on our experience in this case study considering the performance of the methodology actions and the complexity of each scenario. The calculations of the time and cost to develop and deploy the change were made based on the financial information about the costs of professionals per hour considering their profile and role, provided by the department in which we applied the methodology. The calculations of the gained time were made based on users' observations by quantifying the time spent on each step of the eVoIP process before any change; then observing them and quantifying the time spent on UIs after one change. The explanation of the scenarios presents the gains in terms of time, not in costs, for understandability and to keep the confidentiality for the company in terms of their financial values. Nevertheless, the financial values were used to calculate the ROI and create the resulting diagrams. The ROI is calculated considering the cost and the benefits of applying the methodology and an initial investment on acquiring the tool. The cost is calculated considering the time and the costs it takes for a business analyst to apply the methodology and the time and costs of developers to do the changes. The time to apply the methodology considered the time to create the task models and the UI models and to map these models. The benefit is calculated considering the gained time after the alignment, the cost of a user per hour and the number of times the process is executed per month.

Two scenarios have been selected for a cost-benefit analysis as a request from the team who was closely following the application of the methodology, including a process owner, a project architect, and representatives of both the business transformation and methodology departments. They have been selected for quantitative analysis primarily because they apply the backward approach, which centralizes on the participation of end-users.

Scenario 1: configure numbers. The first selected scenario to evaluate the cost-benefit analysis is the scenario to configure numbers, in which users have to do twice the same task on different UIs when choosing the service packages for each dialing number of eVoIP products. This issue decreases their efficiency when managing the orders. In general, it takes an average of two hours per site to introduce a product. Thus, a gain in efficiency in such a complex scenario makes a big difference for the users managing customers with several sites. To solve it, users suggested being able to select voice service packages in only one screen. The change proposed is to merge these two UIs in one that is more productive to users.

The time to apply the methodology for this scenario took a total time of nearly 11 hours. In the probable case, the gained time after the alignment is 2:30 minutes per user, nearly four hours considering 88 users of the ordering system for eVoIP products. After a year executing this process two times per month, the benefit amounts to nearly 63 per cent and the ROI is achieved after the third month. In the *pessimistic case*, the gained time after the alignment is one minute per user, nearly two hours considering 88 users of the ordering system for eVoIP products. After a year executing this process two times per month, the benefit amounts to nearly 15 per cent. In the *optimistic case*, the gained time after the alignment is 2:30 minutes per user, nearly four hours considering 88 users of the ordering system for eVoIP products. After a year executing this process eight times per month, the benefit amounts to nearly 315 per cent. Figure 17 shows the ROI in details for the probable case and the comparison of the three cases for this scenario.

The empirical data were collected from observation of eight users interacting with the ordering system to provision eVoIP products. The few detected deviations on the timing

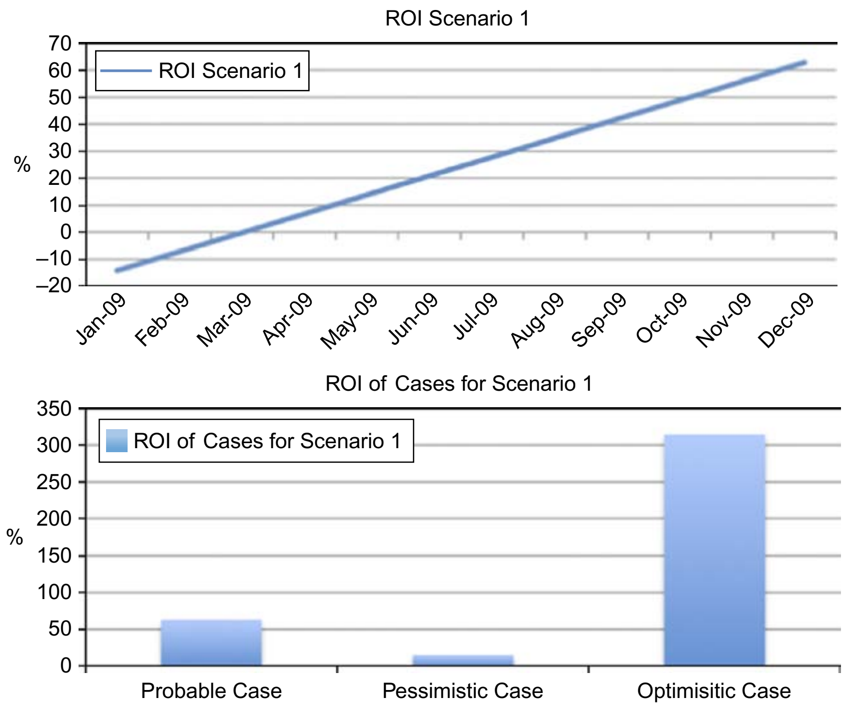


Figure 17. ROI applying the UI-business alignment methodology for scenario 1

between these users are due to loss of data: user lost contract number; user lost customer address; or due to user interaction: user could not find products in the list.

Scenario 2: licenses overview. The second selected scenario to evaluate the cost-benefit analysis is the scenario for licenses overview, in which users negotiate features of products, but as users try to accomplish this task, they have to remember the types and quantities of licenses they introduced in previous screens of the system. As a result, users forget the information, write the information on a piece of paper or have to navigate through five UIs to find the licenses and select each type of license to see the previously informed quantities. To solve it, users suggested being able to see the overview of available licenses for the customer as they request the customer product. The proposed change consists of adding information in the UI where users negotiate features in order to support the user with relevant information about the licenses.

The time to apply the methodology for this scenario took a total time of nearly ten hours. In the probable case, the gained time after the alignment is 3:40 minutes per user, around 30 minutes considering eight users of the ordering system for ITS products. After a year executing this process four times per month, the benefit amounts to nearly 3 per cent and the ROI is achieved after the tenth month. In the pessimistic case, the gained time after the alignment is 3:10 minutes per user, nearly 30 minutes considering eight users of the ordering system for ITS products. After a year executing this process two times per month, the result is 11 per cent. In the optimistic case, the gained time after the alignment is 4:42 minutes per user, nearly 40 minutes considering eight users of the ordering system for ITS products. After a year executing this process eight times per month, the benefit amounts to nearly 40 per cent. Figure 18 shows the ROI in details for the probable case and the comparison of the three cases for this scenario.

Comparison of scenarios. The first scenario clearly brings faster ROI than the second scenario. This is shown in Figure 19 through the comparison of these scenarios showing the ROI in details for the probable case and comparison of the three cases for both scenarios. However, this quantitative representation of the return from the second scenario is only minimal because it does not consider the impact on the organization in the case of loss from input of wrong data for customers' requested products (as users see the data on the system, note it on paper, then pass it to the system again). There are direct and indirect costs to be considered by the organization. Examples of direct costs are the re-work of technicians, negative impact on the brand, among others. Examples of indirect costs are the working on corrections instead of the actual work. These types of costs influence the decision depending on the organization's aversion to risk to assume such costs. After this quantitative analysis, this scenario was selected as a change request to be included in their next release.

4.5 Lessons learned

There were lessons learned in this case study: one lesson learned is related to the time consumed to apply the methodology. As a software platform has been envisioned and designed (Sousa *et al.*, 2008a), but since it is still being developed, the work is currently being done manually. The experience in this case study has been a major source of requirements to specify the functionalities of the platform.

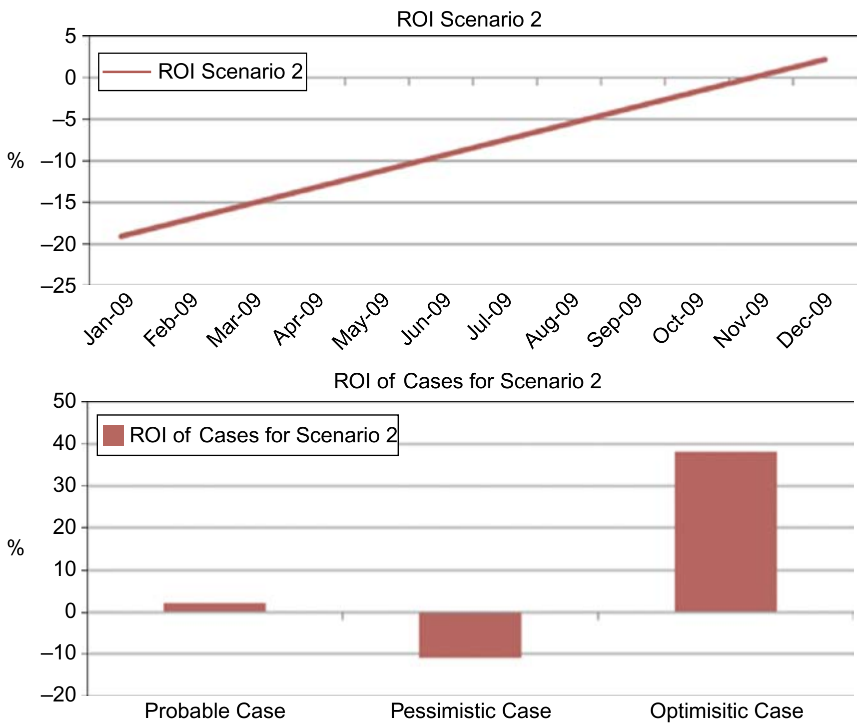


Figure 18.
ROI applying the UI-business alignment methodology for scenario 2

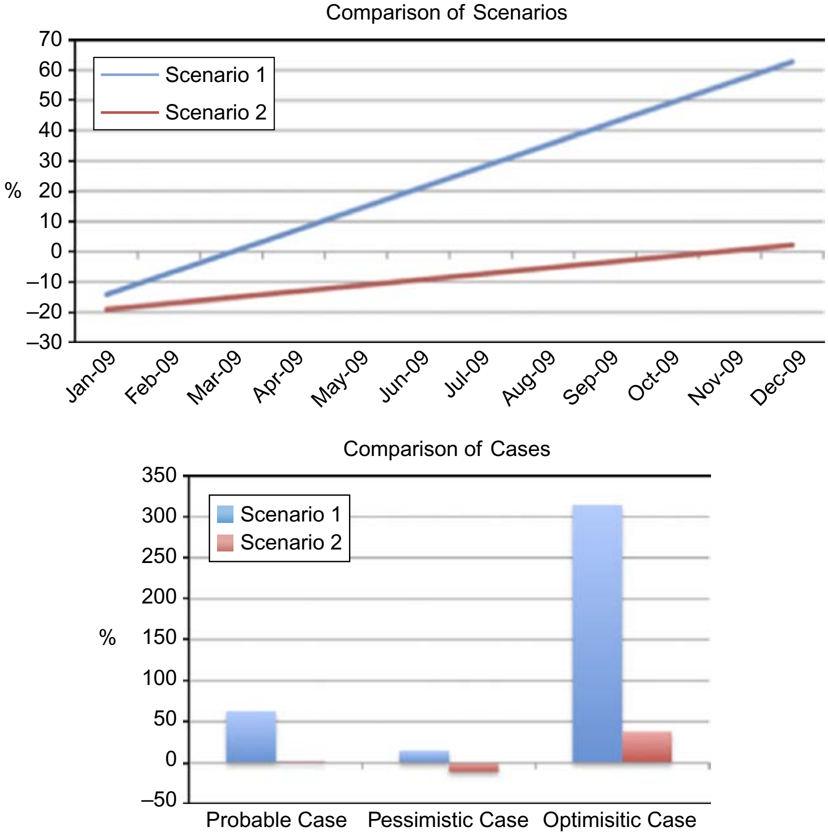


Figure 19.
Comparison of the ROI for both scenarios

Adding requirements as another artifact that can be linked to enterprise systems can increase the acceptance of this methodology. This is especially true in this case and in any other organization that originates their projects through software requirements, as observed in the analysis of their software development process.

Furthermore, people are resistant to change and we acknowledge that this methodology is itself a change within the corporate culture and a support for decision making, which facilitates changes. Change management is a structured process that manages changes and it aims at communicating changes to the people involved in order to effectively implement these change. The key to implement this methodology is to start where the least resistance is perceived; usually through innovators who pull changes and opinion leaders who like to try new ideas, according to the diffusion of innovations theory of Rogers (2003).

4.6 Cross-case synthesis

We have compared the results from these different cases by applying cross-case synthesis. This is an analytic technique that is mostly applied in the analysis of at least two cases by aggregating findings across the cases (Yin, 2003).

The methodology has already been previously tested in the bank sector. The two case studies in the telecommunications sector further contribute to the robustness of the methodology. Three main differences come out when comparing the case studies: the nature of processes, the engineering approach adopted and the participation of end-users.

4.6.1 Nature of processes. Concerning the nature of processes, a distinction is made between process types, namely core and support BPs. Core BPs are those that have a direct impact on the organization's customers; while support BPs are those that enable the core processes to work effectively. The AP process is a support process while the eVoIP process and the insurance process from the bank are core processes. In this case study, the support process was not complex, using a small set of similar UIs. It was easier to convince the teams in charge of core processes of the relevance of the methodology than the team in charge of support processes. This was noticed because the ones involved with eVoIP and the insurance processes have an in-depth understanding of the business strategy, which facilitates understanding the value of process alignment and improvement.

4.6.2 Engineering approach. Even though both cases experienced the same issues concerning UI-business alignment, they have different characteristics that are useful for different approaches as the network of links is being built.

For the AP and insurance projects, the methodology has been applied in a forward engineering way. The departments had their existing BP models that could be used as a starting point to create the task model and the mappings between the models.

In the eVoIP project, the backward engineering approach has been adopted to apply the methodology. The BP had not been previously modeled and consequently, the existing UIs of the supporting system constituted the starting point. From then on, the task model was designed and the BP modeled.

This reality allowed the methodology to be assessed in different contexts. These case studies made the methodology more robust because it has now been tested with different engineering approaches to build the network of links between the models. The backward approach has been analyzed in more details because of the strong value it brings to the company with the participation of end-users, discussed as follows.

4.6.3 Participation of end-users. The main difference between the bank and the telecommunications case studies is the participation of end-users during the application of the methodology. Since the methodology identifies impacts of changes in terms of UIs, end-users can actively participate because UIs are understood by anyone who interacts with systems. In the work of Stoitsev *et al.* (2008), they have already highlighted that business process management has already perceived that the involvement of business users in process specification can make processes better turned to users' needs and organizational changes. This can, therefore, result in processes that are more consistent and still flexible. We go further by saying that end-users can contribute to process improvement through the perception they have of the UIs.

In the bank case study, the participants were from the business department (three business analysts) and IT department (two system analysts/developers and two UI designers/human factors experts). The participation of experts from the business and IT domains aided in specifying how models from different domains can be effectively mapped to give a consistent result for impact analysis.

In the telecommunications case study, we were able to effectively involve end-users (besides business and IT professionals). The main impact of their participation was actually on the suggestions of changes, which were much more relevant for the business as a whole. Their suggestions have a much greater impact because they are the ones who actually perform the process and can better identify the major bottlenecks on the processes and systems.

4.7 Applicability of the methodology

Once the methodology has been defined, we have also considered how it can be applied in other situations by other people in their projects considering the following principles.

The methodology is appropriate to be applied in the context of large organizations that have extensive enterprise systems and have their BPs or are at least interested in designing their BPs. To be able to apply the methodology, it is not required to have both. Having just the system is already a starting point since the methodology enables to derive a business process model that can be evolved by business analysts.

In general, for the methodology to be applied in companies, the stakeholders involved shall be trained to update UI tasks derived from business process, delineate UI models and create the mappings between the models. Normally, we would expect usability experts to update UI tasks since they have an understanding of the UIs of systems and are used to work with textual representations of UIs, such as user manuals. Delineating UI models can be done by UI designers since it requires understanding the structure and navigation of the systems' UIs. Mapping the models can be done by stakeholders that understand both the BPs and the systems, such as business analysts. The business process is not considered as an added model to be learned by the stakeholders because it is considered as a given by the corporate setting. We assume the organization has decided to apply business process management techniques in their projects as part of their corporate strategy.

As in most methodologies, there is the need to consider the learning curve that represents the changing rate of learning how to update UI tasks, delineate UI models and create the mappings. Despite that, the task and UI models are simple; there is just a small set of elements to be learned. There are also the functionalities of the platform under development that make transformations from the business process into the task model, avoiding to create it from scratch and the plug-ins that enable evolving the platform with more support, such as creating prototypes of the UIs. To quantitatively demonstrate that the application of the methodology is worthwhile, therefore, a ROI analysis can be applied for each project. This analysis is useful to check that the benefits of applying the methodology outgrow its costs, thus proving its feasibility in a corporate setting and motivating stakeholders to continue applying it.

Besides the profit that the methodology may bring from resulting improvements on BPs, the human perspective in this methodology enables end-users being heard in the company. The methodology enables a free channel where they can give their opinion about user interaction. This opinion is translated into BPs so operation managers can ponder on their impact. When end-users' suggestions are put in practice and these changes improve their work, they are motivated to collaborate. The more an end-user's suggestions helps other end-users, the stronger is their reputation within the group (e.g. customer representative department) and higher is the trust between people.

5. Conclusion

Some advantages of the UI-business alignment methodology highlighted from the experience in these case studies are its explicitness, simplicity, flexibility and innovation. The stakeholders stated at the end of the projects that it was easy to understand the purpose and how to apply the methodology.

Some limitations were identified from the application of the methodology in different projects. Concerning the models, we recognize that even though UI models are important for model-driven approaches, they are not widely known in the business environment. Thus, this motivates us to study the cognition aspects of the models applied on the business context. Concerning the automation, a platform is needed to apply the methodology with more efficiency. In addition to that, once the platform is concluded, it needs to be largely applied in several situations and empirical data need to be gathered in order to analyze its use. To do that, certain empirical metrics need to be established, such as time to learn, feasibility in the corporate setting, etc. Concerning the applicability, an important aspect to be analyzed is the acceptability from business analysts towards changes proposed in UIs that may have impacts on their BPs, considering organizational policies, hierarchy, power, marketing strategies, product knowledge, etc.

This is an ongoing work that will be continued with future projects envisioned through collaborations with other universities. Concerning future works, a new interest has arisen to include requirements in this methodology. A first proposal has been defined and this reality encourages the application of this new approach considering requirements in the industry, aiming at analyzing their interest on this strategy and their openness to change. The next step is to analyze requirements engineering modeling approaches in order to select a suitable approach. This choice depends on the kind of analysis and the reasoning offered by the approach in order to facilitate the link between requirements and the other models.

In order to further analyze the adoption of this methodology in large organizations, we have emphasized on bringing concrete results in terms of efficiency. Therefore, a new investigation is to demonstrate the effectiveness of the methodology by verifying its adherence to principles and values of the Agile Alliance. The main goal is to bring fast results with its application, not adding bureaucracy, since it is a human-centered methodology that is concerned with what people say to improve their work. This future work is aimed to provide a comparative analysis of the methodology with Agile principles. Since this is a methodology that embraces changes, is result-driven and focuses on end-users of enterprise systems, it is important to analyze the methodology under this perspective to verify that such Agile principles and values are useful.

References

Barclay, P.J., Griffiths, T., McKirdy, J., Kennedy, J.B., Cooper, R., Paton, N.W. and Gray, P. (2003), "Teallach – a flexible user-interface development environment for object database applications", *Journal of Visual Language and Computing*, Vol. 14 No. 1, pp. 47-77.

Bhattacharya, K., Caswell, N., Kumaran, S., Nigam, A. and Wu, F. (2007), "Artifact-centric operational modeling: lessons learned from customer engagements", *IBM Systems Journal*, Vol. 46 No. 4, pp. 703-21.

Calvary, G., Coutaz, J., Thevenin, D., Limbourg, Q., Bouillon, L. and Vanderdonckt, J. (2003), "A unifying reference framework for multi-target user interfaces", *Interacting with Computers*, Vol. 15 No. 3, pp. 289-308.

Costa, D., Nobrega, L. and Nunes, N. (2006), "An MDA approach for generating web interfaces with UML ConcurTaskTrees and canonical abstract prototypes", *International Workshop on Task Models and Diagrams for User Interface Design, Tamodia'2006*, Springer, Berlin, pp. 137-52.

Davenport, T. (2006), *Process Innovation: Reengineering Work through Information Technology*, Harvard Business School Press, Boston, MA.

Decrop, A, (1999), "Qualitative research methods for the study of tourist behavior", in Pizam, A. and Mansfeld, Y. (Eds), *Consumer Behavior in Travel and Tourism*, The Haworth Press, New York, NY, pp. 335-65.

Eisenstein, J., Vanderdonckt, J. and Puerta, A.R. (2001), "Applying model-based techniques to the development of UIs for mobile computers", *International Conference on Intelligent User Interfaces, IUI'2001*, ACM Press, New York, NY, pp. 69-76.

Fischer, G., Giaccardi, E., Ye, Y., Sutcliffe, A.G. and Mehandjiev, N. (2004), "Meta-design: a manifesto for end-user development", *Communications of ACM*, Vol. 47 No. 9, pp. 33-7.

Henderson, J.C. and Venkatraman, N. (1999), "Strategic alignment: leveraging information technology for transforming organizations", *IBM Systems Journal*, Vol. 38 Nos 2/3, pp. 472-84.

IBM (2009), *The New Voice of the CIO*, IBM Global Business Services, Armonk, NY.

IIBA (2006), *Business Analysis Body of Knowledge – BABOK*, International Institute of Business Analysis, Version 1.6, available at: www.theiiba.org/AM/Template.cfm?Section=Home (accessed November 13, 2010).

Krajewski, L., Ritzman, L. and Malhotra, M. (2007), *Operations Management – Processes and Value Chains*, 8th ed., Pearson International Edition, New Jersey, NJ.

Kruchten, P. (2000), *The Rational Unified Process*, Addison-Wesley, Reading, MA.

Limbourg, Q. and Vanderdonckt, J. (2004), "A user interface description language sup-porting multiple levels of independence", in Matera, M. and Comai, S. (Eds), *Engineering Advanced Web Applications*, Rinton Press, Paramus, NJ, pp. 325-38.

Mayhew, D. (1999), *The Usability Engineering Lifecycle: A Practitioners Handbook for User Interface Design*, Morgan Kaufmann Publishers, San Francisco, CA.

Meisenheimer, C. (1997), *Improving Quality: A Guide to Effective Programs*, Jones & Barlett Publishers, Sudbury, MA.

Nielsen, J. (1993), *Usability Engineering*, Academic Press, Cambridge, MA.

OMG (2009), "Business Process Modeling Notation Specification 1.2", available at: www.omg.org/spec/BPMN/1.2 (accessed November 13, 2010).

Paterno, F. and Santoro, C. (2002), "One model, many interfaces", *Proceedings of the Fourth International Conference on Computer-aided Design of User Interfaces CADUI'2002*, Kluwer Academics Publishers, Dordrecht, pp. 143-54.

Prahalad, C.K. and Krishnan, M.S. (2008), *The New Age of Innovation: Driving Co-created Value through Global Networks*, McGraw-Hill, New York, NY.

Rogers, E.M. (2003), *Diffusion of Innovations*, 5th ed., The Free Press, New York, NY.

Sharp, H., Rogers, Y. and Preece, J. (2007), *Interaction Design: Beyond Human-computer Interaction*, 2nd ed., Wiley, New York, NY.

Sousa, K., Mendonça, H. and Vanderdonckt, J. (2008a), "A model-driven approach to align business processes with user interfaces", *International Journal of Universal Computer Science*, Vol. 14 No. 19, pp. 3236-49.

Sousa, K., Mendonça, H. and Vanderdonckt, J. (2009a), "A rule-based approach for model management in a user interface – business alignment framework", *Proceedings of the International Workshop on Task Models and Diagrams for User Interface Design, Tamodia'2009*, Lecture Notes in Computer Science, Vol. 5963, Springer, Berlin, pp. 1-14.

Sousa, K., Mendonça, H. and Vanderdonckt, J. (2009b), "User interface development lifecycle for business-driven enterprise applications", *Proceedings of the 6th International Conference on Computer-aided Design of User Interfaces, CADUI'2008*, Springer, Berlin, pp. 23-34.

Sousa, K., Mendonça, H., Vanderdonckt, J. and Pimenta, M. (2008b), "Supporting requirements in a traceability approach between business processes and user interfaces", *8th Symposium on Human Factors in Computer Systems IHC'08*, ACM Press, New York, NY, pp. 272-5.

Sousa, P., Caetano, A., Vasconcelos, A., Pereira, C. and Tribolet, J. (2006), "Enterprise architecture modelling with the unified modelling language 2.0", in Ritten, P. (Ed.), *Enterprise Modelling and Computing with UML*, IRM Press, Hershey, PA.

Sousa, K., Mendonça, H., Vanderdonckt, J., Rogier, E. and Vandermeulen, J. (2008c), "User interface derivation from business processes: a model-driven approach for organization engineering", *Proceedings of Symposium on Applied Computing SAC'2008*, ACM Press, New York, NY, pp. 553-60.

Stoitsev, T., Scheidl, S., Flentge, F. and Muhlhauser, M. (2008), "From personal task management to end-user driven business process modeling", *Proceedings of the 6th International Conference on Business Process Management, BPM 2008*, Springer, Berlin, pp. 84-99.

Sukaviriya, N., Mani, S. and Sinha, V. (2009), "Reflection of a year long model-driven business and UI modeling development project", *Proceedings of the 12th IFIP TC 13 International Conference on Human-computer Interaction, Interact'2009, Uppsala, Sweden*, Springer, Berlin, pp. 749-62.

Sukaviriya, N., Sinha, V., Ramachandra, T., Mani, S. and Stolze, M. (2007), "User-centered design and business process modeling: cross road in rapid prototyping tools", in Baranauskas, C., Palanque, P., Abascal, J. and Junqueira Barbosa, S.D. (Eds), *Proceedings of the 11th IFIP TC 13 International Conference on Human-computer Interaction, Interact'2007, Rio de Janeiro, Brazil*, Springer, Berlin, pp. 165-78.

Taylor, S.J. and Bogdan, R. (1984), *Introduction to Qualitative Research Methods: The Search for Meanings*, Wiley, New York, NY.

Traetteberg, H. (2008), "UI design without a task modeling language – using BPMN and Diamodl for task modeling and dialog design", *Proceedings of Engineering Interactive Systems HCSE/TAMODIA2008*, Lecture Notes in Computer Science, Vol. 5247, Springer, Berlin, pp. 110-17.

Vanderdonckt, J. (2005), "A MDA-compliant environment for developing user interfaces of in-formation systems", *Proceedings of 17th Conference on Advanced Information Systems Engineering, CAiSE'05*, Lecture Notes in Computer Science, Vol. 3520, Springer, Berlin, pp. 16-31.

Van Mieghem, J.A. (2008), *Operations Strategy: Principles and Practice*, Dynamic Ideas, Belmont, MA.

Vasconcelos, A., da Silva, M.M., Fernandes, A. and Tribolet, J.M. (2004), "An information system architectural framework for enterprise application integration", *Proceedings of 37th Hawaii International Conference on System Sciences, HICSS 2004, Big Island, HI, USA*.

Wolff, A., Forbrig, P., Dittmar, A. and Reichart, D. (2005), "Linking GUI elements to tasks: supporting an evolutionary design process", *Proceedings of Interantional Workshop on Task Models and Diagrams for User Interface Design, Tamodia'2005*, ACM Press, New York, NY, pp. 27-34.

Yin, R. (2003), *Case Study Research – Design and Methods*, 3rd ed., Sage, Thousand Oaks, CA.

Zacarias, M., Caetano, A., Magalhaes, R., Sofia Pinto, H. and Tribolet, J. (2007), "Adding a human perspective to enterprise architectures", *Proceedings of International Workshop on Enterprise Information Systems Engineering, DEXA-WEISE 2007, Regensburg Germany*, pp. 840-4.

Zelkowitz, M.V. (2009), "An update to experimental models for validating computer technology", *Journal of Systems and Software*, Vol. 82 No. 3, pp. 373-6.

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