AMCIS 2011 Proceedings - All Submissions

8-6-2011

Towards Objectives-Based Process Redesign

Jochen Martin
Research Center for Information Technology (FZI), martin@fzi.de

Tobias Conte
Research Center for Information Technology (FZI), conte@fzi.de

Rico Knapper
Research Center for Information Technology (FZI), knapper@fzi.de

Recommended Citation
Martin, Jochen; Conte, Tobias; and Knapper, Rico, "Towards Objectives-Based Process Redesign" (2011). *AMCIS 2011 Proceedings - All Submissions*. 150.
http://aisel.aisnet.org/amcis2011_submissions/150

Towards Objectives-Based Process Redesign

Jochen Martin
Research Center for Information Technology
Haid-und-Neu-Str. 10-14
Karlsruhe, Germany
martin@fzi.de

Tobias Conte
Research Center for Information Technology
Haid-und-Neu-Str. 10-14
Karlsruhe, Germany
conte@fzi.de

Rico Knapper
Research Center for Information Technology
Haid-und-Neu-Str. 10-14
Karlsruhe, Germany
knapper@fzi.de

ABSTRACT

Continuously growing and changing multinational companies oftentimes struggle with heterogeneous degrees of standardization. Especially in case of redesigning business processes that have been historically grown over decades, the capability of handling semi-structures process is central. Nevertheless, for competitive advantages, it is essential for a company to work on the optimization of all processes. Existing redesign techniques either focus on completely unstructured or structured processes. The Redesign Model presented in this paper transforms processes with any level of structuredness into processes with an increased degree of standardization. Our technique consists of four main steps: (i) we extract the objectives for an efficient business process redesign from existing literature; (ii) we formulate a list of requirements an innovative redesign model has to fulfill; (iii) we present a design science based Business Process Redesign Framework including our Redesign model; (iv) we evaluate our model showing its applicability and completeness.

Keywords

Business Process Analysis, Business Process Redesign, Multinational Enterprises, Semi-Structured Processes, Design Science

INTRODUCTION

Globally operating companies often face ever changing environments and therefore need to be flexible in their (business) processes. Thus it is impossible to improve processes and to implement workflows only based on standardized processes. But in order to be as effective and efficient as possible, it is essential to redesign companies processes according to present needs. Governance and compliance rules need to be applied and processes need to be improved. Within continuously growing and changing multinational companies one of the key factors for organizational advancement is process redesign to improve (business) processes as described by Shtub and Karni (2008). This is especially true if enterprises operate in ever changing environments Martin and Blau (2010). Due to mergers and acquisitions together with internal growth the set of legal entities is very heterogeneous regarding the size, the position within the group and the cultural context. For this reason, many companies have implemented their own information system (IS) or applied commercial solutions (Vo, Weinhardt and Wojciechowski (2005)). The implementation of such a system is based on the integration of existing processes and therefore requires methods that divide processes in implementable and not-implementable parts. That implies, that the necessity for redesign models, that support the integration of existing processes into IS, rises with the growing importance of information systems.

Recent academic literature focuses on two extremes: unstructured and totally standardized processes. An example for a standardized application scenario is the work of Van der Aalst (2000) who introduces a framework to verify workflows. But like all workflow management systems (WFMS), this verification is not applicable to a non-standardized scenario (Van der Aalst, Weske and Grünbauer (2005)). Therefore, we present in our paper a model which works in between a WFMS and a case handling approach. This model is a stepwise procedure to redesign an existing process according to a reference process including tailoring to a specific domain. It enables the users to incorporate earlier detected objectives, shortcomings and constraints. Furthermore, there are no limitations regarding the application domain because the extracted objectives are generally accepted. In order to prove our approach we use a generic data transmission and interaction process to qualitatively evaluate our model. We further give hints what kind of architecture can be used to implement a special WFMS for processes in the context of continuously growing and changing multinational companies.

The paper's remainder is structured as follows: We start with the motivating example and continue with the related work in Section Scope & Related Work, the foundation for the extraction of the relevant process analysis aspects (represented by objectives $\mathscr{O}$ in The Business Process Redesign Framework). Furthermore, we derive a set of requirements $\mathscr{R}$ for an innovative process redesign models. In the following we present our Redesign Model that is part of a Business Process Redesign Framework (The Business Process Redesign Framework). Therein, we describe the redesign in detail, including an algorithmic description of the procedure. Finally, we are able to evaluate our Redesign Model qualitatively based on an exemplarily interaction process (cf. Scope & Related Work) in Section Evaluation.

SCOPE & RELATED WORK

In this section we introduce the necessity for an innovative Business Process Redesign Framework, including a Redesign Model, that combines flexibility and standardization in business processes. The challenges arising from the design of such a framework are expressed in our research question (RQ):

RQ How to design a theoretically based process redesign model that combines standardization and flexibility to assure practical relevance?

After a exemplarily problem description, we prove the missing trade off in existing business process redesign literature between standardization and flexibility. Furthermore, we extract redesign objectives as our metric for process quality. Finally, in the last subsection, we formulate the requirements to a model answering the research question RQ.

Motivating Example

The continuous growth of multinational enterprises often leads to a high heterogeneity of employees and applications and business processes with heterogeneous degrees of standardization. One solution for handling the challenges and merging the requirements is the enterprise-wide implementation of IS. Thereby, the integration of business processes into IS contains special challenges, which makes multinational enterprises suitable for our use case. For example, the integration makes the automation of at least parts of the processes necessary. In this subsection, we exemplarily describe the challenges of a data transmission and interaction process within a multinational enterprise. For the graphical illustration we use the Business Process Modeling Notation (BPMN), which has become the de facto standard in academic and practice communities for business process modeling (Recker (2010), Wohed, van der Aalst, Dumas, ter Hofstede and Russell (2006)). Furthermore, BPMN meets our requirements in representing collaborative processes (White (2004)) between local legal entities and central management.

Figure 1 depicts the generic data transmission and interaction process within a multinational enterprise. It comprises of three pools representing the subsidiary (local legal entity), the gateway and the holding (central management) company. The gateway could be email communication in the most simple case or an IS in a further stage of redesign. In our scenario, we assume a holding pool division into two swim lanes. Activities in the lower swim lane are performed mainly with a spreadsheet application. The upper swim lane represents manual process elements performed by knowledge workers in the holding company. Furthermore, Figure 1 contains two different versions of the generic process: (i) manual data processing and (ii) automated data processing/ monitoring. This split simplifies the description of the different redesign steps in the later sections. The process in this use case starts with the subsidiary sending data to the holding via the gateway. The data has to be checked by the holding company. The

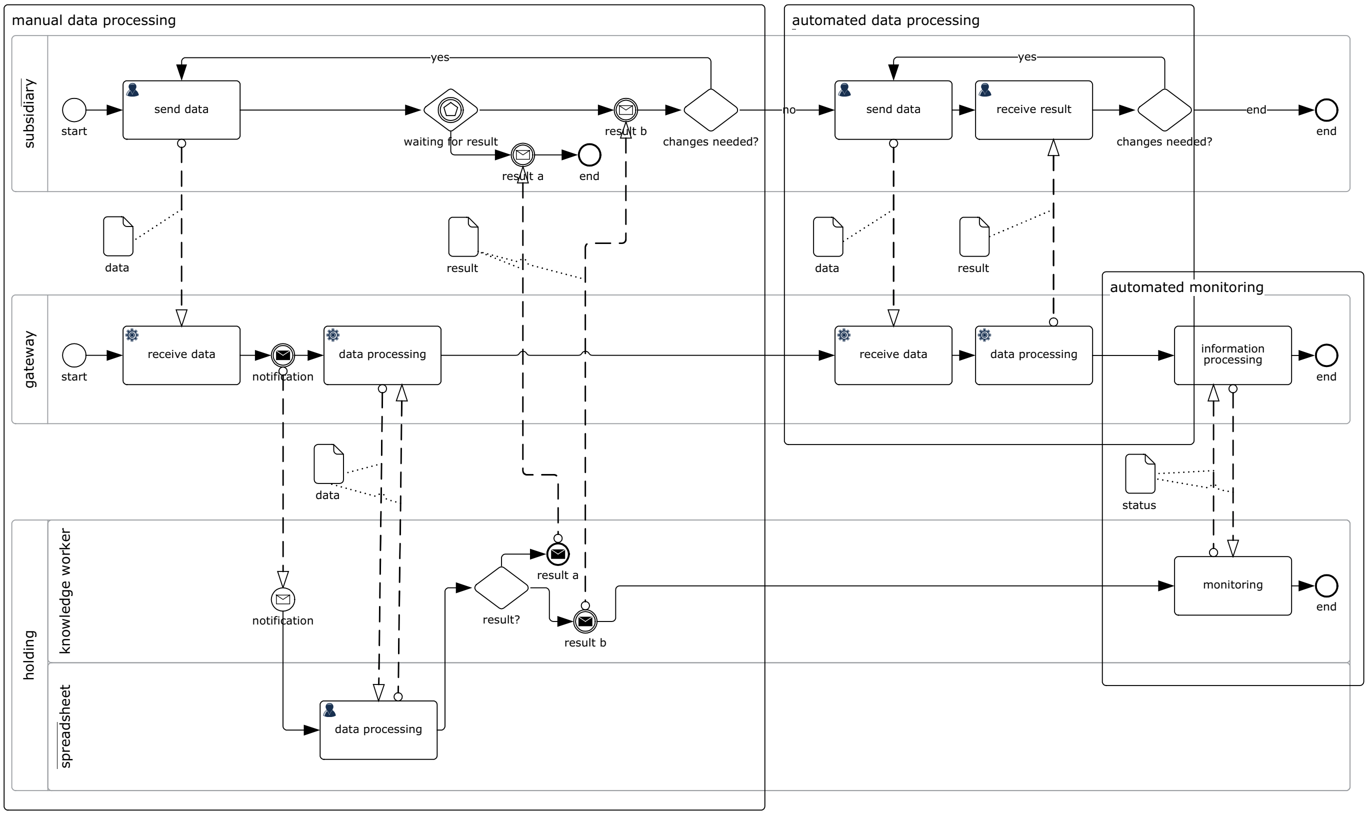

Figure 1: Generic data transmission and interaction process within a multinational enterprise.

result of the data processing in the company determines the sequence flow in the subsidiary's process. Hence, the subsidiary's process has to wait for the result of the check performed by the holding company. The same use case is represented in the second group with the difference that the check is implemented in the gateway and can be performed without manual tasks by the holding. Both kinds of data processing (manual and automated) are depicted in one figure to illustrate the differences. The main differences are the elimination of waiting times and the reduced number of participants.

This illustration contains the standard problems appearing with the implementation of IS and is the central motivation for our approach: the necessity for IS along with the challenges of its realization. Manual tasks are often complex and very time consuming. They are difficult to communicate to colleagues and they hold a high potential for errors. Therefore they should be automated and integrated into IS. But not all tasks are automatable and it is difficult to decide which automation is really necessary. The model presented in the remainder of this paper offers the optimal support for these decisions. Therein, we change the structure of one single process and therefore use the term redesign according to Mansar and Reijers (2007), although there exists no explicit definition of the terms reengineering and redesign in the literature (O'Neill and Sohal (1999)). Reengineering is often associated with more drastic change programs (Mansar and Reijers (2007)). In general reengineering assumes a much broader scope than the specific focus on process redesign. Process redesign concentrates on the process *itself* in terms of its interdependent tasks and resources, while reengineering refers to all aspects of restructuring an organization's processes, e.g. from change management to project management issues. Moreover, our business process definition follows Oberweis (1996), who describes a business process as "a set of manual, semi-automated or automated activities that are performed according to certain rules to achieve a particular business goal". According to Davenport (1993) this definition has a strong emphasis on workflows within an enterprise rather than on products. In the following subsection we characterize existing literature with respect to the required degree of standardization and point out the necessity for an alternative model.

Business Process Redesign

The literature of business process redesign contains numerous papers with the focus on the management of standardized processes and workflows. Reijers and Mansar (2005) derive a conceptual framework with the goal of best practices in business process design. In their paper, they focus on the mechanics of the process, rather than on behavioral or change management aspects. They present a number of concrete redesign goals, but their concept remains very general. Mansar and Reijers (2007) continue this research in their paper. They base their results on an empirical analysis of the top-ten best practices in business process design and the development of a framework to classify the different approaches. Redman (1995) switched the point of view from the model in general to specific redesign goals. In his analysis he pointed out that data quality is a competitive advantage. Within the scenario of AT&T he describes the structure of a process to identify and eliminate deficient data quality. Moreover, Davenport, Harris and Cantrell (2004) intensify this quality focus to guarantee appropriate decision making by process integration and data basis improvement. The addition to this general approaches and overviews are structured methods like WMFS. As Van der Aalst, Weske and Grünbauer (2005) show, the applied method depends a lot on the characteristics of the specific domain. As a consequence, they provide different approaches either for structured or unstructured processes. In the structured domains, they suggest the application of WMFS (Van der Aalst (2000), van der Aalst and Weske (2001)), based on Petri Nets. van der Aalst and Weske (2001) present an approach to handle collaborative processes via integration in an interorganizational context. They identify two characteristics for processes: first the globally visible process and second the private subprocesses of each participant. Analogously to Davenport, Harris and Cantrell (2004) their main goal is the perfect integration of all process parts into one main process. The redesign approach described in our paper is related to this interorganizational idea. Nevertheless, they present a theoretical model and in this way miss to provide concrete support in the new process' realization. In addition to WFMS, van der Aalst et al. suppose the workflow management by knowledge workers who are supported by a system that presents all available informations (Van der Aalst, Weske and Grünbauer (2005)). In doing so, the system supports the decisions made, but does no autonomous decision making. Altogether, Van der Aalst, Weske and Grünbauer (2005) state that not all processes can be transformed into a standardized system. But they do not present a solution for processes that can be standardized in parts.

Most of the above presented papers work on the management of IS and the integration of new processes. But as discussed, they focus either on completely structured or unstructured processes, or they miss to provide a concrete process redesign model. This incompleteness results in the necessity for a model with a higher flexibility regarding the structure degree of the affected processes and the model presentation. Nevertheless, the literature presents criteria for an efficient process, like redesign goals (cp. Stage Initiate in Section Methodology), which we utilize in our work. Reijers and Mansar (2005) try to get rid of unnecessary tasks, reduce contact and reduce waiting times. Moreover, like Redman (1995), they work on task automation. In addition, the research of Redman (1995) explicitly includes the focus on data quality. Davenport, Harris and Cantrell (2004) enrich this data perspective by the need for data completeness. Data quality and completeness often depend on the process integration level and therefore van der Aalst and Weske (2001) and Davenport, Harris and Cantrell (2004) claim an increase of integration. The reduction of the research to such objectives is close to the definition of structural metrics. This allows us in the following subsection to integrate the metrics "communication automation factor" and "activity automation factor" presented by Balasubramanian and Gupta (2005), into our structured notation, too.

Requirements

Before starting the detailed description of the methodology applied to develop our model, we need to define the quality of a redesign model. We measure the quality based on the fulfillment of a set of $n = 6$ requirements $\mathscr{R} = \{R_i | i = 1, ..., n\}$. This requirements that ensure the research rigor along with relevance and application of a business process redesign procedure in practice:

R1 *Objective conformity:* If possible within the constraints of the specific domain, the procedure must be able to realize all defined objectives $\mathscr{O}$.

R2 *Structured model:* The structure of the presented model should follow an accepted framework to support its research rigor.

R3 *Profound design methodology:* "The fundamental principle of design-science research [...] are acquired in the building and application of an artifact" (Hevner, March, Park and Ram (2004)).

R4 *Flexibility:* The realization of objectives fractions $O \subset \mathscr{O}$ must be possible.

R5 *Simplicity of application:* A clear communication along with a structured representation of the model guarantee a simple application.

R6 *Applicable in Information System Design:* Relevant redesign models must support the integration of existing processes into IS.

The requirements $R_1 - R_3$ in combination guarantee the research rigor of the redesign model. In addition, the requirements $R_4 - R_6$ assure the practical relevance of the model. In total, the requirements $\mathscr{R}$ fulfillment ensures an innovative redesign model.

THE BUSINESS PROCESS REDESIGN FRAMEWORK

The Redesign Model presented in this chapter is a *design science artifact* and is part of an overall Business Process Redesign Framework. This framework comprises of the seven guidelines to be followed when pursuing a design science approach as introduced by Hevner, March, Park and Ram (2004). Hevner et al. denote design science as a problem solving process in which knowledge and understanding of a problem "and its solution are acquired in the building and application of an [IT] artifact" (Hevner, March, Park and Ram (2004)). According to Hevner, March, Park and Ram (2004) and Walls, Widmeyer and El Sawy (1992), the definition of an IT artifact includes "not only instantiations [...] of the IT artifact but also the constructs, models, and methods applied in the development and use of information systems". Furthermore, Tsichritzis (1997) and Denning (1997) denote an IT artifact as innovations that define the idea, practices, technical capabilities, and products that are the enabler for the effective and efficient analysis, conceptualization, and utilization of information systems.

The structure of this section is based on the design science guidelines. The first subsection presents the guideline "design as an artifact" in detail as the focus of this work is put upon a model of redesigning semi-structures processes. Within this section, we apply the stages and activities of a business process redesign as presented and evaluated by Kettinger, Teng and Guha (1997). The remaining design guidelines postulated in Hevner, March, Park and Ram (2004) complete our Business Process Redesign Framework in the following subsection.

Design as an Artifact: The Redesign Model

The Redesign Model follows the stage-activity framework for business process reengineering as introduced by Kettinger, Teng and Guha (1997). Their work provides an enhancement of earlier fundamental work presented by Davenport (1993) and Grover, Jeong, Kettinger and Teng (1995) which *(i)* includes a comprehensive survey of commonly used business process reengineering techniques and tools both from academia and business and *(ii)* is empirically derived. The stage-activity framework for business process reengineering is composed of six stages of which our Redesign Model inherits five steps as detailedly shown in the remainder of this section. The evaluation stage was removed here since it maps to the correspondent design guideline described in Section Further Design Science Guidelines.

Stage 1 - Envision: Each redesign project begins with the commitment and decision of the management. Redesign opportunities are discovered, suitable IT-related levers are identified and the targeted process is selected (Kettinger, Teng and Guha (1997)). In Section Scope & Related Work, we already introduced a motivating example for our Redesign Model's application. Analogously to the example, the Redesign Model is designed for *semi-structured processes*, which are non-deterministic sequences of activities: a semi-structured process is somewhere in between of ad-hoc and structured processes (Dustdar and Gall (2003)). Managing semi-structured processes requires a high level of flexibility, since they are not fully standardized, however, bring along a much more higher degree of structure than an ad-hoc process. The latter allows for the application of known activities, tools, and methodologies, yet requires a dedicated consideration of "fuzziness" (cf. Requirement R_2).

Stage 2 - Initiate: Having identified and selected the field of application and the process to be changed, it is necessary to plan the redesign in detail and to define performance goals by analyzing and determining the redesign requirements (Kettinger, Teng and Guha (1997); Balasubramanian and Gupta (2005)). In the Redesign Model, the determination of performance goals (functional and non-functional) for the identified artifacts is defined by the set of objectives $\mathscr{O} = \{O_i | i = 1, ..., m\}$ as a structured representation of the general optimization measures listed in Section Business Process Redesign. Hence, integrating the most fundamental general issues mentioned in literature leads to $m = 6$ objectives which need to be considered in (semi-structured) business process redesign:

- **O1** *Contact reduction:* reduce the number of contacts with customers and third parties. (Reijers and Mansar (2005), Balasubramanian and Gupta (2005))
- **O2** *Task elimination:* clean up all not necessary process tasks. (Reijers and Mansar (2005))
- **O3** *Task automation:* eliminate all manual tasks where automation is possible and promising improvement. (Redman (1995), Reijers and Mansar (2005), Balasubramanian and Gupta (2005))
- **O4** *Process integration:* reduction of system and workflow breaks through data integration. (Davenport, Harris and Cantrell (2004), van der Aalst and Weske (2001))
- **O5** *Waiting time reduction:* Process optimization reducing both the waiting time and the setup time. (Reijers and Mansar (2005))
- **O6** *Data quality:* Assure and, if possible, increase data quality applying measures not included in the objectives above. For instance, such measures aim to ensure completeness of the data base (Davenport, Harris and Cantrell (2004), Redman (1995)).

Stage 3 - Diagnose: The initial state of the process including its subprocesses has to be documented prior to the redesign (at time $t = 0$). We index the sequential redesign steps by $t \in \mathbb{N}$. Let $\mathscr{D}$ denote the *domain* of the process containing all process related information such as process attributes, resources, communication, roles, and IT (Kettinger, Teng and Guha (1997)). $\mathscr{D}$ is the only static documentation element since the domain cannot be changed by redesign steps (i.e. the domain sets the overall scope of the process). Based on $\mathscr{D}$, our Redesign Model identifies two basic concepts to document the process state at each time t: The constraints C_t of the domain $\mathscr{D}$ and the shortcomings S_t of the process. An example for a constraint is a limited automation degree that allows only for a few automated tasks during process runtime. With C_0 denoting the set of limiting characteristics of the domain $\mathscr{D}$. All sets of constraints C_t with $t > 0$ are subsets of C_0. C_t impacts the process P_t at step t. These dependencies can be represented as mappings:

$$\mathscr{C} \quad : \quad \mathscr{D} \longrightarrow C_0, \tag{1}$$

$$\mathscr{P} \quad : \quad C_t \longrightarrow P_t,\ t \geq 0. \tag{2}$$

Deriving the initial set of shortcomings S_t includes, first, the domain-specific process P_t, and, second, the general set of objectives $\mathscr{O}$ (cf. Section Scope & Related Work). The set of shortcomings S_t can be formalized as a mapping:

$$\mathscr{S} : (P_t, \mathscr{O}) \longrightarrow S_t. \tag{3}$$

In a nutshell, stage 3 is based on $\mathscr{D}$ and consists of the derivation of process specific shortcomings S_0 (the instantiations of the objectives $\mathscr{O}$ not fulfilled in the initial process P_0), and the constraints C_t. To exemplify the instantiation, assume that there are 3 system brakes in P_0. In this case, S_0 contains 3 different shortcomings of the class $O_4 = $ *Process integration*. In the following steps of our Redesign Model we present an algorithm that deals with the documented shortcomings based on a stepwise constraint relaxation.

Stage 4 - Redesign: In stage 4 the actual redesign takes place. This stage of our Redesign Model is iterative and repeats along with the reconstruction stage. Each iteration is called a *redesign step* and the first step is indexed by $t = 1$ as $t = 0$ defines the status quo. Within each redesign step t we start by reducing and simplifying respectively the subset of constraints to $C_t \subseteq C_0$. We assume that some of the constraints C_0 can be deleted or at least formulated less restrictively (e.g. because of current technical developments we can automate some process parts which were not automated at $t = 0$). According to the Equations (2) and (3), the reduced/simplified constraint set C_t leads to a new process P_t and a new set of shortcomings S_t. Each redesign step t is successful, if $S_t \neq S_{t-1}$ holds. The redesign iteration will be stopped as soon as $C_t = C_{t-1}$ at a certain time t (i.e. the set of constraints cannot be reduced or simplified any more) and/or if $S_t = S_{t-1}$. We denote the number of the last executed redesign step by T. The algorithm including the exit conditions is depicted in the following:

```
1:  bool terminated = false;
2:  int t = 0;
3:  List<ConstraintSet> C = new List();
4:  List<Process> P = new List();
5:  List<ShortcomingSet> S = new List();
6:  C.add(getC(D));
7:  while (!terminated)
8:    P.add(getP(C(t)));
9:    S.add(getS(P(t), O));
10:   C.add(relaxC(C(t)));
11:   if (t > 0)
12:     then if (S(t) == S(t-1) and C(t) == C(t-1));
13:       then terminated = true;
14:   t = t + 1;
15:   if (C(t) == C(t-1));
16:     then terminated = true;
17: end while
```

Executing the algorithm, we get an optimal process P_T with respect to the constraints C_T. The lists defined in rows (3) to (5) contain a documentation of the processed redesign steps. With k_t denoting the cardinality of C_t and l_t the cardinality of S_t (shortcomings) it holds that $C_t = \left\{c_t^i | i = 1, ..., k_t)\right\}$ and $S_t = \left\{s_t^i | i = 1, ..., l_t)\right\}$.

Stage 5 - Reconstruct: The reconstruction consists of the realization of the new process and its implementation in supporting IT-systems. As mentioned above, stage 5 is part of each iterative redesign step, thus another iterative step. However, since implementing a redesign step, in which one of the termination conditions is fulfilled, generates no benefit, step T only contains stage 4.

Fulfillment of further Design Science Guidelines

After introducing Design as an Artifact as central design guideline to this work, the remaining design guidelines as proposed by Hevner, March, Park and Ram (2004) are summarized and mapped to our Business Process Redesign Framework in the following.

Problem relevance: The overall goal of design science research is not only to provide profound methodology, but also to develop technology-based solutions to relevant, that is, important business problems (Hevner, March, Park and Ram (2004)). Continuously growing and changing multinational companies oftentimes struggle with heterogeneous degrees of standardization (Martin, Betz, Conte, Gerhardt and Weinhardt (2011)). Especially in case of redesigning business processes that have been historically grown over decades, the requirement of handling semi-structures process is central. The crucial issue in practice and in theory is the integration of new processes into existing IS (Martin, Caton, Conte and Weinhardt (2011)). In Section Scope & Related Work, we listed the challenges of such a procedure as requirements defined for the Business Process Redesign Framework. Still, academic literature does not provide a flexible tool, or framework, to handle such issues. The lack of standardization hampers the application of WFMS (Van der Aalst, Weske and Grünbauer (2005)), yet, proposed case handling approaches such as Loeffeler, Striemer and Deiters (1998) exhibit the major shortcoming of supporting the automation of tasks. Thus, the framework presented in this work can be rated both relevant in terms of business applicability and novelty.

Design Evaluation: Hevner, March, Park and Ram (2004) list different possible ways of performing an evaluation. In the subsection above, we present a general model for the redesign of semi-structured processes. In order to abstractly show that the Redesign Model fulfills the requirements stated in Section Evaluation, we therein provide a qualitative evaluation. An instantiation of the Redesign Model as a design artifact adapted to a concrete use case will be evaluated as the central part of our further research which will follow this fundamental framework.

Research Contributions: The research contribution is closely linked to the relevance of the Redesign Model. As abovementioned, our model extends the present state of research by providing a defined procedure to tackle the ever-important issue of redesigning business-processes in historically grown (IS) environments without limitations due to the process' level of structuredness. The model is defined along a checklist that assures its theoretical and practical relevance (cf. requirements $\mathscr{R}$). As a contribution to academia, our Redesign Model yields *(i)* the problem representation in the diagnose step, *(ii)* the solution representation in the redesign step, and finally *(iii)* the design algorithm in the redesign step, too.

Research Rigor: Design science is always a trade off between rigor and relevance (Hevner, March, Park and Ram (2004)). As above-stated, our Redesign Model yields high practical relevance of our technique. Nevertheless, research rigor is achieved by thoroughly applying the well-established design science methodology by Hevner, March, Park and Ram (2004), with the stage-activity framework by Kettinger, Teng and Guha (1997) as an embedded methodology to produce the design artifact.

Design as a Search Process: Design science is also said to be an iterative approach that eventually satisfies the set requirements subject to the laws that constrain the problem environment (Hevner, March, Park and Ram (2004)). Initially, the constraints as introduced in Section Scope & Related Work are restrictive. In several iteration steps, the constraints are relaxed, allowing for new automation steps. It is likely that some hard constraints given by the application domain remain in the final and redesigned process, thereby restricting the objectives listed in Section Scope & Related Work. Yet, the redesign and reconstruct steps as above-described allow for a stepwise and flexible elimination of the shortcomings tailored to the environment of the problem and its constraints.

Communication of Research: The result of design science research shall be made available for both a technology-oriented and management-oriented audience (Hevner, March, Park and Ram (2004)). We present sufficient detail to allow an implementation of the framework in an appropriate application context (technology orientation Martin, Caton, Conte and Weinhardt (2011)) as well as the motivation why organizational resources should be committed to use the Business Process Redesign Framework in practice (management orientation Martin, Betz, Conte, Gerhardt and Weinhardt (2011)).

EVALUATION

In this Section we present an evaluation of our Business Process Redesign Framework pointing out the applicability in Section Applicability and the completeness in Section Completeness. Both parts use the semi-structured process described in the motivating example (cf. Section Introduction) along with the algorithm presented in The Business Process Redesign Framework to demonstrate the expressiveness of our Redesign Model.

Applicability

We start the application of our Redesign Model performing the decision for the interaction process in Figure 1 as the process to be changed (stage 1 “Envision”). Afterwards we determine the fulfillment of the basic objectives $\mathscr{O}$ extracted in Section Scope & Related Work as our non-functional requirements (stages 2 “Initiate”). Figure 1 illustrates two different redesign steps: the box “manual data processing” depicts the initial state at $t = 0$ and the boxes “automated data processing” as well as “automated monitoring” illustrate the process changes after the first and second redesign step at $t = 1$ and $t = 2$. We evaluate our Redesign Model applying the algorithm (cf. stage 4 in Section The Business Process Redesign Framework) to the initial process in the following. To reduce the algorithm’s complexity for the readers convenience, we note the affected rows of the algorithm in our description.

t=0: The first main step is the “Diagnose” (stage 3) to document the domain characteristics $\mathscr{D}$ (represented by its constraints C_0 – cf. Equation (1)) and the characteristics of the original process P_0 (represented by its shortcomings S_0 – cf. Equation (3)). According to row 6 of the algorithm the initial constraints C_0 are derived from the domain $\mathscr{D}$. This leads to $k_0 = 5$ constraints $c_0^i, i = 1,...5$, listed in Table 1. The constraint c_0^1 to c_0^3 reflect the low degree of IT support along with many manual tasks. c_0^4 and c_0^5 arise within an multinational company having autonomously working subsidiaries . All constraints in total result in the initial interaction process P_0. Applying the objectives $\mathscr{O}$ to P_0 (row 9) results in $l_0 = 18$ shortcomings $s_0^i, i = 1,...18$, listed in Table 1. Each s_0^i is driven by exactly one objective o^i but each objective o^i can cause multiple shortcomings s_0^i. For example, o^3 results in the shortcomings “manual result communication” (s_0^2), “manual data processing” (s_0^5), “manual monitoring” (s_0^8), and “manual send data” (s_0^{12}). But with a decreasing number of constraints, the number of shortcomings caused by each objective decreases as well. We illustrate this development on the example of objective o^3.

t=1: This redesign step starts in row 14 by checking if the second termination conditions (row 15) is fulfilled - the first termination condition (row 10) does not have to be checked since the shortcomings could not have changed without any redesign done so far. We assume that the data processing and the communication of the results can be automated (c_0^1 and c_0^3). Thus, our relaxation is successful ($C_1 \subset C_0$) and the algorithm does not terminate. The remaining $k_1 = 3$ constraints result in process P_1. Therein the cardinality of the set of shortcomings S_1 is reduced to $l_1 = 8$ (the components of S_1 are denoted in Table 1). The remaining shortcomings caused by objective o^3 are: "manual monitoring" (s_1^1), and "manual send data" (s_1^4). This significant reduction of the shortcomings in process P_1 is the reason for relaxing the constraints c_0^1 and c_0^3. Hence, for a successful application of our Redesign Model, it is inevitable to predict the benefits that arise from the change of the constraints. For instance, a manual data processing task in the holding process requires costly knowledge worker resources. Moreover, this manual task is done by means of a spreadsheet application which makes an additional data transfer between the gateway and the spreadsheet application necessary. This data transfer generates effort and increases the potential error rate. Altogether, the automation of the data processing promises to solve this shortcomings and therefore it is of high interest to automate such a task.

Redesign step (t)	specifier (C_t/S_t)	cardinality (k_t/l_t)	components $\left(c_t^i \in C_t/s_t^i \in S_t\right)$
$t = 0$	C_0	$k_0 = 5$	c_0^1 manual data processing, c_0^2 manual monitoring, c_0^3 manual communication, c_0^4 black box subsidiary, c_0^5 autonomous subsidiary process.
	S_0	$l_0 = 18$	s_0^1 to s_0^4 manual result communication, s_0^5 to s_0^7 manual monitoring, s_0^8 to s_0^{11} manual data processing, s_0^{12} to s_0^{14} manual send data, s_0^{15} and s_0^{16} system brake data processing, s_0^{17} and s_0^{18} system brake monitoring.
$t = 1$	C_1	$k_1 = 3$	c_1^1 black box subsidiary, c_1^2 manual monitoring, c_1^3 autonomous subsidiary process.
	S_1	$l_1 = 8$	s_1^1 to s_1^3 manual monitoring, s_1^4 to s_1^6 manual send data, s_1^7 and s_1^8 system brake monitoring.
$t = 2$	C_2	$k_2 = 2$	c_2^1 black box subsidiary, c_2^2 autonomous subsidiary process.
	S_2	$l_2 = 3$	s_2^1 to s_2^3 manual send data.
$t = T = 3$	C_3	$k_3 = 0$	$\{\,\}$
	S_3	$l_3 = 0$	$\{\,\}$

Table 1: Development of process characteristics C_t and S_t during the algorithms completion time T.

t=2: The organizational structure of this redesign step is analogous to $t = 1$. Both, the first (row 10) and the second (row 15) termination condition are not hit. The further reduction of the constraints (compare Table 1) allows for the automation of the monitoring. This increases the process integration and abolishes another system brake. Considering the shortcomings caused by objective o^3, only "manual send data" (s_2^1) is left. According to the box "automated monitoring" in Figure 1, only status informations are transmitted from the gateway to the holding.

t=3: We finally assume that the last constraints c_2^1 and c_2^2 can also be relaxed. In this optimal scenario, the process would be entirely automated as it is depicted in Figure 2. Hence, the subsidiary would receive the result of the check immediately after sending the data. There would be no more waiting time and the process could be performed without interruption. Hence, we could avoid time-consuming setup times. Comparing the process in Figure 1 with the optimized version in Figure 2 the system breaks on the holding side have vanished. The data has not to be exported and imported any more to perform data checking in the spreadsheet application. Furthermore, the monitoring functionality is integrated into the gateway and the knowledge worker receives status information about process instances without performing any queries. At the end of this redesign step, it holds $C_3 = \{\,\}$ and $S_3 = \{\,\}$, that implies both sets cannot be reduced any more. Thus, the algorithm terminates.

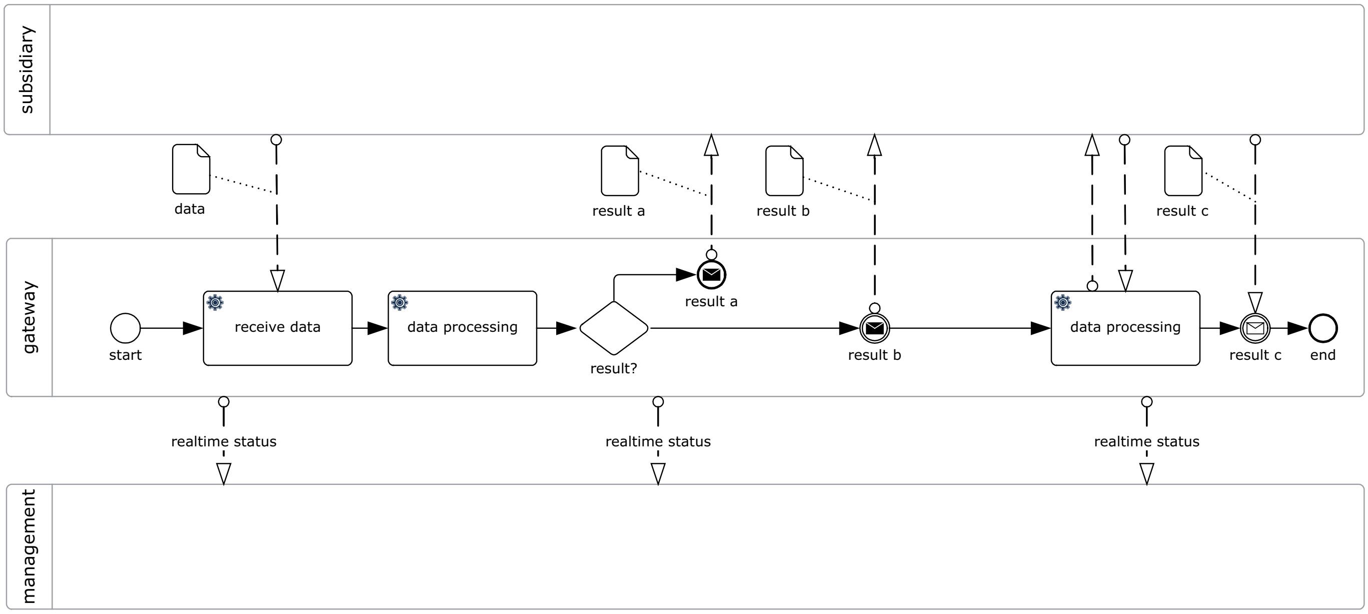

Figure 2: Reference process with a complete automation on management side.

Completeness

In Section Scope & Related Work we derived a list of requirements $\mathscr{R}$, a redesign technique should fulfill. We define a technique complete, if it realizes all $R \in \mathscr{R}$. In Table 2 we prove the completeness of our Redesign Model following this definition. R_2 and R_4 are realized by construction, R_1 can be shown in the above subsection in redesign step $T = 3$. Moreover, the detailed description in the Sections The Business Process Redesign Framework and Applicability ensure the fulfillment of R_5 and R_6.

CONCLUSION AND FUTURE WORK

In this paper we presented a objectives-based process Redesign Model that is part of a design science based Business Process Redesign Framework. It is applicable to all kinds of processes, independent of their structural level and their domain. Furthermore, we presented the special redesign challenges with respect to, for instance, flexibility of semi-structured processes and formulated them in six requirements. Based upon that, we demonstrated the need for a generally applicable redesign model, in particular to semi-structured processes. We established the model based on a well-structured literature representation (the objectives $\mathscr{O}$) and domain characterization (represented by its constraints $\mathscr{C}$) and introduced a stepwise algorithm for business process redesign. The theoretical foundation for the model development are universally accepted methodologies, the design science approach of Hevner, March, Park and Ram (2004) and the stage activity framework by Kettinger, Teng and Guha (1997). The resulting redesign approach enabled us to fulfill all six requirements defined in Section Scope & Related Work and thus assure relevance and research rigor of our model. Furthermore, we qualitatively evaluated the model applying it to an exemplarily semi-structured process and documenting best practices of its application. Finally, this Redesign Model introduces a stepwise automation and implementation of manual processes. In doing so, we frame the automation and implementation of the redesigned tasks and hence provide strong support for a granular and service oriented integration into IS (Martin, Caton, Conte and Weinhardt (2011)).

Our future research will be the completion of our Business Process Redesign Framework. Besides the Redesign Model, this framework includes instantiations of our model that represent additional research artifacts according to design science postulated by Hevner, March, Park and Ram (2004). For instance, Martin, Betz, Conte, Gerhardt and Weinhardt (2011) prove the benefit of the Redesign Model in the domain of financial planning. Finally, we quantitatively evaluate our complete Business Process Redesign Framework, applying it at our industrial cooperation.

requirement $R_i \in \mathscr{R}$	fulfillment
R_1	Assuming that it is possible to get rid of all constraints ($C_3 = \{\,\}, t = T = 3$), the technique generates a redesigned process that fulfills all objectives $\mathscr{O}$ (Figure 2).
R_2	The Redesign Model is embedded into a Business Process Redesign Framework that follows universally accepted design science methodology by Hevner, March, Park and Ram (2004).
R_3	The Redesign Model itself fits into the stage activity framework presented by Kettinger, Teng and Guha (1997).
R_4	Each redesign step described in Section Applicability realizes fractions of the objectives in abolishing shortcomings (compare Table 1). The flexibility results from the ability of the Redesign Model to stop redesign at any time t.
R_5	The structured knowledge representation ($\mathscr{O}$) along with the algorithmic description of the model assure the application.
R_6	The automation focus of the technique together with the representation of the domain in its constraints C_0 supports a stepwise service-oriented IS implementation.

Table 2: Prove of technique completeness based on the fulfillment of all requirements.

REFERENCES

1. Balasubramanian, S. and Gupta, M. (2005) Structural metrics for goal based business process design and evaluation, *Business Process Management Journal*, 11, 6, 680–694.
2. Davenport, T. (1993) *Process innovation: reengineering work through information technology*, Harvard Business Press.
3. Davenport, T. H. (1993) *Process innovation: reengineering work through information technology*, Harvard Business School Press, Boston, MA, USA.
4. Davenport, T. H., Harris, J. G. and Cantrell, S. (2004) Enterprise systems and ongoing process change, *Business Process Management*, 10, 1, 16–26.
5. Denning, P. (1997) A new social contract for research, *Communications of the ACM*, 40, 2, 134.
6. Dustdar, S. and Gall, H. (2003) Architectural concerns in distributed and mobile collaborative systems, *Journal of Systems Architecture*, 49, 10-11, 457 – 473.
7. Grover, V., Jeong, S., Kettinger, W. and Teng, J. (1995) The implementation of business process reengineering, *Journal of Management Information Systems*, 12, 1, 109–144.
8. Hevner, A., March, S., Park, J. and Ram, S. (2004) Design science in information systems research, *Mis Quarterly*, 28, 1, 75–105.
9. Kettinger, W., Teng, J. and Guha, S. (1997) Business process change: a study of methodologies, techniques, and tools, *MIS quarterly*, 21, 1, 55–80.
10. Loeffeler, T., Striemer, R. and Deiters, W. (1998) A framework for identification, classification and IT support of semi-structured business processes, *Knowledge and Process Management*, 5, 1, 51–57.
11. Mansar, S. L. and Reijers, H. A. (2007) Best practices in business process redesign: use and impact, *Business Process Management*, 13, 2, 193–213.

12. Martin, J., Betz, S., Conte, T., Gerhardt, C. and Weinhardt, C. (2011) Objectives-Based Business Process Redesign in Financial Planning - A Case Study, in *Proceedings of the 19th European Conference on Information Systems (ECIS)*, Helsinki, Finland.
13. Martin, J. and Blau, B. (2010) Dynamic Corporate Financial Plan Validation, in *Group Decision and Negotiation (GDN)*, Delft, Netherlands.
14. Martin, J., Caton, S., Conte, T. and Weinhardt, C. (2011) Financial Planning as a Service, in *Proceedings of the 8th International Conference on Service Computing (SCC)*, Washington DC, USA.
15. Oberweis, A. (1996) *Modellierung und Ausführung von Workflows mit Petri-Netzen*, Teubner.
16. O'Neill, P. and Sohal, A. (1999) Business Process Reengineering A review of recent literature, *Technovation*, 19, 9, 571–581.
17. Recker, J. (2010) Opportunities and constraints: the current struggle with BPMN, *Business Process Management Journal*, 16, 1, 181–201.
18. Redman, T. C. (1995) Improve Data Quality for Competitive Advantage, *Sloan Management*, 36, 2, 99–107.
19. Reijers, H. A. and Mansar, S. L. (2005) Best practices in business process redesign: an overview and qualitative evaluation of successful redesign heuristics, *Omega*, 33, 4, 283–306.
20. Shtub, A. and Karni, R. (2008) *ERP: the dynamics of supply chain and process management*, Springer Verlag.
21. Tsichritzis, D. (1997) The dynamics of innovation, *Beyond Calculation: The Next Fifty Years of Computing*, 1980–82.
22. Van der Aalst, W. (2000) Workflow verification: Finding control-flow errors using petri-net-based techniques, *Business Process Management*, 19–128.
23. van der Aalst, W. and Weske, M. (2001) The P2P approach to interorganizational workflows, in *Advanced Information Systems Engineering*, Springer, 140–156.
24. Van der Aalst, W., Weske, M. and Grünbauer, D. (2005) Case handling: a new paradigm for business process support, *Data & Knowledge Engineering*, 53, 2, 129–162.
25. Vo, H. T. K., Weinhardt, C. and Wojciechowski, R. (2005) Integration of Electronic Foreign Exchange Trading and Corporate Treasury Systems with Web Services, *Wirtschaftsinformatik 2005*, 471–488.
26. Walls, J., Widmeyer, G. and El Sawy, O. (1992) Building an information system design theory for vigilant EIS, *Information Systems Research*, 3, 1, 36–59.
27. White, S. (2004) Introduction to BPMN, *IBM Corporation*, 31.
28. Wohed, P., van der Aalst, W., Dumas, M., ter Hofstede, A. and Russell, N. (2006) On the Suitability of BPMN for Business Process Modelling, *Business Process Management*, 4102, 161–176.