A Critical Evaluation and Framework of Business Process Improvement Methods

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Appendix (available online via http://link.springer.com)

Appendix A: Review Protocol

1. Introduction

This appendix presents the final protocol that supported the execution of the literature review. In this protocol, we discuss the different literature review stages as outlined by Kitchenham (2004): purpose, organization, searching for literature, relevance screening, quality screening, data extraction and coding, and data synthesis and reporting. In the second section, we discuss the purpose of this literature review, which includes the research objectives and related scoping decisions. Subsequently, the project organization of this literature review is briefly described in section three. The fourth section describes the search strategy that was used to identify a relatively complete census of relevant literature. The so-called 'relevance and quality screening' are outlined in section five and six. In section seven, we discuss our data extraction and coding strategy. Finally, we explain our data synthesis and reporting strategy in section eight.

2. Purpose

In this section, the research objectives and scoping decisions of this literature review are explained.

2.1 Research objectives

This systematic literature review aims at (1) supporting practitioners in composing a method for the generation of process improvement ideas, and (2) providing inspiration for researchers who aim to developed new methods for this act. A methodological framework is presented that contains a comprehensive overview of method options for six key choices to be made with regard to such a method. Next to presenting the framework, this review offers recommendations that further support researchers in developing methods for generating process improvement ideas.

2.2 Research scope

In order to achieve the research objective, this systematic review consists of two parts that each applies a similar but separate search and screening procedure. The first part targets studies that either have developed a method for generating process improvement ideas (*method development studies*) or reviewed multiple methods for generating these ideas (*method review studies*). The second part targets studies that have investigated success factors of generating process improvement ideas *(success factor studies).* The scope of each part is outlined below.

Scope part 1

With regard to method development and method review studies, four decisions were made concerning the research scope:

- It is limited to methods that aim at redesigning an interdepartmental or inter-organizational order-fulfillment process;
- It is limited to holistic methods;
- It is limited to methods that support practitioners in generating process improvement ideas;
- It is not limited to application domain-independent methods. Methods related to the healthcare domain are also within the scope of this literature review.

The details of the four decisions that were made regarding the scope of the first part are discussed below.

Methods that aim at redesigning an interdepartmental or inter-organizational order-fulfillment process

The scope is limited to methods that aim at redesigning interdepartmental or inter-organizational order-fulfillment processes. It is widely acknowledged that due to the existence of dependencies between sub-processes from different departments, business process redesign initiatives need an interdepartmental or even a cross-organizational focus to achieve significant process performance gains (e.g. Vos et al. 2009). Hence, we focus on methods that aim at redesigning such a comprehensive order-fulfillment process.

Holistic methods

The scope is restricted to holistic (multidimensional) methods. In contrast to one-dimensional methods, multidimensional methods do not have a single pre-defined solution concept in mind, but aim at changing multiple elements of a process simultaneously and take into account the effects on different process performance dimensions. It is assumed that, due to these characteristics, holistic methods have the most potential to achieve significant improvements in practice. Reijers and Limam Mansar (2005) have presented a Business Process Redesign (BPR) framework to describe the elements that can be candidates for redesign. These are: customers, products, business process (with an operation and behavioural view), organization (with a structure and population view), information, technology, and the external environment. In addition to changing multiple elements of a process simultaneously, holistic methods also take into account their effects on multiple process performance dimensions. According to Jansen-Vullers et al. (2008), costs, time, flexibility, internal and external quality dimensions can be distinguished. In this literature review, a method is called a *holistic method* if it aims at changing at least three process elements and takes into account the effects of redesigns on at least two process performance dimensions.

Methods that support practitioners in generating process improvement ideas

A business process redesign initiative broadly covers four phases: 1) framing the process of interest, 2) understanding the current AS-IS process, 3) designing the new TO-BE process, and 4) implementing the new process (Netjes, 2010). The scope is restricted to methods that aim at supporting practitioners in generating process improvement ideas. These methods belong to the third phase of a business process redesign initiative. However, this literature review specifically takes the outputs into consideration that are gained from the framing and understanding of the process in the first two phases since they are clearly relevant as input for the third phase. This literature review neither ignores the outputs of the third phase that are needed as input for the fourth phase. Nevertheless, a detailed analysis of methods that are used in the first, second and fourth phase of a business process redesign initiative is outside the scope of this literature review.

Application domain-independent methods as well as methods related to the healthcare domain

In the healthcare domain, administrative processes, which have been the target of many traditional BPM initiatives, meet (patient-)logistic processes, which are often characterized by a highly complex and flexible interplay of different specialized organizational units (Mans et al., 2009; Mans et al., 2013). As such, the healthcare domain faces special process integration and redesign challenges, which makes this domain an interesting development ground for process improvement methods. Based on this reasoning, our review targets domain-independent methods as well as methods related to the healthcare domain.

Scope part 2

With regard to success factor studies, five decisions were made concerning the research scope:

- It is limited to success factors of initiatives that aim at redesigning an interdepartmental or inter-organizational order-fulfillment process;
- It is limited to success factors of initiatives that aim at holistic business process improvement;
- It is limited to success factors of initiatives that aim at generating process improvement ideas;
- It is not limited to application-domain independent success factors. Also, success factors of business process redesign initiatives in healthcare are investigated.
- It is limited to success factors that are actionable.

The first four decisions have been explained in the preceding subsection. In the remainder of this subsection, the last decision is explained.

Actionable success factors

The term action-ability refers to the degree to which the success factor allows a concrete action to be taken or concrete decision to be made (Grunert and Ellegaard, 1992). In this literature review, it refers to the degree to which the success factor allows a concrete methodological choice to be made. In feedback theory, three information levels are distinguished: the meta-task level, the task level and the task learning level (DeNisi and Kluger 2000). At the meta-task level, the highest level, information is not considered to be actionable. For example, the success factor “ensure top management support” does not allow a concrete action to be taken. The next level, i.e. the task level, is related to actual task performance and is actionable. For instance, “Clearly articulate the purpose of the project and its strategic contribution” is an actionable statement at the task level. The task learning level, the lowest level, focuses on the details of task execution and is also actionable. For example, “Give a 5-sheet PowerPoint presentation at 8:00 AM to discuss the purpose of the project and its strategic contribution” is a statement at the task learning level. Although this statement is actionable, our focus is on identifying success factors at the task level.

3. Organization

For this literature review, a project organization was established. The project organization consisted of a project coordinator, a review team, and an advisory committee. The *project coordinator* was responsible for the coordination of all activities concerning this literature review. Together with another project member, the project coordinator formed the *review team*. This team was responsible for developing the review protocol, searching and selecting the studies to be included in this literature review, extracting and coding data, and synthesizing and reporting the outcomes of this literature review. During the synthesizing and reporting stage, an additional researcher was added to the review team. The *advisory committee* was responsible for reviewing the protocol, the list of studies selected for data extraction, and the draft research paper. This committee consisted of scientific experts in the field of business process redesign. Because research in this field is conducted by scientists that work in different research domains, two experts for each of the relevant domains were invited to participate in the advisory committee. More specifically, the six members of the advisory committee covered the domains of information systems, management sciences, and health sciences.

4. Searching for literature

The aim of the search stage is to identify studies in such a way that a relatively complete census of relevant literature is accumulated (Webster and Watson 2002). As recommended by many studies

(Fink 2010; Kitchenham 2004; Levy and Ellis 2006; Okoli and Schabram 2010; Randolph 2009), multiple search strategies were used in order to establish that important studies did not remain unidentified. We started with an electronic database search in order to enable a comprehensive search (Fink 2010; Okoli and Schabram 2010; Randolph 2009; Rowley and Slack 2004). Subsequently, a secondary search was conducted to identify additional studies by means of backward and forward tracing of references. To further establish that important studies did not remain unidentified, the members of the advisory committee were contacted to assess the completeness of the search at the end of this secondary search. Below, the primary search, secondary search, and advisory committee consultation are explained and corresponding practical concerns are discussed.

4.1 Primary search

The primary search is an electronic database search that is aimed at identifying an initial set of studies.

Selection of electronic databases

As proposed by a number of studies (Brereton et al. 2007; Levy and Ellis 2006), multiple electronic databases were used to cover the different research domains that are active in the field of business process redesign. More specifically, the electronic databases INSPEC, ABI/Inform, and Medline were selected to provide coverage of the information systems, management sciences, and health sciences domain respectively. In addition, the EPOC Cochrane database and the International Journal of Care Pathways were scanned manually. These sources are outside the scope of the selected search engines but are considered to be highly relevant.

Selection of data sources

In line with the recommendations of Rowley and Slack (2004) and Webster and Watson (2002), the primary search was targeted at peer-reviewed journal articles and conference papers in order to efficiently identify high quality studies. This search was further constrained by limiting our attention to studies that contain an abstract and were published in English in or after the year 1990. The year 1990 is considered to be the year of the start of the process wave with publications of Hammer's (1990) and Davenport and Short's (1990) work (Adesola and Baines 2005; Grover et al. 1995).

Search terms electronic databases

As recommended by Fink (2010) and Grimshaw et al. (2003), a broad search using free text and database specific headings was used to identify an initial set of studies in an effective way. Although all three selected electronic databases have a detailed thesaurus, we concluded that for business process redesign initiatives electronic databases are poorly indexed. On the one hand, many different headings can and, in fact, are used to code business process redesign initiatives. On the other hand, many heterogeneous studies are labelled to the same heading. Our stated findings are in line with Grimshaw et al. (2003). Hence, it was decided to complement high-level headings with a free text search in the title of the study to identify studies in an effective way. The free text search term was based on the research objective and derived from the thesaurus terms of all three electronic databases. More details about the construction of the free text search term are described below.

With regard to the first part, the elements "method", "redesign", and "process" were selected for further investigation. The elements "factor", "redesign", and "process" were selected for further investigation with regard to the second part. A structured scan of the thesaurus trees of all electronic databases was performed to discover related thesaurus terms for all these elements. After obtaining

these terms, cross checks were performed between the different electronic databases[1]. In this way, possible undiscovered thesaurus terms during the initial scan were localized and identified. After obtaining the thesaurus terms, additional synonyms, antonyms, and abbreviations were identified by means of a general thesaurus, acronym library, and trial searches. Finally, advanced search options like Boolean operators and truncation symbols were used to construct the free text search term. We created the following Boolean expression with respect to the first part:

(([process] AND [redesign]) OR [process redesign]) AND [method]

Regarding the second part, the following Boolean expression was created:

(([process] AND [redesign]) OR [process redesign]) AND [factor]

Each part in the above Boolean expression surrounded by the ([ ]) symbol is itself a Boolean expression consisting of synonyms, acronyms, and abbreviations. For each part, the complete Boolean expression is shown in Table A.1.

Part	Complete Boolean expression
Process	business model: OR (care ADJ3 continuit:) OR (care ADJ3 continuum:) OR case management OR chain: OR delivery system: OR network: OR operation: OR order fulfil: OR order processing OR organi#ational model: OR pathway: OR patientflow: OR patient flow OR process OR processes OR product: line: OR service: OR workflow: OR work flow:
Redesign	chang: OR CI OR CQI OR CQM OR design: OR develop: OR engineer: OR improv: OR innovat: OR invent OR inventi: OR optim: OR Quality Management OR redesign: OR reengineer: OR re-engineer: OR reform: OR reorgani: OR restructur: OR streamlin: OR total quality OR TQM
Process redesign	BPR OR (clinical ADJ2 path:) OR (critical ADJ2 path:) OR disease management OR integrated delivery OR (integrated ADJ2 path:) OR kaizen OR lean OR (patient ADJ2 centered ADJ2 care) OR (patient ADJ2 focused ADJ2 care) OR six sigma
Method	approach: OR blueprint: OR guide: OR guidebook: OR handbook: OR instruction: OR manual: OR method: OR procedure: OR protocol: OR road map: OR technique: OR tool:
Factor	antecedent OR barrier: OR cause: OR challenge: OR determinant: OR enabler: OR factor: OR guideline: OR hurdle: OR issue: OR lesson: OR obstacle: OR recommendation: OR requirement: OR risk: OR rule:

Table A.1: Overview Boolean expressions. The Boolean expressions in this table are used in the INSPEC and Medline database. In the ABI/Inform database slightly different truncation symbols are used.

As explained earlier, the free text search in the title of the studies was complemented with the use of database specific headings. Specifically, we complemented the free text search with the use of high-level subject headings and classification codes in INSPEC and Mesh headings and sub-headings in Medline. Headings were not used in ABI/Inform due to the absence of a clear hierarchical tree structure of headings. Regarding the other electronic databases, the selection of headings was on the safe side of inclusiveness. The detailed search filters of the three electronic databases, including the selected headings, are shown in Attachment 1.

4.2 Secondary search

After identification of an initial set of potentially relevant studies by means of performing the primary search, the relevance and quality of each identified study was screened. The relevance and quality screening procedures are discussed in detail in section five and six. After these screening procedures, a secondary search was performed based on the articles that passed the relevance and

[1] For each thesaurus term identified within one of the electronic databases, we checked whether this term was also identified within the other electronic databases or not. If it was not identified in a certain database, the term was entered in the thesaurus of the electronic database. In case the term was found in the thesaurus of that database, additional terms were identified by scanning relevant broader, narrower, and related terms in the thesaurus of that database. In this way, possible undiscovered trees / terms during the initial scan were localized by the cross check procedure.

quality screen. More specifically, the backward and forward tracing techniques were used to identify additional relevant studies (for forward tracing of references, Google scholar was used). The full copies of the identified papers by means of this secondary search were screened similar to the full copy screening procedures as discussed in section five and six. As recommended by Webster and Watson (2002), the secondary search stopped when new relevant concepts were no longer discovered.

Data sources

The secondary search was targeted at peer-reviewed journal articles, conference papers, technical reports, and book chapters. Analogously to the primary search, this search was further constrained by limiting our attention to studies that were published in English.

4.3 Advisory committee consultation

After the execution of the secondary search, the members of the advisory committee were contacted to assess the completeness of the search and recommend additional literature. The full copies of the identified papers by means of this consultation were screened similar to the full copy screening procedures as discussed in section five and six.

4.4 Practical concerns

In order to manage the large number of references, a bibliographic package was used. The generated unfiltered search results were saved and retained for further analysis.

5. Relevance screening

During the relevance screening stage, the studies that are considered relevant and the ones that are considered irrelevant were determined. As suggested by a number of studies (Fink 2010; Okoli and Schabram 2010; Randolph 2009; Torraco 2005), inclusion and exclusion criteria were defined and a screening procedure was developed to select studies in an unbiased way. In the remainder of this section, the inclusion and exclusion criteria, screening procedure, and corresponding practical concerns are discussed.

5.1 Inclusion and exclusion criteria

As recommended by Kitchenham (2004), the formulation of the inclusion and exclusion criteria was inspired by the research objectives and related scoping decisions. Regarding the first part, the inclusion and exclusion criteria are shown in Table A.2. All criteria were formulated as questions where the answers to these questions determine whether the study was included or not. A study only passed the relevance screen if all criteria in Table A.2 were fulfilled. More precisely, for each study, all the questions corresponding to the inclusion criteria had to be answered with either “Yes” or “?” and all the questions corresponding to the exclusion criteria had to be answered with “No” or “?”. With regard to *method review studies*, at least one of the reviewed methods should pass the criteria a-d in order to be included.

Inclusion (I) and exclusion (E) criteria
1. Does the study aim at developing a business process redesign method or reviewing multiple business process redesign methods? *(I)* a. Does the method aim at redesigning inter-departmental or inter-organizational order-fulfillment processes? *(I)* b. Is the method a holistic method? *(I)* i. Does the method aim at changing at least three different process elements? *(I)* ii. Does the method take into account the effects of redesigns on at least two different process performance dimensions? *(I)* c. Does the method support practitioners in generating process improvement ideas? *(I)* i. Does the method only aim at framing the process of interest? *(E)* ii. Does the method only aim at modelling or analyzing the AS-IS situation? *(E)* iii. Does the method only aim at evaluating different process alternatives? *(E)* iv. Does the method only aim at implementing a new process improvement idea? *(E)* d. Is the method customized for another domain than the healthcare domain? *(E)*

Table A.2: Overview relevance criteria related to the first part.

The inclusion and exclusion criteria related to second part are shown in Table A.3. A study only passed the relevance screen if all criteria in Table A.3 were fulfilled.

Inclusion (I) and exclusion (E) criteria
1. Does the study aim at identifying success factors of business process redesign initiatives? *(I)* a. Does the study focus on initiatives that aim at redesigning inter-departmental or inter-organizational order-fulfillment processes? *(I)* b. Does the study focus on initiatives that aim at holistic business process improvement? *(I)* i. Do the initiatives aim at changing at least three different process elements? *(I)* ii. Do the initiatives take into account the effects of redesigns on at least two different process performance dimensions? *(I)* c. Does the study focus on initiatives that aim at supporting practitioners in generating process improvement ideas? *(I)* i. Do the initiatives only aim at framing the process of interest? *(E)* ii. Do the initiatives only aim at modelling or analyzing the AS-IS situation? *(E)* iii. Do the initiatives only aim at evaluating different process alternatives? *(E)* iv. Do the initiatives only aim at implementing a new process improvement idea? *(E)* d. Are the success factors actionable and formulated at the task level? *(I)* e. Does the study aim at identifying success factors that are specific for another domain than the healthcare domain? *(E)*

Table A.3: Overview relevance criteria related to the second part.

5.2 Screening procedure

As proposed by a number of studies (Brereton et al. 2007; Kitchenham 2004), a two-stage screening procedure was used to select relevant studies in an efficient way:

- The title and abstract of studies identified by the primary search were screened by a single reviewer and irrelevant studies were excluded from further examination. This screen was on the safe side of inclusiveness and based on the inclusion and exclusion criteria as discussed earlier. For each study, the criteria were judged from top to bottom. If one of the relevance screen criteria was not met, no further analysis of other criteria was performed. A subset of titles and abstracts was screened by a second reviewer in order to test inter-rater-agreement. Analogously to Mistiaen et al. (2007), inter-rater-agreement was assessed on a 10% random sample of studies. Fink (2010) has recommended the use of the Kappa statistic to evaluate inter-rater-agreement. If the Kappa statistic was lower than the generally accepted threshold, i.e. 0.6, then the complete set of studies was reviewed by two reviewers. Any inclusion / exclusion disagreements between the reviewers were resolved by consensus.
- Full copies were obtained for all studies that passed the title and abstract screen. All full copies were independently reviewed against the inclusion and exclusion criteria by two reviewers. For each study, the criteria were judged from top to bottom. If one of the relevance screen criteria was not met, no further analysis of other criteria was performed. Inter-rater-agreement was again

evaluated by means of the Kappa statistic and any disagreements between the reviewers were resolved by means of consensus approach.

Before the start of the screening procedure, all criteria and screening activities were piloted, discussed, and documented in detail by the members of the review team. During the execution of the relevance screening procedure, screening issues, and improvement possibilities were discussed in review meetings without referring to individual studies.

5.3 Practical concerns

A spreadsheet was used to document all inclusion and exclusion decisions in detail. All search results that had been stored in the bibliographic package were exported to this spreadsheet. A flowchart was created to summarize the relevance screening results.

6. Quality screening

After screening for relevant studies, it is necessary to assess the quality of primary studies (Fink 2010; Grimshaw et al. 2003; Kitchenham 2004; Levy and Ellis 2006; Okoli and Schabram 2010). Similar to the previous stage, inclusion and exclusion criteria were defined and screening procedures were developed for an unbiased selection of studies. The final inclusion and exclusion criteria were determined after the relevance screen. In the remainder of this section, the inclusion and exclusion criteria, screening procedure, and corresponding practical concerns are discussed.

6.1 Inclusion and exclusion criteria

Inclusion and exclusion criteria were defined on the safe side of inclusiveness, because further validation of the methodological framework will take place by means of a cross-case survey and a field study among consultancy firms. Analogously to the relevance screen, all criteria in Table A.4 or Table A.5 had to be fulfilled to pass the quality screen. The inclusion and exclusion criteria related to the first part are shown in Table A.4.

Inclusion (I) and exclusion (E) criteria
1. Is a clear statement of the research objective and scope available? *(I)* 2. Is the activity of generating process improvement ideas explained? *(I)* 3. Does a literature review or field study form the basis for the development / review of the business process redesign method(s)? *(I)*

Table A.4: Overview quality criteria related to the first part.

With regard to the second part, the inclusion and exclusion criteria are shown in Table A.5.

Inclusion (I) and exclusion (E) criteria
1. Is a clear statement of the research objective and scope available? *(I)* 2. Is a clear description of the research methodology available? *(I)* 3. Are clear descriptions of success factors available? *(I)*

Table A.5: Overview quality criteria related to the second part.

6.2 Screening procedure

The quality screening was independently executed by two reviewers for all studies that had passed the relevance screen. Full copies of these studies were reviewed based on the inclusion and exclusion criteria of the quality screen. For each study, the criteria were judged from top to bottom. If one of the quality screen criteria was not met, no further analysis of other criteria was performed. In line with the relevance screen, inter-rater-agreement was assessed by means of the Kappa statistic and any disagreements between the two reviewers were resolved by consensus. Similar to the relevance screen, all criteria and screening activities were piloted, discussed, and documented in detail by the members of the review team, before the execution of the screen. During the execution of the quality screening procedure, review meetings were again scheduled to discuss screening issues and improvement possibilities without referring to individual studies.

6.3 Practical concerns

The spreadsheet that had been used to document the results of the relevance screen was also used to document all inclusion and exclusion decisions of the quality screen. A flowchart was again created to summarize the quality screening results.

7. Data extraction and coding

After identification of the studies that had to be included in the literature review, useful data from each included study was extracted and coded. For an unbiased data extraction and coding, a number of studies (Brereton et al. 2007; Kitchenham 2004; Okoli and Schabram 2010; Randolph 2009) recommend the development of a data extraction form and an accompanying data extraction and coding procedure. In the remainder of this section, the data extraction form, the data extraction and coding procedure, and corresponding practical concerns are discussed.

7.1 Data extraction form

As proposed by Okoli and Schabram (2010), the detailed data extraction form was developed after the quality screening procedure had been applied in order to make use of the insights gained during the preceding stages. We decided to extract two types of data elements from the studies. Firstly, we extracted data from the studies with regard to several methodological decision areas, i.e. method elements, in order to build the methodological framework. Secondly, several study characteristics, i.e. context elements, were extracted in order to gain insights into the context of method development and offer recommendations with regard to the development of further methodological support.

Method elements

Several researchers in the field of Method Engineering, i.e. the engineering discipline to design, construct and adapt methods, techniques and tools for systems development, have developed meta-modeling techniques for representing methods (Brinkkemper 1996; Henderson-Sellers and Ralyté 2010). A comparison of these meta-models (Cossentino et al. 2006) reveals that there are four main method elements. These method elements are: Activity (what is to be done?), Guidance (how to do it?), Actor (who does it? and who is responsible for it?), and Artifact (what is the result? and what is input for it?).

These method elements resemble the elements that were used to represent methods by researchers in the context of business process (re)design projects (Alt et al. 2001; Zellner 2011): Procedure model

(what has to be done in which order?), Technique (how to do it?), Role (who does it?), Results document (what is the result?), and Meta-model / information model (consist of the above-described elements and their relationships).

As a method can be seen as a special type of process, the method elements presented above are also closely related to the elements of the Business Process Redesign Framework proposed by Reijers and Limam Mansar (2005). Based on an analysis of this framework, we have concluded that a "tool (with what to do it?)" element is still missing in current method meta-models. In line with Kettinger et al. (1997), a technique defines how a standard activity is executed and a tool is a computer software package that is able to support one or more techniques.

Additionally, we extended the set of elements by adding an "aim (why to do it?)" element, in order to gain, among others, insights into the process performance dimensions that the method aims to change. Because we limited ourselves to a single activity in this literature review, i.e. generating process improvement ideas, an extraction of the procedure model / activity became superfluous. As a result, the meta-model on which our data extraction form was based, contained the following method elements:

- Aim (why to do it?)
- Actors (who do it? and who are responsible for it?)
- Input (what is input for it?)
- Output (what is the result?)
- Technique (how to do it?)
- Tool (with what to do it?)

Context elements

Besides method elements, we decided to extract several characteristics of the studies in order to gain insights into the context of method development. Similar to Walia and Carver (2009), who developed a taxonomy/framework for software requirements errors in a highly structured way, we decided to extract the following context elements from all studies: Identifier, Title, Authors, Publication year, Source, Type of source, Type of study, Label research area, Definition research area, Covered industries, Study objective, Study design, Data collection techniques, Data analysis techniques, Main findings, and Main limitations.

Complete data extraction form

The complete data extraction form including definitions is shown in Table A.6. In the third and fourth column, the "tag names" and "open and axial coding" attributes are introduced that were used during data coding. The detailed data extraction and coding procedure and these attributes are explained in the next subsections.

7.2 Data extraction and coding procedure

In line with the grounded theory approach as recommended by Wolfswinkel et al. (2013), all data fragments were extracted and coded in an iterative fashion by making use of a structured procedure. The first author of this paper extracted data from all studies and a tag name was assigned to each extracted data fragment (e.g. "Method.Actor"). For the data elements that were selected for the open and axial coding step, a more detailed code was also assigned to each extracted data fragment, using terms taken directly from the articles when available (e.g. "Actor.External consultant"). The second author of this paper independently extracted and coded data for a 10% random sample of studies. Subsequently, data extraction and coding discrepancies were discussed in detail by both reviewers

and resolved by consensus. In line with recommendations from Brereton et al. (2007), an extractor-checker construction was used to extract and code data from the remaining studies in an efficient way. The consensus approach was again used to resolve data extraction and coding discrepancies. During the execution of the data extraction and coding procedure, review meetings were scheduled to discuss data extraction and coding issues and improvement possibilities.

After this data extraction and initial coding step, the data elements that were assigned a more detailed code were analyzed in more detail by both reviewers. More specifically, as recommended by Wolfswinkel et al. (2013) an axial coding step was executed by both reviewers that resulted in updated concepts and categories.

Method element			
Data extraction element	**Definition**	**Tag name**	**Open and axial coding**
1. Aim	The objective of the method activity	Method.Aim	Yes
2. Actors	The role who executes the method activity	Method.Actors	Yes
3. Input	The information that is collected prior to the method activity	Method.Input	Yes
4. Output	The artifacts that are the results of the method activity	Method.Output	Yes
5. Technique	Prescription of how to execute the method activity	Method.Technique	Yes
6. Tool	A software package that is able to support the method activity	Method.Tool	Yes
Context element			
Data extraction element	**Definition**	**Tag name**	**Open and axial coding**
1. Identifier	Unique identifier of the study	-	No
2. Title	Title of the study	-	No
3. Authors	Authors of the study	-	No
4. Publication year	Publication year of the study	-	No
5. Source	Source name of the study	-	No
6. Type of source	Type of source (Journal paper / Conference paper / Book chapter / Technical report) of the study	-	No
7. Type of study	Type of study (Method development study / Method review study / Success factor study)	-	No
8. Label research area	The business process redesign related label that is used in the study (e.g. clinical pathways, lean, six sigma)	-	No
9. Definition research area	The definition of the research area	Study.Definition	No
10. Covered industries	The industries that are covered by the study (e.g. healthcare, hospitality, manufacturing)	Study.Industries	No
11. Study objective	The general objective of the study	Study.Objective	No
12. Study design	The research of the design (e.g. literature review, lab experiment, field study)	Study.Design	Yes
13. Data collection techniques	The way data is collected (e.g. interviews, questionnaires, observations, document analysis)	Study.Collection	Yes
14. Data analysis techniques	The way data is analyzed (e.g. structured equation modeling)	Study.Analysis	Yes
15. Main findings	The main findings of the study	Study.Findings	No
16. Main limitations	The main limitations of the study	Study.Limitations	No

Table A.6: Data extraction form.

7.3 Practical concerns

The PDF management and annotation tool Qiqqa was used to extract data from the studies and to assign codings. The context elements 1-8 were semi-automatically entered for each study in the standard or user defined fields in Qiqqa. For each study, all fragments within the PDF file that were related to one of the other data elements were annotated and tagged with the tag names as outlined in Table A.6 (e.g. “Method.Actor”, “Study.Definition”). For the data elements that were selected for the open and axial coding step, each fragment was additionally coded with a more detailed description. These codings were accompanied by the element name (e.g. “Actor.External consultant”; “Input.Clinical guideline”) in order to facilitate the creation of relevant annotation reports in Qiqqa.

For the axial coding step, all Qiqqa codings were exported to a spreadsheet. After the axial coding step, codings were updated and Qiqqa annotations were re-coded. Finally, all Qiqqa codings were exported to a spreadsheet for further statistical analysis.

8. Data synthesis and reporting

In the data synthesis and reporting stage, the extracted and coded data were summarized and compared critically. For that, a qualitative synthesis procedure was used that aimed at:

- Putting the knowledge from the review into conceptual framework that offers a new perspective on the topic (Torraco 2005);
- Including a critical evaluation of how well the literature presents the issue: strengths, key contributions as well as deficiencies, omissions, and inaccuracies are identified (Torraco 2005).

As recommended by Randolph (2009) and Webster and Watson (2002), the experts in the advisory committee contributed to the critical evaluation and reviewed the draft research paper.

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Attachment 1

Date electronic searches: 27/07/2011; date advisory committee consultation: 27/03/2012.

ABI/Inform:

Filter settings advanced search:

- Database: ABI/INFORM GLOBAL
- Data range: after this data: 01/01/1990
- Limit results to: Scholarly journal, including peer-reviewed
- Exclude: Book reviews; Dissertations; Newspapers

INSPEC:

Filter settings multi-field search:

- English language
- Abstract
- Publication year: 1990 - Current
- Publication types: Conference paper; Conference Proceedings; Journal paper
- Subject headings:
    - Systems analysis (not exploded)
        - Systems re-engineering
    - Business process re-engineering
    - Customer services
    - Management of change
    - Organizational aspects (not exploded)
    - Production management (not exploded)
        - Process planning
        - Logistics
    - Quality management (not exploded)
        - Total quality management
        - Continuous improvement
        - Six sigma (quality)
        - Innovation management
    - Supply chain management (not exploded)
    - Administrative data processing
    - Operations research (not exploded)
    - Order processing
    - Management science (not exploded)
    - Health care
    - Patient care
    - Systems engineering
    - Production engineering
    - Industrial engineering
    - Value engineering
    - Process design
    - Optimal systems
    - Constraint theory
    - Constraint handling
    - Lean production
    - Benchmark testing

- Classification codes:
    - Systems theory applications in economics and business
    - Systems theory applications in industry
    - Business and administration (not exploded)
        - Office automation
        - Public administration
        - Medical administration
        - Manufacturing and industrial administration
        - Administration of other service industries
    - Business and professional IT applications
    - Health care applications of IT
    - Industrial and manufacturing applications of IT
    - General topics in manufacturing and production engineering (not exploded):
        - Management and business
        - Organizational aspects
        - Management issues
        - Information technology applications (not exploded)
            - Industrial applications of IT
            - Business applications of IT
    - Production management
    - Research and development
    - Design
    - Manufacturing systems
    - System theory applications

Medline:

Filter settings multi-field search:

- English language
- Abstract
- Publication year: 1990 - Current
- Mesh headings:
    - *Information sciences / Information science* / Systems analysis
    - *Health care / Health care facilities, manpower and services* / Capacity building
    - *Health care / Health care facilities, manpower and services* / Health facilities
    - *Health care / Health care facilities, manpower and services* / Health services
    - *Health care / Health care economics and organizations* / Health planning
    - *Health care / Health service administration* / Organization and administration
    - *Health care / Health service administration* / Patient care management
    - *Health care / Health service administration* / Quality of care
    - *Health care / Health care quality, access and evaluation* / Delivery of health care
    - *Health care / Health care quality, access and evaluation* / Health services research
    - *Health care / Health care quality, access and evaluation* / Health care quality assurance
    - *Health care / Health care quality, access and evaluation* / Quality of health care
- Sub-headings
    - ec (economics);
    - og (organization & administration);
    - st (standards);
    - sd (supply and distribution);
    - ut (utilization)

Appendix B: Search and Selection Results

1. Introduction

This appendix presents the search and selection results of the literature review. The first part targets studies that either have developed a method for generating process improvement ideas (*method development studies*) or reviewed multiple methods for generating these ideas (*method review studies*). The second part targets studies that have investigated success factors of generating process improvement ideas *(success factor studies)*. For each part, we applied a similar but separate search and screening procedure. In the next section, we present the search and selection results for both parts.

2. Results search and screening activities

In this section, multiple flowcharts are presented that show the results of our searching and screening activities. The numbers in the first row of these figures represent the number of search hits (per electronic database). The numbers in the other rows represent the number of studies that passed the different screening activities. Next to the label of each relevance and quality screening activity, the observed agreement (O) and Kappa statistic (K) are presented. The observed agreement is the percentage of papers for which the same inclusion / exclusion decision was made by the two reviewers. The Kappa statistic is a commonly used statistic for measuring agreement between two reviewers. This statistic is defined as the agreement beyond chance divided by the amount of agreement possible beyond chance (Fink 2010). According to Fink (2010), the following qualitative terms need to be attached to the Kappa statistic in the context of a literature review: 0.0-0.2 = slight, 0.2-0.4 = fair, 0.4-0.6 = moderate, 0.6-0.8 = substantial and 0.8-1.0 = almost perfect. Fink (2010) suggests aiming for Kappa statistics of 0.6 and higher. As shown in all figures below, we fulfill this requirement.

In the remainder of this section, we start with discussing the results of the primary search. Subsequently, we discuss the results that were obtained by means of backward and forward tracing of references, i.e. the results of the secondary search. Finally, the results that were obtained by consulting the advisory committee members are explained.

Primary search

The primary search of each part contained an electronic database search. More specifically, the databases INSPEC, ABI/Inform and Medline were selected to provide coverage of the information systems, management sciences, and health sciences domain respectively. In addition, the primary search of each part contained a manual scan of two relevant sources outside the scope of these search engines, i.e. the EPOC Cochrane database and the International Journal of Care Pathways. After this primary search, we used a two-stage relevance screening and a quality screening procedure to select relevant and high quality studies for each part. Regarding the first part, the results of the primary search and related screening activities are shown in Figure B.1. With respect to the second part, these results are shown in Figure B.2.

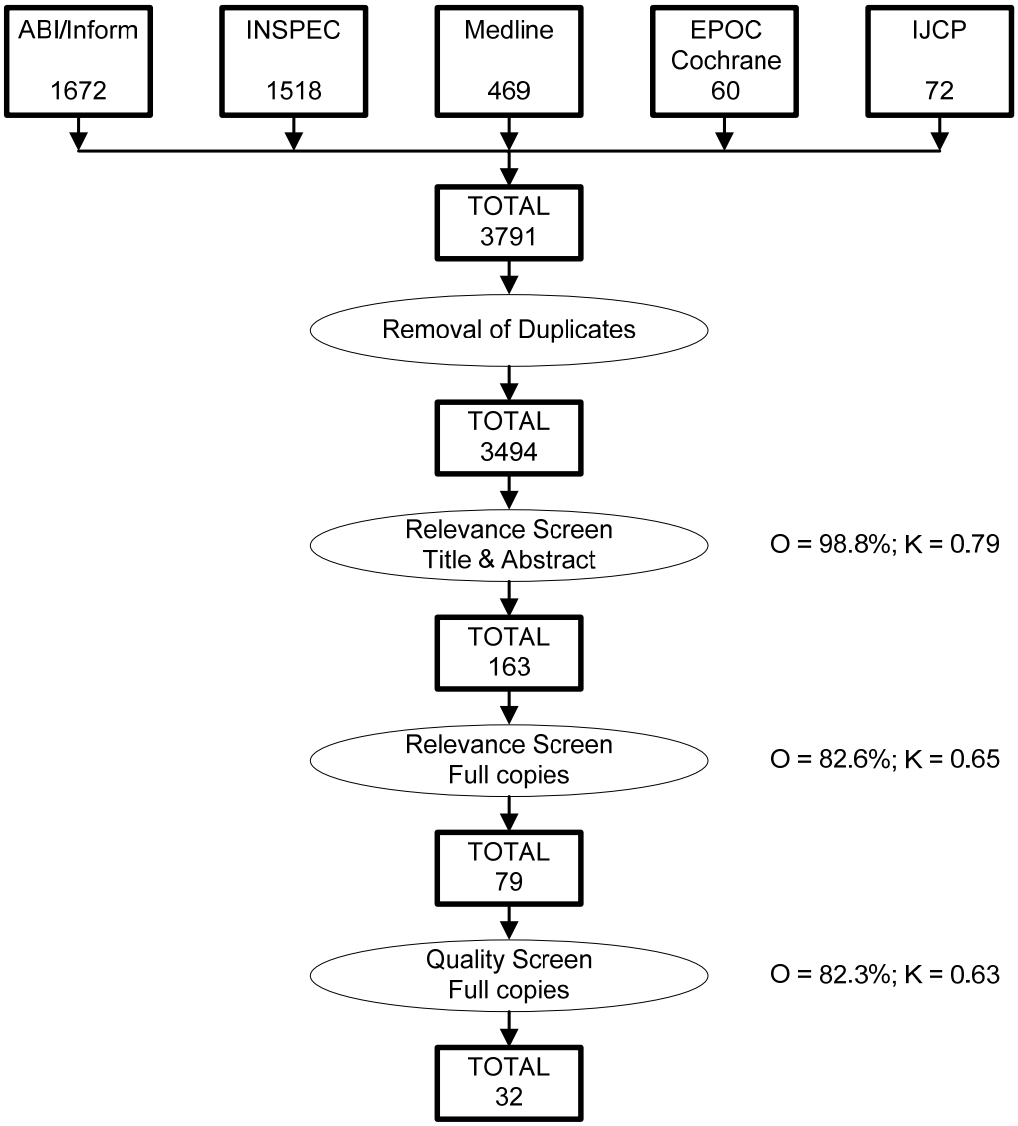

Figure B.1: Primary search results part 1.We were not able to obtain seven full copies of studies that passed the "Relevance Screen Title & Abstract", although we tried to obtain these at seven European universities (Eindhoven, Maastricht, Delft, Rotterdam, Leuven, Berlin and Stockholm) and tried to contact the authors of these articles directly.

The results in Figure B.1 show that the electronic database search retrieved 3791 matching articles with regard to the first part. 32 articles out of these 3791 passed all screening activities. Inter-rater-agreement, as determined by the Kappa statistic, was substantial (0.63 - 0.79) for all screening activities.

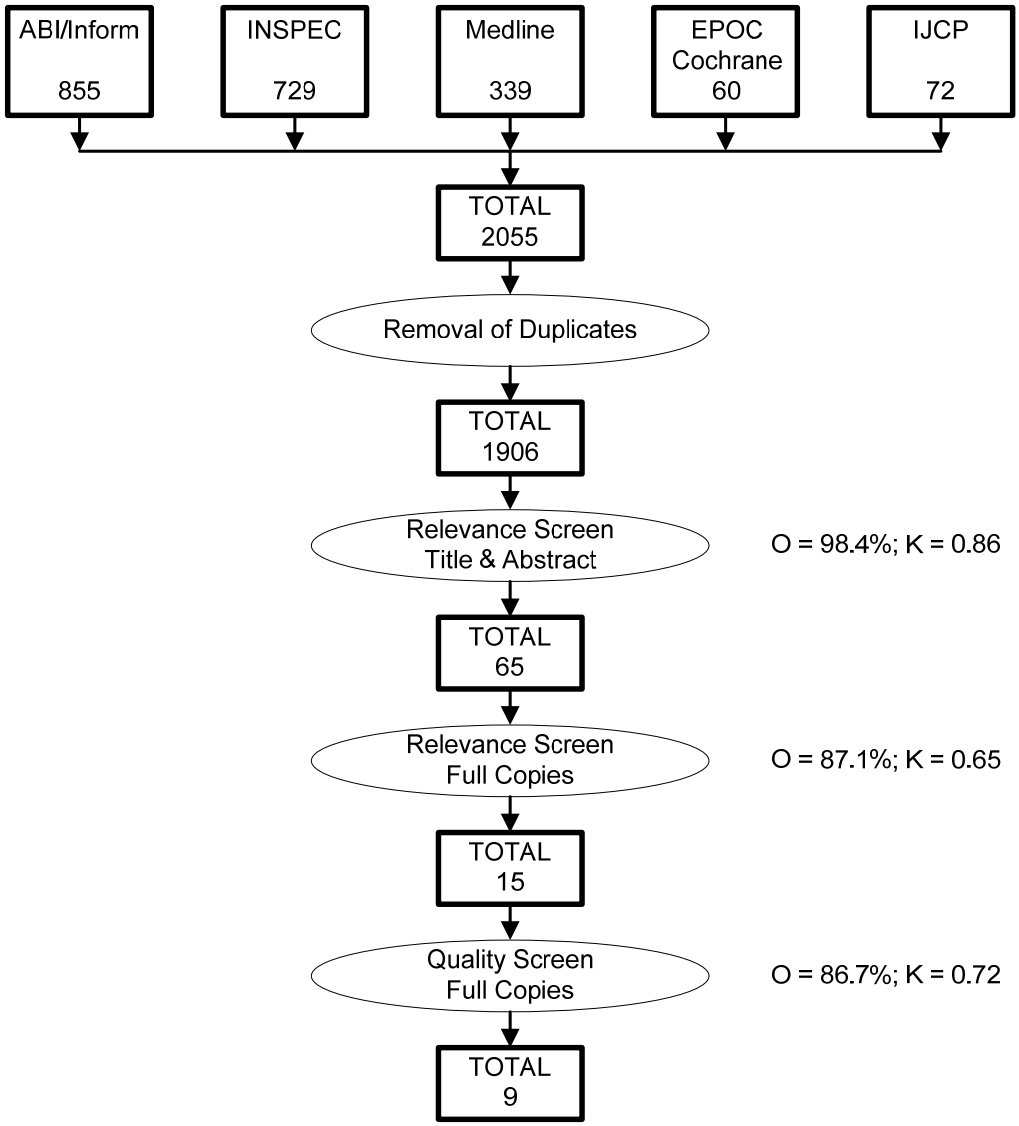

Figure B.2: Primary search results part 2. We were not able to obtain three full copies of studies that passed the "Relevance Screen Title & Abstract", although we tried to obtain these at all universities mentioned earlier and tried to contact the authors of these articles directly.

Figure B.2 shows that the electronic database search retrieved 2055 matching articles regarding the second part. Nine out of these 2055 articles passed all screening activities. Inter-rater-agreement, as determined by the Kappa statistic, varied from substantial (0.63 and 0.72) till almost perfect (0.86) agreement for all screening activities.

Secondary search

After the execution of the primary search and related screening activities, a secondary search and related screening activities were performed for each part. The secondary search and screening procedure took the final set of selected studies of the primary phase as a basis. By making use of backward and forward tracing (BFT) of references, additional relevant, high quality studies were identified. For the forward tracing of references, Google Scholar was used. After the identification of additional articles, the full copies were obtained and reviewed. This full copy screening was similar to the full copy screening of the primary search. From the second round onwards, the final set of selected studies during the previous round was used as a basis for the backward and forward tracing activities. Tracing activities were stopped when no new concepts were discovered. For the first part, three rounds of backward and forward tracing were performed. The third round did not reveal any new

concepts. The results of the first and second round are shown in Figure B.3 and Figure B.4 respectively. For the second part, backward and forward tracing stopped after two rounds. The results of the first round are shown in Figure B.5.

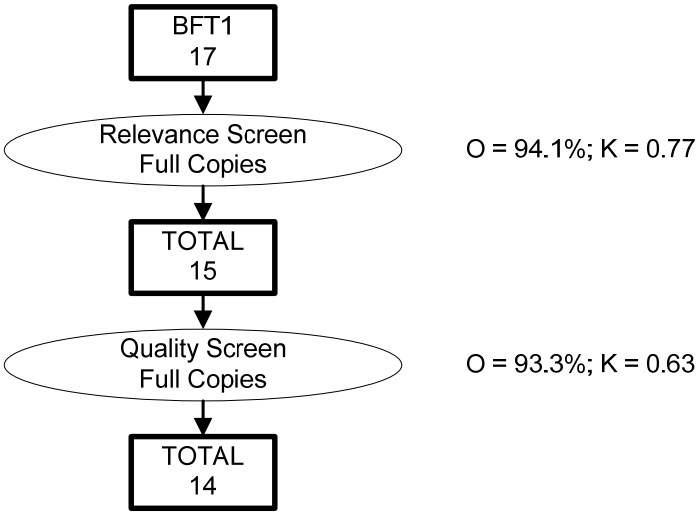

Figure B.3: Secondary search results part 1 round 1.

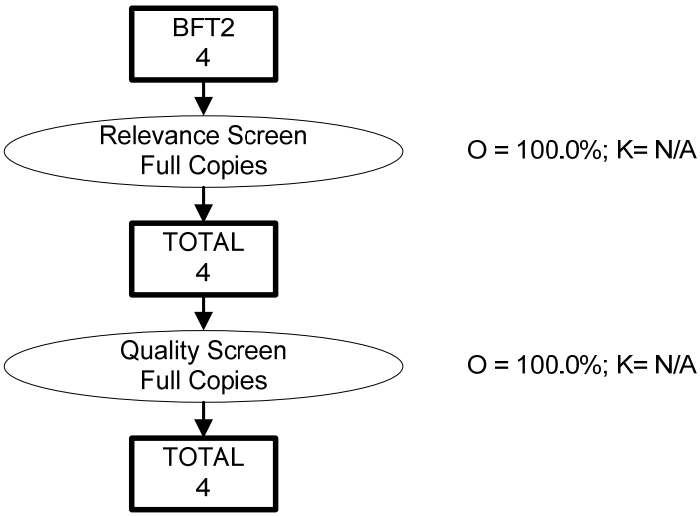

Figure B.4: Secondary results part 1 round 2.

With regard to the first part, the results in Figure B.3 and B.4 show that 21 studies (17 + 4) were identified by means of backward and forward tracing of references. 18 out of these 21 studies (14 + 4) passed the related screening activities and were selected for further examination. Inter-rater-agreement, as determined by the Kappa statistic, varied from substantial (0.63 and 0.77) till perfect (N/A) agreement for all screening activities.

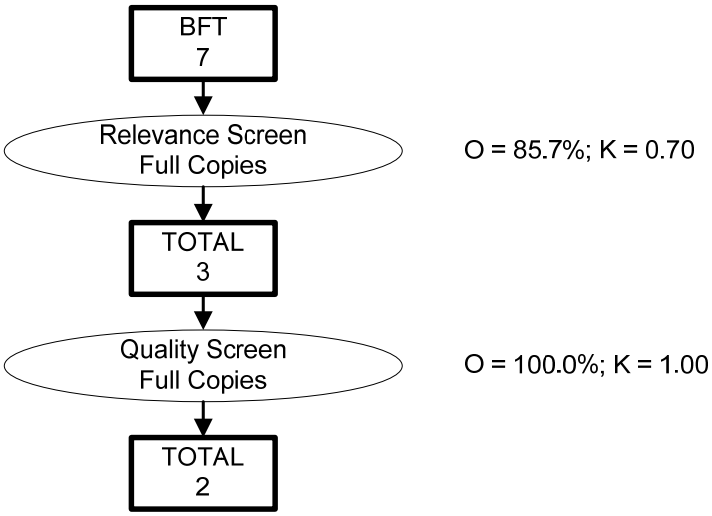

Figure B.5: Secondary search results part 2 round 1.

With respect to the second part, Figure B.5 shows that seven studies were identified by means of backward and forward tracing of references. Two out of these seven studies passed the related screening activities and were selected for further examination. Inter-rater-agreement, as determined by the Kappa statistic, varied from substantial (0.70) till perfect (1.00) agreement for all screening activities.

Advisory committee consultation

To further establish that important studies did not remain unidentified, the members of the advisory committee were invited to assess the completeness of the primary and secondary search and to recommend additional literature. For each part, all articles that were obtained from the advisory committee members were screened similar to the full copy screening procedure described earlier. In Figure B.6, the results of this activity are shown with regard to the first part. Regarding the second part, these results are shown in Figure B.7.

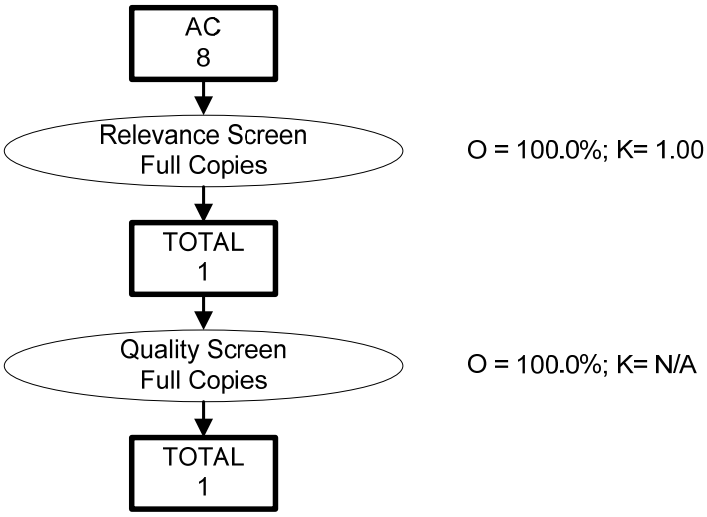

Figure B.6: Advisory committee consult results part 1.

Figure B.6 shows that eight studies were suggested by our advisory committee. One out of these eight studies passed the related screening activities and was selected for further examination

regarding the first part. Inter-rater-agreement, as determined by the Kappa statistic, was perfect (1.00 and N/A) for all screening activities.

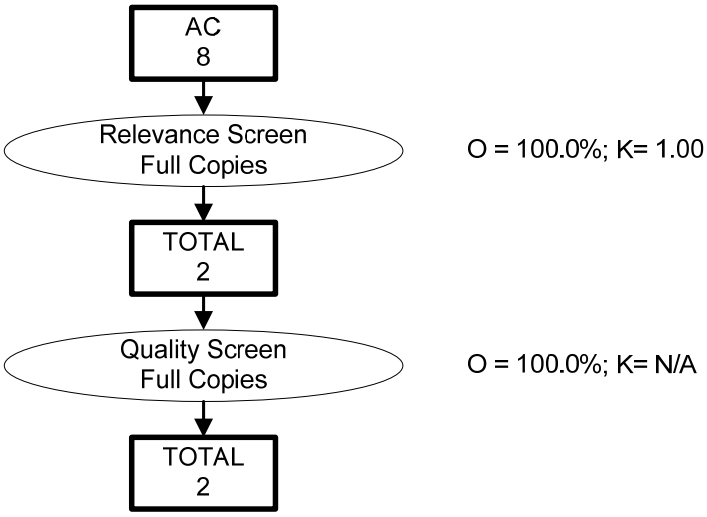

Figure B.7: Advisory committee consult results part 2.

With respect to the second part, Figure B.7 shows that two additional articles were selected for further examination due to consulting the advisory committee. Similar to the first part, inter-rater-agreement, as determined by the Kappa statistic, was perfect (1.00 and N/A) for all screening activities.

In total, 51 studies were selected for further examination with regard to the first part (primary search: 32; secondary search: 18; advisory committee consult: 1). With respect to the second part, 13 studies were selected for further examination (primary search: 9; secondary search: 2; advisory committee consult: 2). A further examination of all 64 studies (first part: 51; second part: 13) revealed that two articles of the first part could be excluded because these reports were predecessors of other articles and did not contain any new information. Furthermore, one report of the first part was an appendix that we decided to merge with the main publication that was also part of our set of included studies. Hence, our final set contained 61 unique studies.

3. References

Fink A (2010) Conducting research literature reviews: from the internet to paper, 3rd ed. Sage Publications, London, UK

Appendix C: Context Element Codings per Study

P	ID	Title	Journal	Authors	Year	Study.Source	Study.Type	Study.Label
1	642	Business process redesign in healthcare: towards a structured approach	INFOR	MH Jansen-Vullers; HA Reijers	2005	Journal paper	Method development study	Business Process Redesign
1	664	A TRIZ-based method for new service design	Journal of Service Research	K-H Chai; J Zhang; K-C Tan	2005	Journal paper	Method development study	New Service Development
1	865	A consolidated methodology for business process reengineering	International Journal of Computer Applications in Technology	JYL Thong; C-S Yap; KL Seah	2003	Journal paper	Method development study	Business Process Reengineering
1	1073	Visualized guidelines for IT-enabled process change	Information Resources Management Journal	MR Hoogeweegen	2000	Journal paper	Method development study	Business Process Change
1	1076	An intelligent tool for process redesign: manufacturing supply-chain applications	International Journal of Flexible Manufacturing Systems	ME Nissen	2000	Journal paper	Method development study	No label
1	1111	New approaches to business process redesign: a case study of collaborative group technology and service mapping	Group Decision and Negotiation	GF Corbitt; M Christopolus; L Wright	2000	Journal paper	Method development study	Business Process Redesign
1	1331	Business process change: a study of methodologies, techniques, and tools	MIS Quarterly	WJ Kettinger; JTC Teng; S Guha	1997	Journal paper	Method review study	Business Process Reengineering
1	1464	Methodology-driven use of automated support in business process re-engineering	Journal of Management Information Systems	AR Dennis; RM Daniels Jr; G Hayes et al	1994	Journal paper	Method development study	Business Process Reengineering

1	1616	Applying Lean Six Sigma and TRIZ methodology in banking services	Total Quality Management & Business Excellence	F-K Wang; K-S Chen	2010	Journal paper	Method development study	Lean Six Sigma
1	1768	ARMA: a multi-disciplinary approach to BPR	Knowledge and Process Management	M Glykas; G Valiris	1999	Journal paper	Method development study	Business Process Redesign
1	1771	Critical review of existing BPR methodologies: the need for a holistic approach	Business Process Management Journal	G Valiris; M Glykas	1999	Journal paper	Method development study	Business Process Redesign
1	1774	Process reverse engineering for BPR: a form-based approach	Information & Management	K-H Kim; Y-G Kim	1998	Journal paper	Method development study	Business Process Redesign
1	1819	Metrics-based process redesign with the MIT process handbook	Knowledge and Process Management	A Margherita; M Klein; G Elia	2007	Journal paper	Method development study	Business Process Reengineering
1	1973	A structured evaluation of business process improvement approaches	Business Process Management Journal	G Zellner	2011	Journal paper	Method review study	Business Process Improvement
1	1989	A Service Experience Engineering (SEE) method for developing new services	International Journal of Management	S-L Hsiao; H-L Yang	2010	Journal paper	Method development study	Service Engineering
1	2085	A handbook-based methodology for redesigning business processes	Knowledge and Process Management	M Klein; C Petti	2006	Journal paper	Method development study	Business Process Reengineering
1	2089	Service blueprinting: a practical technique for service innovation	California Management Review	MJ Bitner; AL Ostrom; FN Morgan	2008	Journal paper	Method development study	Service Innovation
1	2149	Multilevel service design: From customer value constellation to service experience blueprinting	Journal of Service Research	L Patrício; RP Fisk; JF e Cunha et al	2011	Journal paper	Method development study	Service Design
1	2225	Systematic improvement in service quality through TRIZ methodology: an exploratory study	Total Quality Management & Business Excellence	C-T Su; C-S Lin; T-L Chiang	2008	Journal paper	Method development study	New Service Development
1	2428	PAWS: towards a participatory approach to business process reengineering	International Workshop on Groupware	MRS Borges; JA Pino	1999	Conference paper	Method development study	Business Process Reengineering

1	2530	An innovative way to create new services: applying the TRIZ methodology	Journal of the Chinese Institute of Industrial Engineers	C-S Lin; C-T Su	2007	Journal paper	Method development study	New Service Development
1	2560	Enhancing business process redesign: using tools to condense the process	Hawaii International Conference on System Sciences	G Corbitt; L Wright	1997	Conference paper	Method development study	Business Process Redesign
1	3136	Tools for inventing organizations: toward a handbook of organizational processes	Management Science	TW Malone; K Crowston; J Lee et al	1999	Journal paper	Method development study	No label
1	3137	Tools for inventing organizations: toward a handbook of organizational processes	Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises	TW Malone; K Crowston; J Lee et al	1993	Conference paper	Method development study	No label
1	3200	A groupware tool to support participatory business process reengineering	International Workshop on Groupware	EZ Mouro; MRS Borges; CR Garcez	1999	Conference paper	Method development study	Business Process Reengineering
1	3227	Intelligent tools for workflow process redesign: a research agenda	International Conference on Business Process Management	M Netjes; I Vanderfeesten; HA Reijers	2006	Conference paper	Method development study	Business Process Redesign
1	3298	Improving the effectiveness of business process development through collaboration engineering: a method for process elicitation	Hawaii International Conference on System Sciences	K Piirainen; K Elfvengren; J Korpela et al	2009	Conference paper	Method development study	Business Process Reengineering
1	3408	Process life cycle engineering: a knowledge-based approach and environment	International Journal of Intelligent Systems in Accounting, Finance and Management	W Scacchi; P Mi	1997	Journal paper	Method development study	Process Life Cycle Engineering
1	3440	A decision-based approach to business process improvement	International Conference on Systems, Man and Cybernetics	K Shahzad; J Zdravkovic	2010	Conference paper	Method development study	Business Process Improvement

1	3447	Workflow reengineering: a methodology for business process reengineering using workflow management technology	Hawaii International Conference on System Sciences	LTSM Bitzer; MN Kamel	1997	Conference paper	Method development study	Workflow Reengineering
1	3469	Service/product engineering as a potential approach to value enhancement in supply chains	Progress in Industrial Ecology - An International Journal	A Simboli; A Raggi; L Petti et al.	2008	Journal paper	Method development study	Service Engineering
1	BFT01	Participatory business process reengineering design: generating solutions	International Conference of the Chilean Computer Science Society	F Albano; JA Pino; MRS Borges	2001	Conference paper	Method development study	Business Process Reengineering
1	BFT02	The process recombinator: a tool for generating new business process ideas	International Conference on Information Systems	A Bernstein; M Klein; TW Malone	1999	Conference paper	Method development study	No label
1	BFT03	Analysis of techniques for business process improvement	European Conference on Information Systems	P Griesberger; S Leist; G Zellner	2011	Conference paper	Method review study	Business Process Improvement
1	BFT04	Selecting the best strategic practices for business process redesign	Business Process Management Journal	P Hanafizadeh; M Moosakhani; J Bakhshi	2009	Journal paper	Method development study	Business Process Redesign
1	BFT06	Grammatical approach to organizational design	MIT Center for Coordination Science Technical Report	J Lee; BT Pentland	2000	Technical report	Method development study	No label
1	BFT07	Case-based reasoning as a technique for knowledge management in business process redesign	Electronic Journal on Knowledge Management	S Limam Mansar; F Marir; HA Reijers	2003	Journal paper	Method development study	Business Process Redesign
1	BFT08	Development of a decision-making strategy to improve the efficiency of BPR	Expert Systems with Applications	S Limam Mansar; H A Reijers; F Ounnar	2009	Journal paper	Method development study	Business Process Redesign
1	BFT09	On the formal generation of process redesigns	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2009	Conference paper	Method development study	Business Process Redesign

1	BFT10	Performing business process redesign with best practices: an evolutionary approach	International Conference on Enterprise Information Systems	M Netjes; S Limam Mansar; HA Reijers et al	2009	Conference paper	Method development study	Business Process Redesign
1	BFT11	Best practices in business process redesign: an overview and qualitative evaluation of successful redesign heuristics	Omega	HA Reijers; S Limam Mansar	2005	Journal paper	Method development study	Business Process Redesign
1	BFT12	A tutorial on business process improvement	Journal of Operations Management	TR Rohleder; EA Silver	1997	Journal paper	Method development study	Business Process Improvement
1	BFT13	Towards a goal-driven approach for business process improvement using process-oriented data warehouse	International Conference on Business Information Systems	K Shahzad; C Giannoulis	2011	Conference paper	Method development study	Business Process Improvement
1	BFT18	Designing robust business processes	Organizing business knowledge: The MIT process handbook	M Klein; C Dellarocas	2003	Book chapter	Method development study	No label
1	BFT19	Process grammar as a tool for business process design	MIS Quarterly	J Lee; GM Wyner; BT Pentland	2008	Journal paper	Method development study	No label
1	BFT20	The PrICE Tool Kit: tool support for process improvement	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2010	Conference paper	Method development study	No label
1	BFT21	Development of a hybrid model to improve the efficiency of business process reengineering	International Conference on Industrial Engineering and Engineering Management	W-H Tsai; C-C Yang; H-C Kuo	2009	Conference paper	Method development study	Business Process Reengineering
1	AC4	Model-based support for business re-engineering	Information and Software Technology	S Jarzabek; TW Ling	1996	Journal paper	Method development study	Business Re-engineering
2	176	Empirically testing determinants of hospital BPR success	International Journal of Health Care Quality Assurance	M Do Carmo Caccia-Bava; VCK Guimaraes; T Guimaraes	2005	Journal paper	Success factor study	Business Process Reengineering

2	627	An examination of the role of organizational enablers in business process reengineering and the impact of information technology	Information Resources Management Journal	HR Ahadi	2004	Journal paper	Success factor study	Business Process Reengineering
2	834	Business process change and organizational performance: exploring an antecedent model	Journal of Management Information Systems	S Guha; V Grover; WJ Kettinger et al	1997	Journal paper	Success factor study	Business Process Change
2	836	Empirically testing the antecedents of BPR success	International Journal of Production Economics	T Guimaraes	1997	Journal paper	Success factor study	Business Process Reengineering
2	870	Critical factors for the effectiveness of clinical pathway in improving care outcomes	International Conference on Service Systems and Service Management	J Shi; Q Su; Z Zhao	2008	Conference paper	Success factor study	Clinical pathways
2	1286	Critical success factors of TQM in service organizations: a proposed model	Services Marketing Quarterly	F Talib; Z Rahman	2010	Journal paper	Success factor study	Total Quality Management
2	1661	The state of business process reengineering: a search for success factors	Total Quality Management & Business Excellence	D Paper; R-D Chang	2005	Journal paper	Success factor study	Business Process Reengineering
2	1672	Breaking the rules: success and failure in groupware-supported business process reengineering	Decision Support Systems	AR Dennis; TA Carte; GG Kelly	2003	Journal paper	Success factor study	Business Process Reengineering
2	2059	Is there a future for pathways? Five pieces of the puzzle	International Journal of Care Pathways	K Vanhaecht; M Panella; R van Zelm et al	2009	Journal paper	Success factor study	Care pathways
2	BFT3	Collaborative business engineering: a decade of lessons from the field	Journal of Management Information Systems	M Hengst; GJ de Vreede	2004	Journal paper	Success factor study	Business Process Reengineering
2	BFT7	Prevalence and use of clinical pathways in 23 countries - an international survey by the European Pathway Association	International Journal of Care Pathways	K Vanhaecht; M Bollmann; K Bower et al	2006	Journal paper	Success factor study	Clinical pathways

2	AC2	The implementation of business process reengineering	Journal of Management Information Systems	V Grover; SR Jeong; WJ Kettinger et al	1995	Journal paper	Success factor study	Business Process Reengineering
2	AC7	Business process reengineering: application and success - an Australian study	International Journal of Operations & Production Management	P O'Neill; AS Sohal	1998	Journal paper	Success factor study	Business Process Reengineering

Table C.1: Context element codings per study (Study.Source, Study.Type, Study.Label). P = Part.

P	ID	Title	Journal	Authors	Year	Study.Design	Study.Collection	Study.Analysis
1	642	Business process redesign in healthcare: towards a structured approach	INFOR	MH Jansen-Vullers; HA Reijers	2005	Literature review (build) Case study (evaluation)	Simulation (case study)	Descriptive analysis (case study)
1	664	A TRIZ-based method for new service design	Journal of Service Research	K-H Chai; J Zhang; K-C Tan	2005	Literature review (build) Case study (2) (evaluation)	-	-
1	865	A consolidated methodology for business process reengineering	International Journal of Computer Applications in Technology	JYL Thong; C-S Yap; KL Seah	2003	Literature review (build)	-	-
1	1073	Visualized guidelines for IT-enabled process change	Information Resources Management Journal	MR Hoogeweegen	2000	Literature review (build) Case study (evaluation)	-	-
1	1076	An intelligent tool for process redesign: manufacturing supply-chain applications	International Journal of Flexible Manufacturing Systems	ME Nissen	2000	Literature review (build) Case study (evaluation)	Simulation (case study)	Descriptive analysis (case study)
1	1111	New approaches to business process redesign: a case study of collaborative group technology and service mapping	Group Decision and Negotiation	GF Corbitt; M Christopolus; L Wright	2000	Literature review (build) Case study (evaluation)	Interviews (case study) Observations (case study) Questionnaires (case study) Time measurements (case study)	Descriptive analysis (case study)
1	1331	Business process change: a study of methodologies, techniques, and tools	MIS Quarterly	WJ Kettinger; JTC Teng; S Guha	1997	Literature review Field study Lab study	Literature review approach (literature review) Document and software analysis (field study) Interviews (field study) Semi-structured (telephone) interviews (field study)	Structured analysis approach (no specific name) Q-sort (lab study)
1	1464	Methodology-driven use of automated support in business process re-engineering	Journal of Management Information Systems	AR Dennis; RM Daniels Jr; G Hayes et al	1994	Literature review (build) Case study (evaluation)	Documentation analysis (case study) Interviews (case study) Observations (case study) Questionnaires (case study)	Descriptive analysis (case study)
1	1616	Applying Lean Six Sigma and TRIZ methodology in banking services	Total Quality Management & Business Excellence	F-K Wang; K-S Chen	2010	Literature review (build) Case study (evaluation)	Time measurements (case study)	Descriptive analysis (case study)

1	1768	ARMA: a multi-disciplinary approach to BPR	Knowledge and Process Management	M Glykas; G Valiris	1999	Literature review (build)	-	-
1	1771	Critical review of existing BPR methodologies: the need for a holistic approach	Business Process Management Journal	G Valiris; M Glykas	1999	Literature review (build)	-	-
1	1774	Process reverse engineering for BPR: a form-based approach	Information & Management	K-H Kim; Y-G Kim	1998	Literature review (build) Case study (evaluation)	-	-
1	1819	Metrics-based process redesign with the MIT process handbook	Knowledge and Process Management	A Margherita; M Klein; G Elia	2007	Literature review (build) Illustration (evaluation)	-	-
1	1973	A structured evaluation of business process improvement approaches	Business Process Management Journal	G Zellner	2011	Literature review	Literature review approach	Qualitative content analysis
1	1989	A Service Experience Engineering (SEE) method for developing new services	International Journal of Management	S-L Hsiao; H-L Yang	2010	Literature review (build) Field study (build)	-	-
1	2085	A handbook-based methodology for redesigning business processes	Knowledge and Process Management	M Klein; C Petti	2006	Literature review (build) Illustration (evaluation)	-	-
1	2089	Service blueprinting: a practical technique for service innovation	California Management Review	MJ Bitner; AL Ostrom; FN Morgan	2008	Literature review (build) Case study (5) (evaluation)	-	-
1	2149	Multilevel service design: From customer value constellation to service experience blueprinting	Journal of Service Research	L Patrício; RP Fisk; JF e Cunha et al	2011	Literature review (build) Case study (2) (evaluation)	-	-
1	2225	Systematic improvement in service quality through TRIZ methodology: an exploratory study	Total Quality Management & Business Excellence	C-T Su; C-S Lin; T-L Chiang	2008	Literature review (build) Case study (evaluation)	Questionnaires (case study)	Descriptive analysis (case study)
1	2428	PAWS: towards a participatory approach to business process reengineering	International Workshop on Groupware	MRS Borges; JA Pino	1999	Literature review (build)	-	-
1	2530	An innovative way to create new services: applying the TRIZ methodology	Journal of the Chinese Institute of Industrial Engineers	C-S Lin; C-T Su	2007	Literature review (build) Case study (evaluation)	Questionnaires (case study)	Descriptive analysis (case study)

1	2560	Enhancing business process redesign: using tools to condense the process	Hawaii International Conference on System Sciences	G Corbitt; L Wright	1997	Literature review (build) Case study (evaluation)	Questionnaires (case study) Time measurements (case study)	Descriptive analysis (case study)
1	3136	Tools for inventing organizations: toward a handbook of organizational processes	Management Science	TW Malone; K Crowston; J Lee et al	1999	Literature review (build) Case study (evaluation)	-	-
1	3137	Tools for inventing organizations: toward a handbook of organizational processes	Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises	TW Malone; K Crowston; J Lee et al	1993	Literature review (build) Illustration (evaluation)	-	-
1	3200	A groupware tool to support participatory business process reengineering	International Workshop on Groupware	EZ Mouro; MRS Borges; CR Garcez	1999	Literature review (build)	-	-
1	3227	Intelligent tools for workflow process redesign: a research agenda	International Conference on Business Process Management	M Netjes; I Vanderfeesten; HA Reijers	2006	Literature review (build) Illustration (evaluation)	-	-
1	3298	Improving the effectiveness of business process development through collaboration engineering: a method for process elicitation	Hawaii International Conference on System Sciences	K Piirainen; K Elfvengren; J Korpela et al	2009	Literature review (build) Case study (evaluation)	Interviews (case study) Observations (case study) Questionnaires (case study)	Descriptive analysis (case study)
1	3408	Process life cycle engineering: a knowledge-based approach and environment	International Journal of Intelligent Systems in Accounting, Finance and Management	W Scacchi; P Mi	1997	Literature review (build) Case study (evaluation)	-	-
1	3440	A decision-based approach to business process improvement	International Conference on Systems, Man and Cybernetics	K Shahzad; J Zdravkovic	2010	Literature review (build) Illustration (evaluation)	-	-
1	3447	Workflow reengineering: a methodology for business process reengineering using workflow management	Hawaii International Conference on System Sciences	LTSM Bitzer; MN Kamel	1997	Literature review (build) Case study (evaluation)	-	-

		technology						
1	3469	Service/product engineering as a potential approach to value enhancement in supply chains	Progress in Industrial Ecology - An International Journal	A Simboli; A Raggi; L Petti et al.	2008	Literature review (build) Case study (evaluation)	-	-
1	BFT01	Participatory business process reengineering design: generating solutions	International Conference of the Chilean Computer Science Society	F Albano; JA Pino; MRS Borges	2001	Literature review (build)	-	-
1	BFT02	The process recombinator: a tool for generating new business process ideas	International Conference on Information Systems	A Bernstein; M Klein; TW Malone	1999	Literature review (build) Case study (evaluation)	-	-
1	BFT03	Analysis of techniques for business process improvement	European Conference on Information Systems	P Griesberger; S Leist; G Zellner	2011	Literature review	Literature review approach	Structured analysis approach (no specific name)
1	BFT04	Selecting the best strategic practices for business process redesign	Business Process Management Journal	P Hanafizadeh; M Moosakhani; J Bakhshi	2009	Literature review (build) Case study (evaluation)	-	-
1	BFT06	Grammatical approach to organizational design	MIT Center for Coordination Science Technical Report	J Lee; BT Pentland	2000	Literature review (build) Illustration (evaluation)	-	-
1	BFT07	Case-based reasoning as a technique for knowledge management in business process redesign	Electronic Journal on Knowledge Management	S Limam Mansar; F Marir; HA Reijers	2003	Literature review (build)	-	-
1	BFT08	Development of a decision-making strategy to improve the efficiency of BPR	Expert Systems with Applications	S Limam Mansar; H A Reijers; F Ounnar	2009	Literature review (build) Case study (evaluation)	-	Descriptive analysis (case study)
1	BFT09	On the formal generation of process redesigns	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2009	Literature review (build) Formal analysis (evaluation)	-	Formal analysis
1	BFT10	Performing business process redesign with best practices: an evolutionary approach	International Conference on Enterprise Information Systems	M Netjes; S Limam Mansar; HA Reijers et al	2009	Literature review (build) Illustration (evaluation)	-	-

1	BFT11	Best practices in business process redesign: an overview and qualitative evaluation of successful redesign heuristics	Omega	HA Reijers; S Limam Mansar	2005	Literature review (build)	-	Structured analysis approach (no specific name)
1	BFT12	A tutorial on business process improvement	Journal of Operations Management	TR Rohleder; EA Silver	1997	Literature review (build)	-	-
1	BFT13	Towards a goal-driven approach for business process improvement using process-oriented data warehouse	International Conference on Business Information Systems	K Shahzad; C Giannoulis	2011	Literature review (build) Case study (evaluation)	Questionnaires (case study)	Descriptive analysis (case study)
1	BFT18	Designing robust business processes	Organizing business knowledge: The MIT process handbook	M Klein; C Dellarocas	2003	Literature review (build) Illustration (evaluation)	-	-
1	BFT19	Process grammar as a tool for business process design	MIS Quarterly	J Lee; GM Wyner; BT Pentland	2008	Literature review (build) Illustration (evaluation)	-	-
1	BFT20	The PrICE Tool Kit: tool support for process improvement	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2010	Literature review (build) Illustration (evaluation)	-	-
1	BFT21	Development of a hybrid model to improve the efficiency of business process reengineering	International Conference on Industrial Engineering and Engineering Management	W-H Tsai; C-C Yang; H-C Kuo	2009	Literature review (build) Case study (evaluation)	-	-
1	AC4	Model-based support for business re-engineering	Information and Software Technology	S Jarzabek; TW Ling	1996	Literature review (build)	-	-
2	176	Empirically testing determinants of hospital BPR success	International Journal of Health Care Quality Assurance	M Do Carmo Caccia-Bava; VCK Guimaraes; T Guimaraes	2005	Literature review Field survey	Questionnaires (field survey)	Descriptive analysis (field survey) Factor analysis (field survey) Stepwise multivariate regression analysis (field survey)

2	627	An examination of the role of organizational enablers in business process reengineering and the impact of information technology	Information Resources Management Journal	HR Ahadi	2004	Literature review Field survey	Questionnaires (field survey)	Descriptive analysis (field survey) ANOVA (field survey)
2	834	Business process change and organizational performance: exploring an antecedent model	Journal of Management Information Systems	S Guha; V Grover; WJ Kettinger et al	1997	Literature review Case study (3)	Document analysis (case study) Questionnaires (case study) (Telephone) interviews (case study)	Explanation building and pattern matching (case study)
2	836	Empirically testing the antecedents of BPR success	International Journal of Production Economics	T Guimaraes	1997	Literature review Field survey	Questionnaires (field survey)	Descriptive analysis (field survey)
2	870	Critical factors for the effectiveness of clinical pathway in improving care outcomes	International Conference on Service Systems and Service Management	J Shi; Q Su; Z Zhao	2008	Literature review	Literature review approach	
2	1286	Critical success factors of TQM in service organizations: a proposed model	Services Marketing Quarterly	F Talib; Z Rahman	2010	Literature review	Literature review approach	
2	1661	The state of business process reengineering: a search for success factors	Total Quality Management & Business Excellence	D Paper; R-D Chang	2005	Literature review Case study	-	Structured analysis approach (no specific name) (case study)
2	1672	Breaking the rules: success and failure in groupware-supported business process reengineering	Decision Support Systems	AR Dennis; TA Carte; GG Kelly	2003	Literature review Case study (4)	Interviews (case study) Observations (case study)	-
2	2059	Is there a future for pathways? Five pieces of the puzzle	International Journal of Care Pathways	K Vanhaecht; M Panella; R van Zelm et al	2009	Literature review	-	-
2	BFT3	Collaborative business engineering: a decade of lessons from the field	Journal of Management Information Systems	M Hengst; GJ de Vreede	2004	Literature review Case study (9)	Interviews (case study) Observations (case study) Questionnaires (case study) Session data (case study)	Structured analysis approach (no specific name) (case study)
2	BFT7	Prevalence and use of clinical pathways in 23 countries - an international survey by the European Pathway Association	International Journal of Care Pathways	K Vanhaecht; M Bollmann; K Bower et al	2006	Field survey	Questionnaires (field survey)	Descriptive analysis (field survey)

2	AC2	The implementation of business process reengineering	Journal of Management Information Systems	V Grover; SR Jeong; WJ Kettinger et al	1995	Literature review Field study Field survey	Interviews (field study) Literature review approach (literature review) Questionnaires (field survey)	Q-sort procedure (field study) Descriptive analysis (field survey) Principal component analysis (field survey)
2	AC7	Business process reengineering: application and success - an Australian study	International Journal of Operations & Production Management	P O'Neill; AS Sohal	1998	Literature review Field survey	Questionnaires (field survey)	Descriptive analysis (field survey)

Table C.2: Context element codings per study (Study.Design, Study.Collection, Study.Analysis). P = Part.

Appendix D: Details Methodological Framework

1. Introduction

In this appendix, the developed methodological framework is presented in detail. The developed methodological framework contains an overview of 60 method options for six key choices to be made with regard to a method for generating process improvement ideas: aim (8), actors (11), input (18), output (8), technique (10) and tool (5).

In section two, we present all method options and related (sub-)categories that were identified during the open and axial coding step. In section three, definitions are given for all method options.

2. Methodological framework

In Table D.1-3, we present the complete methodological framework as well as a quantitative analysis of the number of citations per method option.

Decision area	*Category*	*Sub-category*	*Method option*	*No. of studies part 1*	*No. of studies part 2*	*No. of studies part 1 + 2*
Aim	Performance dimensions		Revenue	6	7	13
			Costs	31	12	43
			Time	26	11	37
		Quality	Quality (unspecified)	17	4	21
			External quality	22	11	33
			Internal quality	4	7	11
			Flexibility	13	1	14
	Degree of improvement		Radical improvement	6	3	9
			Incremental improvement	6	3	9
Actors	Daily involved		Process actor	23	10	33
			Management	15	7	22
	Advising	Supporting staff	BPR specialist	4	1	5
			Finance specialist	1	1	2
			HR specialist	0	1	1
			IS specialist	5	5	10
			Marketing specialist	1	1	2
			Customer	4	7	11
			Supplier	1	5	6
			External consultant	14	7	21
			Peer	0	1	1

Table D.1: Methodological framework (Aim, Actors).

Decision area	*Category*	*Sub-category*	*Method option*	*No. of studies part 1*	*No. of studies part 2*	*No. of studies part 1 + 2*
Input	Redesign requirements		Process output goals	27	5	32
			Stakeholder / customer needs	11	5	16
	Redesign limitations		Constraints	2	0	2
			Risks	2	0	2
	AS-IS process specification		Textual process description	8	0	8
			Process model	28	6	34
			Simulation model	3	1	4
	Process weaknesses		Process output measures	14	2	16
			Process measures	6	0	6
			Different opinions regarding AS-IS process specification	1	0	1
			Problem investigation	20	6	26
			Culture scan	1	0	1
	Redesign catalysts		Medical guidelines / key interventions	0	2	2
			Previous solutions	3	0	3
			Benchmark process insights	3	2	5
			Benchmark process models	1	0	1
			Technology developments	4	2	6
			Industry value net	1	0	1
Output	TO-BE specifications		TO-BE service concepts	3	0	3
		TO-BE process specification	Summary redesign proposals	19	0	19
			Textual process descriptions	8	0	8
			Process models	26	1	27
			Simulation models	11	1	12
			TO-BE exception handlers	3	0	3
	TO-BE assessments		Impact analyses	17	0	17
			Force-field-analyses	3	0	3

Table D.2: Methodological framework (Input, Output).

Decision area	*Category*	*Sub-category*	*Method option*	*No. of studies part 1*	*No. of studies part 2*	*No. of studies part 1 + 2*
Technique	Unstructured		Brainstorming	15	1	16
			Out-of-the-box thinking	5	1	6
			Visioning	4	1	5
			Unspecified	16	0	16
	Semi-structured		Delphi	1	0	1
			Nominal group	10	0	10
			Multi-level design	3	0	3
			Grammar-based	4	0	4
	Structured		Rule-based	23	1	24
			Case-based	5	0	5
			Repository-based	9	0	9
Tool			Communication	9	2	11
			Voting	6	1	7
			Modeling	13	2	15
			Simulation	8	1	9
			Repository	19	2	21
			Specific	4	0	4

Table D.3: Methodological framework (Technique, Tool).

3. Definitions method options

All method option definitions with regard to the methodological decision areas aim, actors, input, output, technique and tool are shown in Table D.4-9.

Method option	Definition
Performance dimensions (delineating the kind of performance measures that need improvement)	
Revenue	The income that is received from the sales of goods or services that are created by the process.
Costs	The value of money that has been used to produce goods or services that are created by the process.
Time	A measure of durations of events or intervals between them.
External quality	The quality of products or services as perceived by customers.
Internal quality	The quality of work as perceived by process actors.
Flexibility	The ability of the process to react to changes (Jansen-Vullers et al 2008).
Degree of improvement (addressing the kind of improvement that is needed)	
Radical improvement	The aim is to achieve dramatic improvement gains by often challenging the organizational framework and applying new technology (Glykas and Valiris 1999).
Incremental improvement	The aim is to make some small changes to an existing process by typically eliminating non-value added activities (Glykas and Valiris 1999).

Table D.4: Aim related definitions.

Method option	Definition
Daily involved (involved in either executing tasks within the process under study or managing the process)	
Process actor	Actor who is involved in executing tasks within the process.
Management	Actor who is involved in managing the process.
Advising (not being responsible for the process under study, but able to contribute to the development of process alternatives due to expertise or experience)	
BPR specialist	Supporting staff specialist who has specific expertise in redesigning business processes.
Finance specialist	Supporting staff specialist who is knowledgeable about financial issues.
HR specialist	Supporting staff specialist who is knowledgeable about human resource management.
IS specialist	Supporting staff specialist who has specific expertise in designing information systems.
Marketing specialist	Supporting staff specialist who has specific expertise in communicating the value of a product or service to customers.
Customer	Recipient of the products or services that are provided by the process.
Supplier	Actor who supplies goods or services that are used by the process.
External consultant	Actor who is employed externally (not a member of the firms where the process actors are employed) and provides professional advice on a temporary basis.
Peer	Actor who is employed internally or externally and is actively involved in a non-competing similar process.

Table D.5: Actors related definitions.

Method option	Definition
Redesign requirements (delineating the redesign objectives that need to be achieved)	
Process output goals	Desired end results of the redesign project in terms of process performance dimensions, e.g. the average access time of coronary artery bypass patients needs to be reduced with 60%.
Stakeholder / customer needs	Requirements that need to be fulfilled by the process according to customers or other process stakeholders.
Redesign limitations (outlining the factors that restrict the solution space)	
Constraints	Restrictions that delineate the kind of process alternatives that are not going to be considered.
Risks	Factors that challenge the redesign of the process and might restrict the kind of process alternatives that are going to be considered (Limam Mansar et al. 2009).
AS-IS process specification (providing a description of the current process)	
Textual process description	Textual description of the AS-IS process.
Process model	Model that provides a graphical representation of the AS-IS process (Kettinger et al. 1997).
Simulation model	Model that allows for the dynamic modelling of the AS-IS process (Kettinger et al. 1997).
Process weaknesses (identifying redesign priorities)	
Process output measures	Measures that are related to the process performance dimensions.
Process measures	Measures that provide a global view on the characteristics of the process, such as the degree of automation or parallelism (Netjes et al. 2009).
Different opinions regarding AS-IS process specification	Points of disagreement about how the AS-IS process works. Typically, these points of disagreement become apparent during process mapping activities (Bitner et al. 2008).
Problem investigation	Investigation which offers information regarding problems as perceived by the different process stakeholders.
Culture scan	Assessment of the shared values and beliefs of process stakeholders (Kettinger et al. 1997).
Redesign catalysts (providing inspiration for the creation of effective process alternatives)	
Medical guidelines / key interventions	Documents with the aim of guiding decisions and criteria regarding diagnosis, management and treatment in specific areas of healthcare. Typically, they are based on an examination of current evidence in the paradigm of evidence-based management (Vanhaecht et al. 2009).
Previous solutions	Solutions that have been suggested for problems that are related to the problems associated with the process under study (Chai et al. 2005; Lin and Su 2007; Su et al. 2008).
Benchmark process insights	Insights gained from comparing one's process with a similar process (Rohleder and Silver 1997; Talib and Rahman 2010).
Benchmark process models	Process models of a similar process (Bitner et al. 2008).
Technology developments	Insights gained from technology observing research (Hsiao and Yang 2010).
Industry value net	Overview of suitable partners with which the process under study could be integrated (Hsiao and Yang 2010).

Table D.6: Input related definitions.

Method option	Definition
TO-BE specifications (providing descriptions of process improvement ideas)	
TO-BE service concepts	Concepts that provide a description of the benefits that the process is expected to offer to the customers and determine the value proposition in the broader context of the value network within which it is embedded. As such, TO-BE service concepts are able to guide the design of TO-BE process specifications (Patrício et al. 2011).
Summary redesign proposals	Summary that provides a brief description of redesign proposals, i.e. changes with regard to the AS-IS process that are worth further investigation.
Textual process descriptions	Textual descriptions of TO-BE processes.
Process models	Models that provide graphical representation s of TO-BE processes (Kettinger et al. 1997).
Simulation models	Models that allow for the dynamic modelling of TO-BE processes and support practitioners in validating and evaluating process alternatives (Kettinger et al. 1997).
TO-BE exception handlers	Handlers that describe ways to anticipate, avoid, detect and resolve process exceptions (Klein and Dellarocas 2003).
TO-BE assessments (including preliminary evaluations of process alternatives)	
Impact analyses	Analyses that provide insights into the potential performance improvement impact and feasibility of process alternatives (Jansen-Vullers and Reijers 2005).
Force-field-analyses	Analyses that provide insights into the forces that either drive or restrain the implementation of process alternatives (Corbitt and Wright 1997; Corbitt et al. 2000; Kettinger et al. 1997).

Table D.7: Output related definitions.

Method option	Definition
Unstructured (not containing a detailed procedure that specifies how to get from current process insights (as-is) to concrete improvement ideas (to-be), and not providing guidance regarding the kind of process alternatives that need to be considered)	
Brainstorming	Creativity technique that provides room for spontaneous generation of ideas by redesign participants, where creative thinking is stimulated through a process of adding on the other's concepts (Dennis et al. 2003; Kettinger et al. 1997).
Out-of-the-box thinking	Creativity technique that stimulates redesign participants to stretch redesign goals and reconsider assumptions underlying current process execution (Dennis et al. 2003; Kettinger et al. 1997).
Visioning	Creativity technique that encourages redesign participants to develop images of possible future processes by identifying and progressively breaking sacred cow assumptions or unsubstantiated constraints (Dennis et al. 2003; Kettinger et al. 1997).
Semi-structured (offering a work procedure that specifies how to get from current process insights (as-is) to concrete improvement ideas (to-be), but lacking any guidance regarding the kind of process alternatives that need to be considered)	
Delphi	Technique that distributes a sequence of anonymous questionnaires to redesign participants to successively refine their opinions and finally reach consensus (Kettinger et al. 1997).
Nominal group	Technique that offers a procedure for reaching group consensus through anonymous idea generation by individual redesign participants, followed by discussion and voting (Kettinger et al. 1997).
Multi-level design	Technique that starts with designing the to-be situation at a relatively high level of abstraction, i.e. the to-be service concept. After completion, two lower levels of abstraction, which together specify the to-be process, are successively considered (Patrício et al. 2011).
Grammar-based	Technique that captures the grammar underlying a business process and makes use of lexicon and rewrite rules to systematically explore process alternatives (Lee et al. 2008; Lee and Pentland 2000).
Structured (offering a work procedure that specifies how to get from current process insights (as-is) to concrete improvement ideas (to-be), and including guidance regarding the kind of process alternatives that need to be considered)	
Rule-based	Technique that makes use of generic process redesign rules that have accumulated in literature or practice to develop process alternatives (Chai et al. 2005; Nissen 2000; Reijers and Limam Mansar 2005). The premise of these techniques is that specific process problems can be translated to generic process problems, for which generic process redesign rules can offer generic process solutions (Jansen-Vullers and Reijers 2005; Lin and Su 2007; Nissen 2000). An example of a generic process redesign rule is the parallelism rule, which states that redesign participants should consider executing tasks in parallel instead of executing them sequentially (Reijers and Limam Mansar 2005). As a final step, the generic process solutions have to be translated to specific process solutions (Jansen-Vullers and Reijers 2005; Lin and Su 2007; Nissen 2000).
Case-based	Technique that enables an efficient identification of earlier business process redesign projects. These projects offer guidance regarding the process alternatives that have to be considered (Limam Mansar et al. 2003). These techniques make use of libraries of well-document previous business process redesign projects (Limam Mansar et al. 2009; Limam Mansar et al. 2003; Nissen 2000).
Repository-based	Technique that makes use of the notions of process specializations, coordination mechanisms and process exception handlers to systematically generate process alternatives on the basis of an identified list of core activities of the process under study and a repository (Bernstein et al. 1999; Klein and Petti 2006; Malone et al. 1999; Margherita et al. 2007). The repository that is used as a basis includes and organizes numerous specifications of existing processes (Bernstein et al. 1999; Klein and Petti 2006; Malone et al. 1999; Margherita et al. 2007).

Table D.8: Technique related definitions.

Method option	Definition
Communication	Functionality that enables large groups to communicate face-to-face or distributed in a computer-mediated electronic environment. Typically, this environment allows for parallel and anonymous input (Albano et al. 2001; Corbitt et al. 2000; Piirainen et al. 2009).
Voting	Functionality that allows participants to rate different process alternatives (Corbitt and Wright 1997; Mouro et al. 1999).
Modeling	Functionality that supports practitioners in creating graphical representations of process alternatives (Albano et al. 2001; Netjes et al. 2010; Thong et al. 2003).
Simulation	Functionality that allows dynamic modelling of business processes and supports practitioners in validating and evaluating process alternatives (Kettinger et al. 1997; Nissen 2000).
Repository	Functionality that provides support for the storage and retrieval of descriptions of process alternatives and related discussions (Albano et al. 2001; Mouro et al. 1999; Valiris and Glykas 1999).
Specific	Functionality that provides support for a specific technique and does not provide general-purpose functionality.

Table D.9: Tool related definitions.

4. References

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Appendix E: Method Element Codings per Study

P	ID	Title	Source name	Authors	Year	Method.Aim (developed method)	Method.Aim (reviewed method)	Method.Actors (developed method)	Method.Actors (reviewed method)
1	642	Business process redesign in healthcare: towards a structured approach	INFOR	MH Jansen-Vullers; HA Reijers	2005	Costs Time Quality External quality Flexibility		Process actor Management IS specialist External consultant	Process actor Management External consultant
1	664	A TRIZ-based method for new service design	Journal of Service Research	K-H Chai; J Zhang; K-C Tan	2005				
1	865	A consolidated methodology for business process reengineering	International Journal of Computer Applications in Technology	JYL Thong; C-S Yap; KL Seah	2003	Costs Time Quality External quality		Process actor IS specialist External consultant	
1	1073	Visualized guidelines for IT-enabled process change	Information Resources Management Journal	MR Hoogeweegen	2000	Costs Time External quality Flexibility	Radical improvement Incremental improvement		
1	1076	An intelligent tool for process redesign: manufacturing supply-chain applications	International Journal of Flexible Manufacturing Systems	ME Nissen	2000	Costs Time		Process actor Management	External consultant
1	1111	New approaches to business process redesign: a case study of collaborative group technology and service mapping	Group Decision and Negotiation	GF Corbitt; M Christopolus; L Wright	2000	Revenue Costs Quality		Process actor	

1	1331	Business process change: a study of methodologies, techniques, and tools	MIS Quarterly	WJ Kettinger; JTC Teng; S Guha	1997		Costs Quality External quality Radical improvement Incremental improvement		Process actor Management IS specialist
1	1464	Methodology-driven use of automated support in business process re-engineering	Journal of Management Information Systems	AR Dennis; RM Daniels Jr; G Hayes et al	1994	Costs Time Quality External quality Radical improvement Incremental improvement		Process actor Management Customer Supplier External consultant	
1	1616	Applying Lean Six Sigma and TRIZ methodology in banking services	Total Quality Management & Business Excellence	F-K Wang; K-S Chen	2010	Costs Time Quality External quality			
1	1768	ARMA: a multi-disciplinary approach to BPR	Knowledge and Process Management	M Glykas; G Valiris	1999	Radical improvement Incremental improvement		Process actor	
1	1771	Critical review of existing BPR methodologies: the need for a holistic approach	Business Process Management Journal	G Valiris; M Glykas	1999	Radical improvement Incremental improvement	Costs Time External quality		Process actor Management
1	1774	Process reverse engineering for BPR: a form-based approach	Information & Management	K-H Kim; Y-G Kim	1998	Time External quality			
1	1819	Metrics-based process redesign with the MIT process handbook	Knowledge and Process Management	A Margherita; M Klein; G Elia	2007	Costs Time External quality Internal quality Flexibility			

1	1973	A structured evaluation of business process improvement approaches	Business Process Management Journal	G Zellner	2011				
1	1989	A Service Experience Engineering (SEE) method for developing new services	International Journal of Management	S-L Hsiao; H-L Yang	2010	Revenue Costs External quality			
1	2085	A handbook-based methodology for redesigning business processes	Knowledge and Process Management	M Klein; C Petti	2006			Process actor BPR specialist	
1	2089	Service blueprinting: a practical technique for service innovation	California Management Review	MJ Bitner; AL Ostrom; FN Morgan	2008	External quality		Process actor Management BPR specialist Customer	
1	2149	Multilevel service design: From customer value constellation to service experience blueprinting	Journal of Service Research	L Patrício; RP Fisk; JF e Cunha et al	2011			Process actor Management IS specialist Marketing specialist	
1	2225	Systematic improvement in service quality through TRIZ methodology: an exploratory study	Total Quality Management & Business Excellence	C-T Su; C-S Lin; T-L Chiang	2008	External quality			
1	2428	PAWS: towards a participatory approach to business process reengineering	International Workshop on Groupware	MRS Borges; JA Pino	1999			Process actor Management External consultant	
1	2530	An innovative way to create new services: applying the TRIZ methodology	Journal of the Chinese Institute of Industrial Engineers	C-S Lin; C-T Su	2007	Costs Time		Management	

1	2560	Enhancing business process redesign: using tools to condense the process	Hawaii International Conference on System Sciences	G Corbitt; L Wright	1997	External quality		Process actor	
1	3136	Tools for inventing organizations: toward a handbook of organizational processes	Management Science	TW Malone; K Crowston; J Lee et al	1999	Costs Time Internal quality			
1	3137	Tools for inventing organizations: toward a handbook of organizational processes	Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises	TW Malone; K Crowston; J Lee et al	1993	Costs Time External quality		Process actor Management BPR specialist External consultant	
1	3200	A groupware tool to support participatory business process reengineering	International Workshop on Groupware	EZ Mouro; MRS Borges; CR Garcez	1999	Costs Quality		Process actor Management External consultant	
1	3227	Intelligent tools for workflow process redesign: a research agenda	International Conference on Business Process Management	M Netjes; I Vanderfeesten; HA Reijers	2006	Costs Time Quality Flexibility			Process actor Management External consultant
1	3298	Improving the effectiveness of business process development through collaboration engineering: a method for process elicitation	Hawaii International Conference on System Sciences	K Piirainen; K Elfvengren; J Korpela et al	2009	Revenue Costs External quality		Process actor	
1	3408	Process life cycle engineering: a knowledge-based approach and environment	International Journal of Intelligent Systems in Accounting, Finance and Management	W Scacchi; P Mi	1997				
1	3440	A decision-based approach to business process improvement	International Conference on Systems, Man and Cybernetics	K Shahzad; J Zdravkovic	2010	Costs Time Quality Flexibility			

1	3447	Workflow reengineering: a methodology for business process reengineering using workflow management technology	Hawaii International Conference on System Sciences	LTSM Bitzer; MN Kamel	1997	Revenue Costs Time External quality Internal quality Flexibility		Process actor Finance specialist IS specialist Customer External consultant	
1	3469	Service/product engineering as a potential approach to value enhancement in supply chains	Progress in Industrial Ecology - An International Journal	A Simboli; A Raggi; L Petti et al.	2008	Costs External quality			
1	BFT01	Participatory business process reengineering design: generating solutions	International Conference of the Chilean Computer Science Society	F Albano; JA Pino; MRS Borges	2001			Process actor Management External consultant	
1	BFT02	The process recombinator: a tool for generating new business process ideas	International Conference on Information Systems	A Bernstein; M Klein; TW Malone	1999				
1	BFT03	Analysis of techniques for business process improvement	European Conference on Information Systems	P Griesberger; S Leist; G Zellner	2011		Costs Time External quality Internal quality Flexibility		
1	BFT04	Selecting the best strategic practices for business process redesign	Business Process Management Journal	P Hanafizadeh; M Moosakhani; J Bakhshi	2009	Costs Time Quality Flexibility			
1	BFT06	Grammatical approach to organizational design	MIT Center for Coordination Science Technical Report	J Lee; BT Pentland	2000				

1	BFT07	Case-based reasoning as a technique for knowledge management in business process redesign	Electronic Journal on Knowledge Management	S Limam Mansar; F Marir; HA Reijers	2003	Costs Time Quality Flexibility		Management External consultant	
1	BFT08	Development of a decision-making strategy to improve the efficiency of BPR	Expert Systems with Applications	S Limam Mansar; H A Reijers; F Ounnar	2009	Revenue Costs Time Quality External quality			External consultant
1	BFT09	On the formal generation of process redesigns	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2009	Costs Time Quality			
1	BFT10	Performing business process redesign with best practices: an evolutionary approach	International Conference on Enterprise Information Systems	M Netjes; S Limam Mansar; HA Reijers et al	2009	Costs Time Quality			
1	BFT11	Best practices in business process redesign: an overview and qualitative evaluation of successful redesign heuristics	Omega	HA Reijers; S Limam Mansar	2005	Costs Time Quality Flexibility			
1	BFT12	A tutorial on business process improvement	Journal of Operations Management	TR Rohleder; EA Silver	1997	Costs Time External quality Flexibility Radical improvement Incremental improvement		Process actor Customer External consultant	
1	BFT13	Towards a goal-driven approach for business process improvement using process-oriented data warehouse	International Conference on Business Information Systems	K Shahzad; C Giannoulis	2011	Costs Time Quality Flexibility			

1	BFT18	Designing robust business processes	Organizing business knowledge: The MIT process handbook	M Klein; C Dellarocas	2003				
1	BFT19	Process grammar as a tool for business process design	MIS Quarterly	J Lee; GM Wyner; BT Pentland	2008				
1	BFT20	The PrICE Tool Kit: tool support for process improvement	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2010				Process actor External consultant
1	BFT21	Development of a hybrid model to improve the efficiency of business process reengineering	International Conference on Industrial Engineering and Engineering Management	W-H Tsai; C-C Yang; H-C Kuo	2009	Revenue Costs Time Quality External quality		Process actor Management	
1	AC4	Model-based support for business re-engineering	Information and Software Technology	S Jarzabek; TW Ling	1996	Costs Time External quality Flexibility		Process actor BPR specialist	
2	176	Empirically testing determinants of hospital BPR success	International Journal of Health Care Quality Assurance	M Do Carmo Caccia-Bava; VCK Guimaraes; T Guimaraes	2005		Revenue Costs Time External quality Internal quality		Process actor
2	627	An examination of the role of organizational enablers in business process reengineering and the impact of information technology	Information Resources Management Journal	HR Ahadi	2004		Revenue Costs Time External quality Internal quality		Process actor Management HR specialist IS specialist Customer External consultant

2	834	Business process change and organizational performance: exploring an antecedent model	Journal of Management Information Systems	S Guha; V Grover; WJ Kettinger et al	1997		Revenue Costs Time External quality Internal quality Flexibility Radical improvement Incremental improvement		Process actor Management External consultant
2	836	Empirically testing the antecedents of BPR success	International Journal of Production Economics	T Guimaraes	1997		Revenue Costs Time External quality Internal quality		External consultant
2	870	Critical factors for the effectiveness of clinical pathway in improving care outcomes	International Conference on Service Systems and Service Management	J Shi; Q Su; Z Zhao	2008		Costs Time External quality		Process actor
2	1286	Critical success factors of TQM in service organizations: a proposed model	Services Marketing Quarterly	F Talib; Z Rahman	2010		Revenue Costs Time Quality External quality		Process actor Supplier
2	1661	The state of business process reengineering: a search for success factors	Total Quality Management & Business Excellence	D Paper; R-D Chang	2005				Process actor
2	1672	Breaking the rules: success and failure in groupware-supported business process reengineering	Decision Support Systems	AR Dennis; TA Carte; GG Kelly	2003		Costs Time Quality External quality Radical improvement Incremental improvement		Process actor Management Finance specialist IS specialist Marketing specialist Customer Supplier External consultant Peer

2	2059	Is there a future for pathways? Five pieces of the puzzle	International Journal of Care Pathways	K Vanhaecht; M Panella; R van Zelm et al	2009		Costs Quality Internal quality		Process actor Management Patient
2	BFT3	Collaborative business engineering: a decade of lessons from the field	Journal of Management Information Systems	M Hengst; GJ de Vreede	2004		Costs Time External quality Internal quality Radical improvement Incremental improvement		Management IS specialist Customer Supplier External consultant
2	BFT7	Prevalence and use of clinical pathways in 23 countries - an international survey by the European Pathway Association	International Journal of Care Pathways	K Vanhaecht; M Bollmann; K Bower et al	2006		Costs Time External quality Internal quality		Process actor Management Patient Supplier
2	AC2	The implementation of business process reengineering	Journal of Management Information Systems	V Grover; SR Jeong; WJ Kettinger et al	1995		Revenue Costs Time External quality		IS specialist Customer External consultant
2	AC7	Business process reengineering: application and success - an Australian study	International Journal of Operations & Production Management	P O'Neill; AS Sohal	1998		Revenue Costs Time Quality External quality		Process actor Management BPR specialist IS specialist Customer Supplier External consultant

Table E.1: Method element codings per study (Method.Aim, Method.Actors). P = Part.

P	ID	Title	Source name	Authors	Year	Method.Input (developed method)	Method.Input (reviewed method)	Method.Output (developed method)	Method.Output (reviewed method)
1	642	Business process redesign in healthcare: towards a structured approach	INFOR	MH Jansen-Vullers; HA Reijers	2005	Process output goals Risks Process model Simulation model	Process model	Summary redesign proposals Process models Simulation models Impact analyses	
1	664	A TRIZ-based method for new service design	Journal of Service Research	K-H Chai; J Zhang; K-C Tan	2005	Process output goals Customer needs Constraints Problem investigation Previous solutions		Summary redesign proposals	
1	865	A consolidated methodology for business process reengineering	International Journal of Computer Applications in Technology	JYL Thong; C-S Yap; KL Seah	2003	Process output goals Customer needs Process model Process output measures Problem investigation Technology developments		Summary redesign proposals Process models Simulation models Impact analyses	
1	1073	Visualized guidelines for IT-enabled process change	Information Resources Management Journal	MR Hoogeweegen	2000	Process model	Process output goals	Process models	
1	1076	An intelligent tool for process redesign: manufacturing supply-chain applications	International Journal of Flexible Manufacturing Systems	ME Nissen	2000	Process model Process measures		Summary redesign proposals Simulation models Impact analyses	
1	1111	New approaches to business process redesign: a case study of collaborative group technology and service mapping	Group Decision and Negotiation	GF Corbitt; M Christopolus; L Wright	2000	Customer needs Process model Problem investigation		Summary redesign proposals Textual process descriptions Process models Force-field-analyses	

1	1331	Business process change: a study of methodologies, techniques, and tools	MIS Quarterly	WJ Kettinger; JTC Teng; S Guha	1997		Process output goals Customer needs Process model Process output measures Problem investigation Culture scan Technology developments		Process models Simulation models Force-field-analyses
1	1464	Methodology-driven use of automated support in business process re-engineering	Journal of Management Information Systems	AR Dennis; RM Daniels Jr; G Hayes et al	1994	Process output goals Constraints Process model Problem investigation		Summary redesign proposals	
1	1616	Applying Lean Six Sigma and TRIZ methodology in banking services	Total Quality Management & Business Excellence	F-K Wang; K-S Chen	2010	Process output goals Process model Process output measures Problem investigation		Process models	
1	1768	ARMA: a multi-disciplinary approach to BPR	Knowledge and Process Management	M Glykas; G Valiris	1999	Process output goals Process model Process output measures		Summary redesign proposals Process models	
1	1771	Critical review of existing BPR methodologies: the need for a holistic approach	Business Process Management Journal	G Valiris; M Glykas	1999	Process output goals Process model Process output measures	Process output goals Process model Process output measures	Summary redesign proposals Process models	
1	1774	Process reverse engineering for BPR: a form-based approach	Information & Management	K-H Kim; Y-G Kim	1998	Process model Process output measures Process measures	Process model	Process models	
1	1819	Metrics-based process redesign with the MIT process handbook	Knowledge and Process Management	A Margherita; M Klein; G Elia	2007	Textual process description	Process output goals Process output measures Problem investigation	Textual process descriptions TO-BE exception handlers Impact analyses	

1	1973	A structured evaluation of business process improvement approaches	Business Process Management Journal	G Zellner	2011				
1	1989	A Service Experience Engineering (SEE) method for developing new services	International Journal of Management	S-L Hsiao; H-L Yang	2010	Customer needs Technology developments Industry value net		TO-BE service concepts Process models	
1	2085	A handbook-based methodology for redesigning business processes	Knowledge and Process Management	M Klein; C Petti	2006	Textual process description		Textual process descriptions TO-BE exception handlers	
1	2089	Service blueprinting: a practical technique for service innovation	California Management Review	MJ Bitner; AL Ostrom; FN Morgan	2008	Process model Different opinions with regard to AS-IS process specification Benchmark process models		Summary redesign proposals Process models	
1	2149	Multilevel service design: From customer value constellation to service experience blueprinting	Journal of Service Research	L Patrício; RP Fisk; JF e Cunha et al	2011	Customer needs Process model Problem investigation		TO-BE service concepts Process models	
1	2225	Systematic improvement in service quality through TRIZ methodology: an exploratory study	Total Quality Management & Business Excellence	C-T Su; C-S Lin; T-L Chiang	2008	Process output goals Customer needs Problem investigation Previous solutions		Summary redesign proposals Impact analyses	
1	2428	PAWS: towards a participatory approach to business process reengineering	International Workshop on Groupware	MRS Borges; JA Pino	1999	Process output goals Process model Problem investigation		Summary redesign proposals Process models Simulation models Impact analyses	
1	2530	An innovative way to create new services: applying the TRIZ methodology	Journal of the Chinese Institute of Industrial Engineers	C-S Lin; C-T Su	2007	Process output goals Customer needs Problem investigation Previous solutions		Summary redesign proposals Impact analyses	

1	2560	Enhancing business process redesign: using tools to condense the process	Hawaii International Conference on System Sciences	G Corbitt; L Wright	1997	Customer needs Process model Problem investigation		Summary redesign proposals Process models Force-field-analyses	
1	3136	Tools for inventing organizations: toward a handbook of organizational processes	Management Science	TW Malone; K Crowston; J Lee et al	1999			Textual process descriptions	
1	3137	Tools for inventing organizations: toward a handbook of organizational processes	Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises	TW Malone; K Crowston; J Lee et al	1993	Process output goals Textual process description		Textual process descriptions	
1	3200	A groupware tool to support participatory business process reengineering	International Workshop on Groupware	EZ Mouro; MRS Borges; CR Garcez	1999	Process output goals Process model Problem investigation		Summary redesign proposals Process models Impact analyses	
1	3227	Intelligent tools for workflow process redesign: a research agenda	International Conference on Business Process Management	M Netjes; I Vanderfeesten; HA Reijers	2006	Process output goals Process model		Process models	
1	3298	Improving the effectiveness of business process development through collaboration engineering: a method for process elicitation	Hawaii International Conference on System Sciences	K Piirainen; K Elfvengren; J Korpela et al	2009	Process output goals Process model Problem investigation		Summary redesign proposals	
1	3408	Process life cycle engineering: a knowledge-based approach and environment	International Journal of Intelligent Systems in Accounting, Finance and Management	W Scacchi; P Mi	1997	Process model Simulation model Process output measures Process measures Problem investigation		Process models Simulation models	
1	3440	A decision-based approach to business process improvement	International Conference on Systems, Man and Cybernetics	K Shahzad; J Zdravkovic	2010	Process output goals Process output measures		Summary redesign proposals Impact analyses	

1	3447	Workflow reengineering: a methodology for business process reengineering using workflow management technology	Hawaii International Conference on System Sciences	LTSM Bitzer; MN Kamel	1997	Process output goals Customer needs Process model Process output measures Benchmark process insights Technology developments		Process models Simulation models Impact analyses	
1	3469	Service/product engineering as a potential approach to value enhancement in supply chains	Progress in Industrial Ecology - An International Journal	A Simboli; A Raggi; L Petti et al.	2008	Customer / stakeholder needs Process output measures		TO-BE service concepts Process models	
1	BFT01	Participatory business process reengineering design: generating solutions	International Conference of the Chilean Computer Science Society	F Albano; JA Pino; MRS Borges	2001	Process output goals Process model Problem investigation		Summary redesign proposals Process models Simulation models Impact analyses	
1	BFT02	The process recombinator: a tool for generating new business process ideas	International Conference on Information Systems	A Bernstein; M Klein; TW Malone	1999	Textual process description		Textual process descriptions Impact analyses	
1	BFT03	Analysis of techniques for business process improvement	European Conference on Information Systems	P Griesberger; S Leist; G Zellner	2011				
1	BFT04	Selecting the best strategic practices for business process redesign	Business Process Management Journal	P Hanafizadeh; M Moosakhani; J Bakhshi	2009	Process output goals Process model Problem investigation		Process models	
1	BFT06	Grammatical approach to organizational design	MIT Center for Coordination Science Technical Report	J Lee; BT Pentland	2000	Textual process description	Benchmark process insights	Textual process descriptions	

1	BFT07	Case-based reasoning as a technique for knowledge management in business process redesign	Electronic Journal on Knowledge Management	S Limam Mansar; F Marir; HA Reijers	2003	Process output goals Textual process description Problem investigation		Summary redesign proposals	
1	BFT08	Development of a decision-making strategy to improve the efficiency of BPR	Expert Systems with Applications	S Limam Mansar; H A Reijers; F Ounnar	2009	Process output goals Risks			
1	BFT09	On the formal generation of process redesigns	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2009	Process model Process measures		Process models Impact analyses	
1	BFT10	Performing business process redesign with best practices: an evolutionary approach	International Conference on Enterprise Information Systems	M Netjes; S Limam Mansar; HA Reijers et al	2009	Process model Process measures		Process models Simulation models Impact analyses	
1	BFT11	Best practices in business process redesign: an overview and qualitative evaluation of successful redesign heuristics	Omega	HA Reijers; S Limam Mansar	2005	Process model			
1	BFT12	A tutorial on business process improvement	Journal of Operations Management	TR Rohleder; EA Silver	1997	Process output goals Process model Process output measures Problem investigation Benchmark process insights		Process models Simulation models Impact analyses	
1	BFT13	Towards a goal-driven approach for business process improvement using process-oriented data warehouse	International Conference on Business Information Systems	K Shahzad; C Giannoulis	2011	Process output goals Process output measures		Summary redesign proposals Impact analyses	

1	BFT18	Designing robust business processes	Organizing business knowledge: The MIT process handbook	M Klein; C Dellarocas	2003	Textual process description		TO-BE exception handlers	
1	BFT19	Process grammar as a tool for business process design	MIS Quarterly	J Lee; GM Wyner; BT Pentland	2008	Textual process description		Textual process descriptions	
1	BFT20	The PrICE Tool Kit: tool support for process improvement	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2010	Process model Process measures		Process models Simulation models Impact analyses	
1	BFT21	Development of a hybrid model to improve the efficiency of business process reengineering	International Conference on Industrial Engineering and Engineering Management	W-H Tsai; C-C Yang; H-C Kuo	2009	Process output goals			
1	AC4	Model-based support for business re-engineering	Information and Software Technology	S Jarzabek; TW Ling	1996	Process output goals Process model Process output measures Problem investigation	Process model Simulation model Process output measures Problem investigation	Process models	
2	176	Empirically testing determinants of hospital BPR success	International Journal of Health Care Quality Assurance	M Do Carmo Caccia-Bava; VCK Guimaraes; T Guimaraes	2005		Problem investigation		
2	627	An examination of the role of organizational enablers in business process reengineering and the impact of information technology	Information Resources Management Journal	HR Ahadi	2004		Process output goals Customer needs		

2	834	Business process change and organizational performance: exploring an antecedent model	Journal of Management Information Systems	S Guha; V Grover; WJ Kettinger et al	1997		Process output goals Process model Process output measures Problem investigation Technology developments		
2	836	Empirically testing the antecedents of BPR success	International Journal of Production Economics	T Guimaraes	1997		Process output goals Process model Problem investigation		
2	870	Critical factors for the effectiveness of clinical pathway in improving care outcomes	International Conference on Service Systems and Service Management	J Shi; Q Su; Z Zhao	2008				
2	1286	Critical success factors of TQM in service organizations: a proposed model	Services Marketing Quarterly	F Talib; Z Rahman	2010		Customer needs Process output measures Benchmark process insights		
2	1661	The state of business process reengineering: a search for success factors	Total Quality Management & Business Excellence	D Paper; R-D Chang	2005		Process model		
2	1672	Breaking the rules: success and failure in groupware-supported business process reengineering	Decision Support Systems	AR Dennis; TA Carte; GG Kelly	2003		Process model Problem investigation Benchmark process insights		Process models

2	2059	Is there a future for pathways? Five pieces of the puzzle	International Journal of Care Pathways	K Vanhaecht; M Panella; R van Zelm et al	2009		Customer needs Medical guidelines / key interventions		
2	BFT3	Collaborative business engineering: a decade of lessons from the field	Journal of Management Information Systems	M Hengst; GJ de Vreede	2004		Process model Simulation model Problem investigation		Simulation models
2	BFT7	Prevalence and use of clinical pathways in 23 countries - an international survey by the European Pathway Association	International Journal of Care Pathways	K Vanhaecht; M Bollmann; K Bower et al	2006		Customer needs Medical guidelines		
2	AC2	The implementation of business process reengineering	Journal of Management Information Systems	V Grover; SR Jeong; WJ Kettinger et al	1995		Process output goals Customer needs Problem investigation Technology developments		
2	AC7	Business process reengineering: application and success - an Australian study	International Journal of Operations & Production Management	P O'Neill; AS Sohal	1998		Process output goals Process model		

Table E.2: Method element codings per study (Method.Input, Method.Output). P = Part.

P	ID	Title	Source name	Authors	Year	Method.Technique (developed method)	Method.Technique (reviewed method)	Method.Tool (developed method)	Method.Tool (reviewed method)
1	642	Business process redesign in healthcare: towards a structured approach	INFOR	MH Jansen-Vullers; HA Reijers	2005	Rule-based	Unstructured (unspecified)	Modeling Simulation Specific	
1	664	A TRIZ-based method for new service design	Journal of Service Research	K-H Chai; J Zhang; K-C Tan	2005	Rule-based	Unstructured (unspecified) Brainstorming		
1	865	A consolidated methodology for business process reengineering	International Journal of Computer Applications in Technology	JYL Thong; C-S Yap; KL Seah	2003	Brainstorming Out-of-the-Box thinking Visioning		Modeling Simulation	
1	1073	Visualized guidelines for IT-enabled process change	Information Resources Management Journal	MR Hoogeweegen	2000	Rule-based	Unstructured (unspecified) Brainstorming		
1	1076	An intelligent tool for process redesign: manufacturing supply-chain applications	International Journal of Flexible Manufacturing Systems	ME Nissen	2000	Rule-based	Case-based	Simulation Specific	
1	1111	New approaches to business process redesign: a case study of collaborative group technology and service mapping	Group Decision and Negotiation	GF Corbitt; M Christopolus; L Wright	2000	Nominal group		Communication Voting Modeling Repository	

1	1331	Business process change: a study of methodologies, techniques, and tools	MIS Quarterly	WJ Kettinger; JTC Teng; S Guha	1997		Brainstorming Out-of-the-Box thinking Visioning Delphi Nominal group		Communication Voting Modeling Simulation
1	1464	Methodology-driven use of automated support in business process re-engineering	Journal of Management Information Systems	AR Dennis; RM Daniels Jr; G Hayes et al	1994	Nominal group		Communication Repository	
1	1616	Applying Lean Six Sigma and TRIZ methodology in banking services	Total Quality Management & Business Excellence	F-K Wang; K-S Chen	2010	Rule-based	Brainstorming		
1	1768	ARMA: a multi-disciplinary approach to BPR	Knowledge and Process Management	M Glykas; G Valiris	1999				
1	1771	Critical review of existing BPR methodologies: the need for a holistic approach	Business Process Management Journal	G Valiris; M Glykas	1999				Repository
1	1774	Process reverse engineering for BPR: a form-based approach	Information & Management	K-H Kim; Y-G Kim	1998	Rule-based		Specific	
1	1819	Metrics-based process redesign with the MIT process handbook	Knowledge and Process Management	A Margherita; M Klein; G Elia	2007	Repository-based		Repository	

1	1973	A structured evaluation of business process improvement approaches	Business Process Management Journal	G Zellner	2011		Unstructured (unspecified) Brainstorming		
1	1989	A Service Experience Engineering (SEE) method for developing new services	International Journal of Management	S-L Hsiao; H-L Yang	2010	Multi-level design			
1	2085	A handbook-based methodology for redesigning business processes	Knowledge and Process Management	M Klein; C Petti	2006	Repository-based	Brainstorming Out-of-the-Box thinking Visioning Nominal group	Repository	
1	2089	Service blueprinting: a practical technique for service innovation	California Management Review	MJ Bitner; AL Ostrom; FN Morgan	2008	Brainstorming			
1	2149	Multilevel service design: From customer value constellation to service experience blueprinting	Journal of Service Research	L Patrício; RP Fisk; JF e Cunha et al	2011	Multi-level design			
1	2225	Systematic improvement in service quality through TRIZ methodology: an exploratory study	Total Quality Management & Business Excellence	C-T Su; C-S Lin; T-L Chiang	2008	Rule-based	Unstructured (unspecified) Brainstorming Out-of-the-Box thinking		
1	2428	PAWS: towards a participatory approach to business process reengineering	International Workshop on Groupware	MRS Borges; JA Pino	1999	Nominal group		Communication Modeling Repository	
1	2530	An innovative way to create new services: applying the TRIZ methodology	Journal of the Chinese Institute of Industrial Engineers	C-S Lin; C-T Su	2007	Rule-based	Unstructured (unspecified) Brainstorming Out-of-the-Box thinking		

1	2560	Enhancing business process redesign: using tools to condense the process	Hawaii International Conference on System Sciences	G Corbitt; L Wright	1997	Nominal group		Communication Voting Repository	
1	3136	Tools for inventing organizations: toward a handbook of organizational processes	Management Science	TW Malone; K Crowston; J Lee et al	1999	Repository-based	Case-based	Repository	
1	3137	Tools for inventing organizations: toward a handbook of organizational processes	Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises	TW Malone; K Crowston; J Lee et al	1993	Repository-based		Repository	
1	3200	A groupware tool to support participatory business process reengineering	International Workshop on Groupware	EZ Mouro; MRS Borges; CR Garcez	1999	Nominal group		Communication Voting Modeling Repository	
1	3227	Intelligent tools for workflow process redesign: a research agenda	International Conference on Business Process Management	M Netjes; I Vanderfeesten; HA Reijers	2006	Rule-based	Unstructured (unspecified) Grammar-based Case-based Repository-based		
1	3298	Improving the effectiveness of business process development through collaboration engineering: a method for process elicitation	Hawaii International Conference on System Sciences	K Piirainen; K Elfvengren; J Korpela et al	2009	Nominal group		Communication Voting Repository	
1	3408	Process life cycle engineering: a knowledge-based approach and environment	International Journal of Intelligent Systems in Accounting, Finance and Management	W Scacchi; P Mi	1997	Rule-based	Unstructured (unspecified)	Simulation	
1	3440	A decision-based approach to business process improvement	International Conference on Systems, Man and Cybernetics	K Shahzad; J Zdravkovic	2010	Rule-based			

1	3447	Workflow reengineering: a methodology for business process reengineering using workflow management technology	Hawaii International Conference on System Sciences	LTSM Bitzer; MN Kamel	1997	Rule-based		Modeling Simulation	
1	3469	Service/product engineering as a potential approach to value enhancement in supply chains	Progress in Industrial Ecology - An International Journal	A Simboli; A Raggi; L Petti et al.	2008	Multi-level design		Modeling Repository	
1	BFT01	Participatory business process reengineering design: generating solutions	International Conference of the Chilean Computer Science Society	F Albano; JA Pino; MRS Borges	2001	Nominal group		Communication Voting Modeling Simulation Repository	
1	BFT02	The process recombinator: a tool for generating new business process ideas	International Conference on Information Systems	A Bernstein; M Klein; TW Malone	1999	Repository-based	Unstructured (unspecified) Brainstorming	Repository	
1	BFT03	Analysis of techniques for business process improvement	European Conference on Information Systems	P Griesberger; S Leist; G Zellner	2011		Unstructured (unspecified) Brainstorming		
1	BFT04	Selecting the best strategic practices for business process redesign	Business Process Management Journal	P Hanafizadeh; M Moosakhani; J Bakhshi	2009	Rule-based			
1	BFT06	Grammatical approach to organizational design	MIT Center for Coordination Science Technical Report	J Lee; BT Pentland	2000	Grammar-based	Brainstorming Visioning Nominal group Rule-based		

1	BFT07	Case-based reasoning as a technique for knowledge management in business process redesign	Electronic Journal on Knowledge Management	S Limam Mansar; F Marir; HA Reijers	2003	Case-based	Rule-based	Repository	
1	BFT08	Development of a decision-making strategy to improve the efficiency of BPR	Expert Systems with Applications	S Limam Mansar; H A Reijers; F Ounnar	2009	Rule-based	Unstructured (unspecified) Brainstorming Grammar-based Case-based Repository-based	Specific	
1	BFT09	On the formal generation of process redesigns	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2009	Rule-based		Modeling	
1	BFT10	Performing business process redesign with best practices: an evolutionary approach	International Conference on Enterprise Information Systems	M Netjes; S Limam Mansar; HA Reijers et al	2009	Rule-based		Modeling	
1	BFT11	Best practices in business process redesign: an overview and qualitative evaluation of successful redesign heuristics	Omega	HA Reijers; S Limam Mansar	2005	Rule-based	Unstructured (unspecified)		
1	BFT12	A tutorial on business process improvement	Journal of Operations Management	TR Rohleder; EA Silver	1997	Unstructured (unspecified) Brainstorming			
1	BFT13	Towards a goal-driven approach for business process improvement using process-oriented data warehouse	International Conference on Business Information Systems	K Shahzad; C Giannoulis	2011	Rule-based			

1	BFT18	Designing robust business processes	Organizing business knowledge: The MIT process handbook	M Klein; C Dellarocas	2003	Repository-based	Unstructured (unspecified)	Repository	
1	BFT19	Process grammar as a tool for business process design	MIS Quarterly	J Lee; GM Wyner; BT Pentland	2008	Grammar-based	Unstructured (unspecified) Rule-based Repository-based	Repository	
1	BFT20	The PrICE Tool Kit: tool support for process improvement	International Conference on Business Process Management	M Netjes; HA Reijers; WMP van der Aalst	2010	Rule-based	Unstructured (unspecified)	Modeling Simulation Repository	
1	BFT21	Development of a hybrid model to improve the efficiency of business process reengineering	International Conference on Industrial Engineering and Engineering Management	W-H Tsai; C-C Yang; H-C Kuo	2009	Rule-based			
1	AC4	Model-based support for business re-engineering	Information and Software Technology	S Jarzabek; TW Ling	1996			Communication Repository	Modeling
2	176	Empirically testing determinants of hospital BPR success	International Journal of Health Care Quality Assurance	M Do Carmo Caccia-Bava; VCK Guimaraes; T Guimaraes	2005				
2	627	An examination of the role of organizational enablers in business process reengineering and the impact of information technology	Information Resources Management Journal	HR Ahadi	2004				

2	834	Business process change and organizational performance: exploring an antecedent model	Journal of Management Information Systems	S Guha; V Grover; WJ Kettinger et al	1997				
2	836	Empirically testing the antecedents of BPR success	International Journal of Production Economics	T Guimaraes	1997				
2	870	Critical factors for the effectiveness of clinical pathway in improving care outcomes	International Conference on Service Systems and Service Management	J Shi; Q Su; Z Zhao	2008				
2	1286	Critical success factors of TQM in service organizations: a proposed model	Services Marketing Quarterly	F Talib; Z Rahman	2010				
2	1661	The state of business process reengineering: a search for success factors	Total Quality Management & Business Excellence	D Paper; R-D Chang	2005				
2	1672	Breaking the rules: success and failure in groupware-supported business process reengineering	Decision Support Systems	AR Dennis; TA Carte; GG Kelly	2003		Brainstorming Out-of-the-Box thinking Visioning Rule-based		Communication Voting Modeling Repository

2	2059	Is there a future for pathways? Five pieces of the puzzle	International Journal of Care Pathways	K Vanhaecht; M Panella; R van Zelm et al	2009				
2	BFT3	Collaborative business engineering: a decade of lessons from the field	Journal of Management Information Systems	M Hengst; GJ de Vreede	2004				Communication Modeling Simulation Repository
2	BFT7	Prevalence and use of clinical pathways in 23 countries - an international survey by the European Pathway Association	International Journal of Care Pathways	K Vanhaecht; M Bollmann; K Bower et al	2006				
2	AC2	The implementation of business process reengineering	Journal of Management Information Systems	V Grover; SR Jeong; WJ Kettinger et al	1995				
2	AC7	Business process reengineering: application and success - an Australian study	International Journal of Operations & Production Management	P O'Neill; AS Sohal	1998				

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