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Business process re-design methodology to support supply chain integration

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ABSTRACT

Although a number of methodologies exist for business process re-design (BPR), supply chain re-design (SCR), and e-business process design, there is a lack of an integrated BPR methodological framework to support supply chain integration (SCI). This paper proposes a detailed framework based on integrating a number of different methodological strands from the literature. A literature review was conducted in three different domains – business process re-design, supply chain re-design and e-business process design. The literature review revealed the potential for integrating elements of a number of different methods and techniques found in different methodological strands into a framework for conducting BPR to support SCI. Accordingly a number of relevant methodologies were identified, decomposed and compared at their stage and technique/method level to identify a combination for development of the integrated framework. The proposed BPR methodology can be applied in any company or sector; methods and techniques incorporated are not specific to any sector. The proposed BPR methodology proposed constitutes an aid for supply chain practitioners in the construction of SCI.

1. Introduction

1.1. Supply chain integration

The necessity to coordinate several business partners, internal corporate departments, business processes and diverse customers across the supply chain gave rise to the field of supply chain management (SCM), (Turban, King, Lee, Liang, & Turban, 2011). At the core of gaining competitive advantage through SCM is supply chain integration (SCI); when integration is achieved, the supply chain operates as a single entity driven directly by customer demand (Farhoomand, 2005). However the supply chain literature shows the existence of a number of challenges associated with the integration of supply chains (Awad & Nassar, 2010; Bagchi & Skjoett-Larsen, 2005; Sweeney, 2011). Among these challenges, sharing of information, coordination of physical good flows, and integration of business processes appear to be most critical (Prajogo & Olhager, 2012; Robertson, Gibson, & Flanagan, 2002; Sahin & Robinson, 2002).

1.2. SCI construction

In search of solutions, which can facilitate the construction of SCI, companies have turned their attention to e-business technologies (Auramo, Aminoff, & Punakavi, 2002; Cagliano, Caniato, & Spina, 2003; Chen & Holsapple, 2012; Wiengarten, Humpreys, McKittrick, & Fynes, 2013). According to a study conducted by Auramo et al. (2002), organizations across different sectors have recognized the potential of e-business to share timely and reliable information, to enable business process integration and coordination of activities. Nevertheless evidence in the e-business and supply chain literature shows only a limited adoption of e-business for SCI, (Auramo et al., 2002; Bagchi & Skjoett-Larsen, 2005; Chen & Holsapple, 2012; Croom, 2005). Chen and Holsapple (2012) conducted a study on two hundred and sixty five articles published from 2006 to 2010 on organizational e-business adoption, and found only 1.1% dealing with supply chain integration. This limited adoption highlights the existence of challenges in the application of e-business to enable SCI.

New internet based e-collaboration tools allow the integration of multiple organizations, making it feasible to construct SCI systems. However, tools alone are not sufficient; it is necessary to

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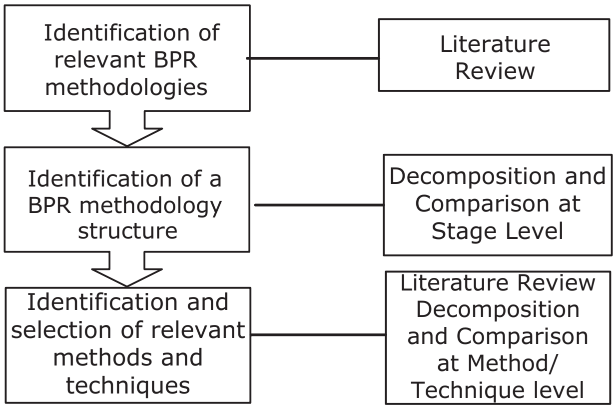

Fig. 1. Research methodology.

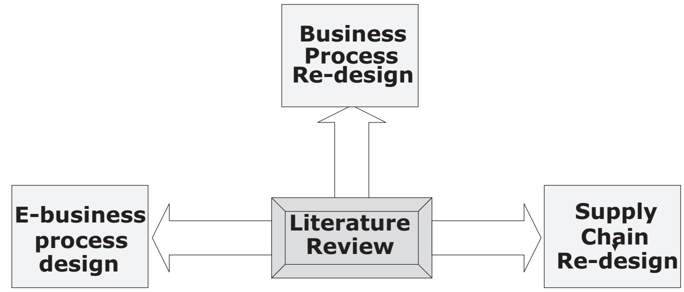

Fig. 2. Literature review: main domains.

undertake organizational and technological changes together with a co-alignment in structure, management processes, strategy, technology, and individuals/roles for successful e-business adoption (Chen & Ching, 2002). At the core of organizational changes from an operational point of view are business processes; when e-business technologies are implemented the business processes should be re-designed to support the new technology (Gunasekaran & Ngai, 2004).

1.3. Business process redesign to support e-business adoption for SCI

Redesigning business processes to support the adoption of e-business technologies is difficult. The increase of complexity in business processes in supply chains results in the need for new methodologies to handle this complexity, in particular, on how to integrate process information in enterprise networks (Roder & Tibken, 2006). Thus, based on the identified necessity to change business processes the following research question is posed: "How to change business processes in support of e-business adoption for SCI?".

2. Research methodology

To answer the research question the next steps were followed (Fig. 1).

First, a number of relevant methodologies were identified within the relevant domains shown in Fig. 2.

These methodologies were selected for their process re-design oriented approach (Tables 1 and 2). The review found that none of the methodologies provides a comprehensive solution to the research question, although it seems that a number of the methodologies reviewed could potentially be combined for that aim. Whilst considering different methodologies for a particular intervention, a number of methodologies tend to be more useful in relation to some phases than others, so it becomes attractive to combine different methodologies for a better result. When linking different methodologies it is necessary to decompose them into detachable elements. According to Mingers and Brocklesby (1997), it is possible to decompose methodologies at the stage level (what) or at the technique level (how). Accordingly, the relevant methodologies (Tables 1 and 2) were first decomposed at their stage level. Next through an inductive approach of pattern recognition similar to the one used by Kettinger, Teng, and Guha (1997), the commonalities and differences between the decomposed methodologies were analyzed in terms of their stages and activities. This analysis identified a set of distinct stages included in each methodology. Then a set of common stages were identified to be present in all the methodologies reviewed. Finally a brief description for each common stage was elaborated, giving as result the identification of generic stages for the construction of a BPR methodology structure.

Lessons learned from the review conducted on the methodologies shown in Tables 1 and 2, is that no particular methodology exists to tackle the research question, although it seems that a number of the methodologies reviewed could potentially be combined for that aim. After being decomposed at stage level, it can be observed that the methodologies reviewed share common stages; these similarities can be used for the purpose of combining different methodologies for a particular intervention into a single BPR structure (Mingers & Brocklesby, 1997).

3. Business process re-design methodology: methods and techniques

The methodologies reviewed were decomposed a second time in terms of their techniques and methods employed in order to select the most suitable for each stage. Additional methods and techniques were adopted from the wider supply chain management and e-business literature. The resulting methodology is a multi-methodology, the essence of which is to link together parts of different methodologies to tackle a particular problem situation (Mingers & Brocklesby, 1997). First, the generic stages (Tables 1 and 2) were refined by splitting some as follows:

- Strategic vision: This stage was found to be present in most of the methodologies reviewed. The only modification, which appeared to be necessary, was to separate the top management commitment and visioning from the construction of a "rich picture" about

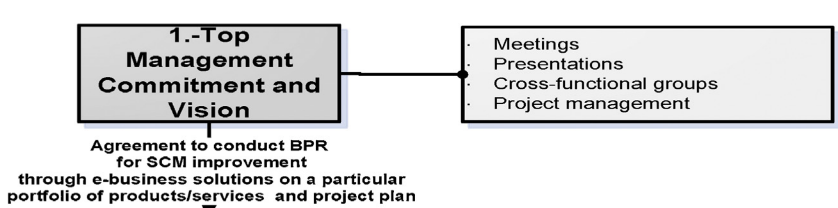

Fig. 3. Stage 1: top management commitment and vision.

Table 1
Decomposed generic stages and BPR methodologies.

Generic stages	Process analysis and design methodology (Wastell, White & Kawalek, 1994)	Conceptual framework for decision support system (Ashayeri, Keij, & Broker, 1998)	Business process redesign method (Adair & Murray, 1994)	Business process redesign with IT (Davenport & Short, 1990)
Strategic vision and business understanding	N/A	N/A	• Understanding customer and market • Develop vision • Determine vision imperatives • Develop strategy	Develop business vision
Process definition and business objectives	• Process definition	• Formulation of objectives • Criteria selection	• Choose the right process • Customer/client surveys	• Develop process objectives • Identify Process to be re-designed
Understanding business process AS IS	• Baseline process capture	• Identification of business process and activities • Evaluation of business process and activities • SD model	• Baseline process	• Understand and measure existing process
Design of process TO BE	• Process evaluation	• Scenario formulation • Impact analysis	• Analyze	• Identify IT levers
Implementation of changes	• Target process design	• Choice of strategy to implement	• Implement breakthrough improvements or innovative designs	• Design and build a prototype of the process
Evaluation of changes	N/A	N/A	• Monitor • Measure • Adjust	N/A

the company. In a number of the methodologies reviewed, the need to understand the business context and business logic in preparation for the start of a BPR project was regarded as important (Bolstorff & Rosenbaum, 2012).

• Process definition and business objectives: This stage was also divided into two, one dealing with process definition, here defined as "Identification of relevant SC processes and selection of key target for re-design", and the other with defining objectives for improvement.

3.1. Stage 1 – top management commitment and vision

According to the literature this stage should include meetings with management executives (in cross functional groups), presentations and discussions to reach an agreement on project scope, reach, and outcomes. The particular focus should be on a specific portfolio of products/services. This stage should conclude with the development of an initial project plan and assembly of a project team (Kettinger et al., 1997).

Table 2
Decomposed generic stages and supply chain re-design/e-business process design methodologies.

Generic Stages	Cardiff supply chain modelling and reengineering methodology (Towil, 1996)	Supply chain excellence approach (Bolstorff & Rosenbaum, 2012)	Supply chain re-design framework (Changchien & Shen, 2002)	E-business process Improvement (Kirchmer, 2004)
Strategic vision and business understanding	• Real world supply chain	• Business context • Strategic background	• Evaluation of organizational structure • Identification of needs	N/A
Process definition and business objectives	• Business objectives	• Supply chain definition and priorities • Metric definition • Industry comparison	• Definition of objectives • Identification of core processes to be re-designed	N/A
Understanding business process AS IS	• Systems input-output analysis • Conceptual model • Block diagram formation • Control theory, computer simulation and statistical techniques • Verification and validation Dynamic analysis	• Understanding process AS IS • Identification of problems and solutions	• Analysis of current process	N/A
Design of process TO BE	• Tune existing parameters • Structural re-design What if Scenarios	• Design of to be process	• Design for innovation, use of IT as enabler of alternatives for improvement • Evaluating new processes • Selection of best alternative	• Vision
Implementation of changes	N/A	N/A	• Implementation	• Specification • Realization
Evaluation of changes	N/A	N/A	N/A	• Continuous Improvement

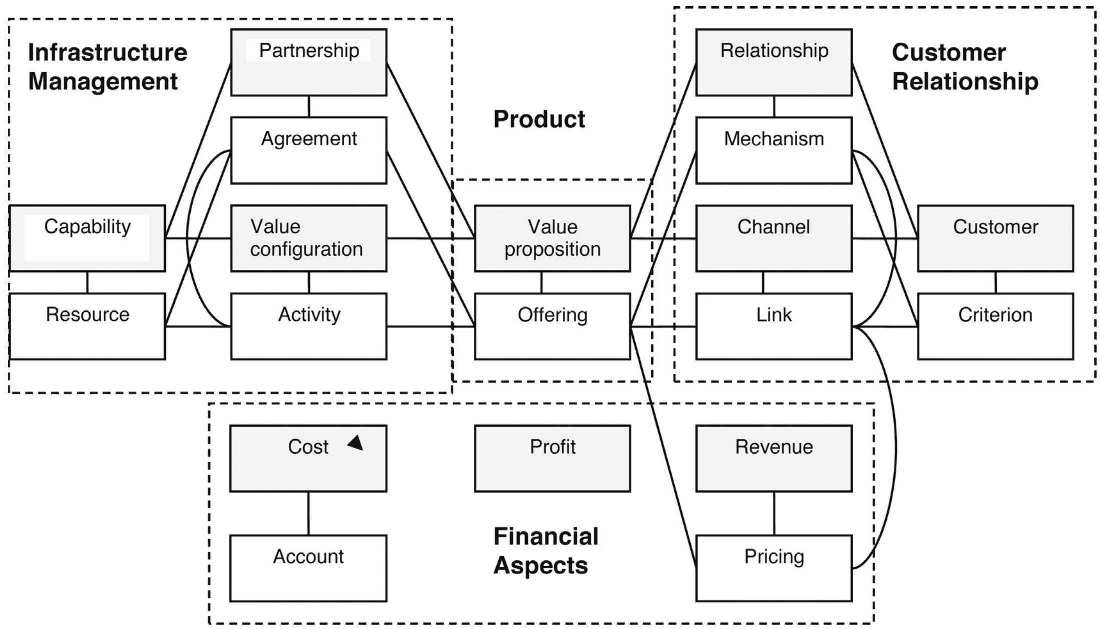

Fig. 4. Business model ontology.

Source: Osterwalder and Pigneur (2004).

Fig. 3 shows the relevant methods and techniques for this stage and its main output.

3.2. *Stage 2 – business understanding*

The objective of this stage is to develop an overall understanding of the business in which the BPR project will be conducted. This understanding can be divided into two, first understanding the business context, followed by understanding the business logic.

3.2.1. *Understanding the business context*

Understanding the business context involves gaining knowledge about the sector in which the company competes, the market characteristics and company history. Annual report analysis and Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis are the most useful methods to follow (Bolstorff & Rosenbaum, 2012).

3.2.2. *Understanding the business logic*

Next it is necessary to understand the business logic; meaning: how the company operates to satisfy its customers with emphasis on identifying the current roles of supply chain management and e-business technologies, if present. However none of the process design methodologies reviewed was found to address this. For this purpose, the business model ontology proposed by Osterwalder and Pigneur (2004) is adopted from the e-business literature. The business ontology allows the construction of a business logic map around a particular value proposition to represent the most important elements of a business model (Fig. 4). Its block structure allows the description of the current role performed by supply chain management and e-business.

At the centre is the value proposition consisting of a portfolio of products/services; customer relationship, representing how the company reaches/serves its customers; the activities supporting the value creation represented by the infrastructure management block; and finally the financial aspects affected by the value proposition.

Fig. 5 shows the relevant methods and techniques for this stage and its main output.

3.3. *Stage 3 – identification of relevant supply chain processes and selection of target for re-design*

Next it is necessary to identify the most relevant supply chain processes present and then, to select a specific process for re-design.

3.3.1. *Identification of relevant supply chain processes*

An initial identification of relevant supply chain processes comes from the business model ontology (Osterwalder & Pigneur, 2004) used in stage 2. The infrastructure management block provides information on the activities necessary to deliver the value proposition, including supply chain processes. A number of high level supply chain processes related to the construction of the value proposition are identified together with associated resources and actors. However, this initial identification can be enhanced by the use of the supply chain operations reference (SCOR) model as recommended by a number of researchers (Bolstorff & Rosenbaum, 2012; Kirchmer, 2004). The SCOR model was developed by the supply chain council (SCC) in 1996, to understand, describe, and evaluate supply chains. It provides a common framework, standard terminology, common metrics, and best practices (Huan, Sheoran, & Wang, 2004). The SCOR model follows a hierarchical structure with different levels of decomposition. The basic hierarchical composition of the SCOR model is as follows:

- SCOR model level I process types: Level 1 defines scope and content using five process types: Plan, Source, Make, Delivery, and Return.

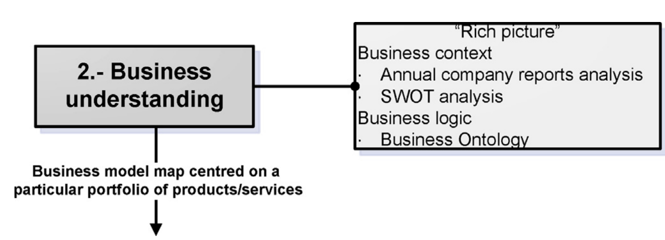

Fig. 5. Stage 2: business understanding.

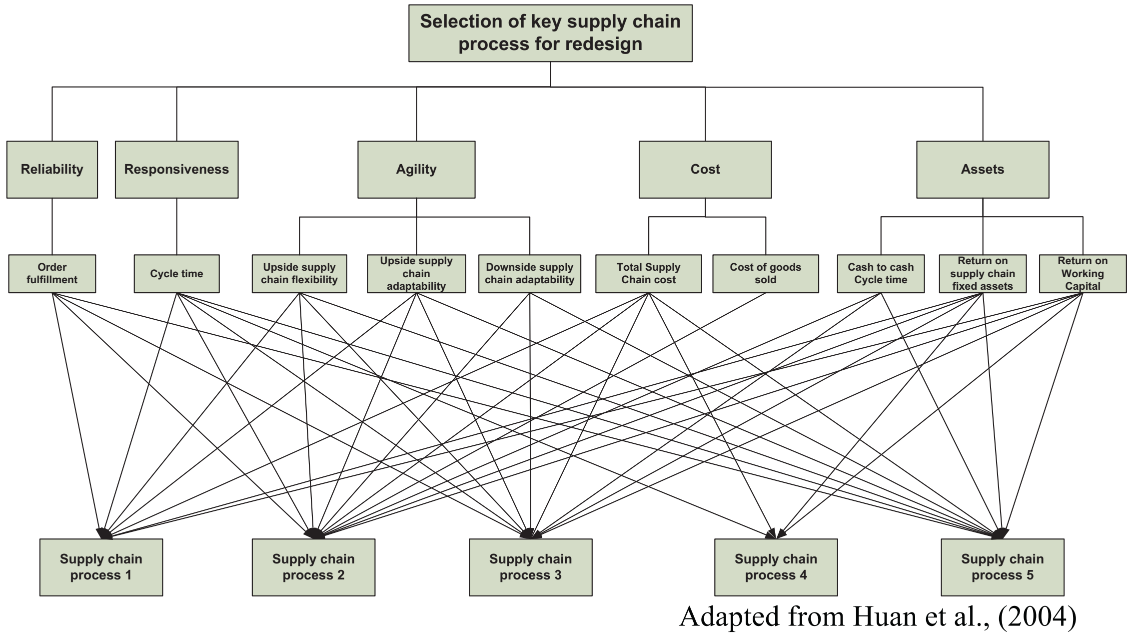

Fig. 6. AHP structure for selection of key supply chain process.

Adapted from Huan et al. (2004).

- SCOR model level II process categories: This level defines configuration level, where a supply chain can be defined using core process categories such as configured-to-order and configured-to-stock.
- SCOR model level III process elements: This level decompose processes in process elements, describing inputs and outputs, process performance metrics, and recommended best practices

The SCOR model aids the understanding of a particular supply chain by means of mapping it in business process terms. Accordingly, SCOR model levels I (process types) and II (process categories) are used for this stage of the methodology to identify and map the supply chain processes present.

3.3.2. Selection of key supply chain process for re-design

Some processes in a supply chain are more critical than others; thus, it is better to focus on the process or processes, which will make the highest contribution to the business (Ashayeri et al., 1998). Here it is proposed to use multi-criteria decision analysis such as AHP (analytical hierarchy process) as a decision support tool for process selection in a BPR project. AHP assumes that decision problems can be structured by translating goals into measurable criteria, which, in turn, can be related to alternative decisions. As result, AHP provides a priority number at each level of the hierarchy; then priorities of the alternatives are weighted against those of the criteria so that the eventual importance of the alternatives related to the goal are quantified (Saaty & Vargas, 2006).

Within the context of supply chain decision making, Huan et al. (2004) suggest the use of SCOR model performance attributes and level 1 metrics as criteria to provide a robust way to obtain a valid result from an AHP analysis. They used this approach in evaluating alternative methods for improving supply chain efficiency. In the proposed methodology, a modified version of the AHP structure of Huan et al. (2004) is used for evaluating instead the importance of the relevant supply chain processes (Fig. 6.) and choose a target for redesign.

Based on the SCOR model version 10, the performance attributes are: Reliability, Responsiveness, Agility, Cost, and Assets; similarly, the performance metrics are: Perfect order fulfilment, Order Fulfilment cycle, Upside Supply chain flexibility, Upside supply chain adaptability, Supply chain management cost, Cost of goods sold, Cash-to-cash cycle time, Return on supply chain fixed assets, and Return on working capital. The supply chain processes are those identified through SCOR model mapping (see Section 3.3.1).

Fig. 7 shows the relevant methods and techniques for this stage and its main output.

3.4. Stage 4 – definition of objectives for improvement

Next it is necessary to define objectives for improvement. Few methodologies in the reviewed literature address this in detail. A number of suggestions and approaches in the wider supply chain literature are combined here to provide a method for definition of objectives for improvement. First relevant metrics are identified, followed by a benchmark analysis to define the levels of improvement desired.

3.4.1. Identification of relevant metrics for objective definition

An important first step in defining objectives for improvement is the identification of key SCOR metrics associated with the supply chain process selected for redesign. The SCOR model defines a number of metrics associated with each process category to measure its performance, and these metrics form part of the AHP structure in Stage 3 (see Fig. 6). From the AHP analysis, it is possible to calculate a priority rank for the metric criteria used; thus making it possible

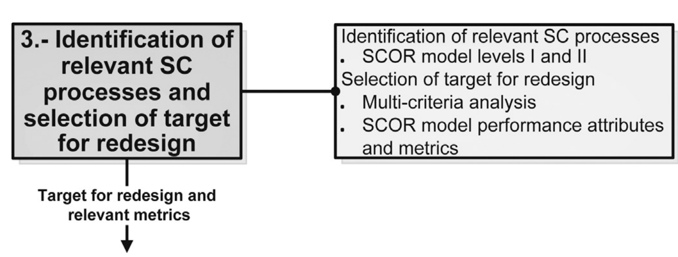

Fig. 7. Stage 3: identification of relevant SC processes and selection of target for re-design.

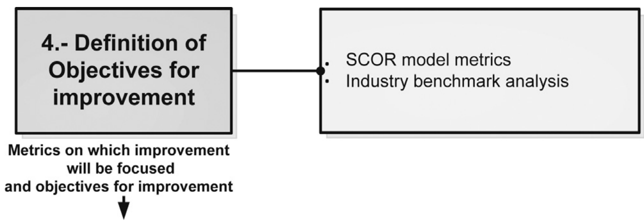

Fig. 8. Stage 4: definition of objectives for improvement.

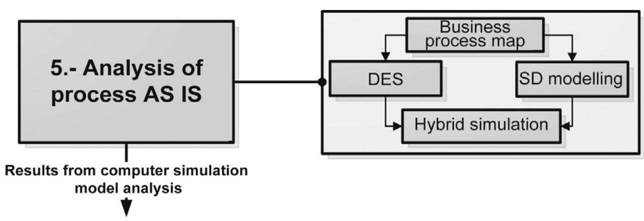

Fig. 9. Stage 5: analysis of process AS IS.

to identify the most important SCOR metrics associated with the process targeted for re-design.

3.4.2. *Definition of objectives for improvement*

For the definition of objectives for improvement, Bolstorff and Rosenbaum (2012) recommend conducting a benchmark analysis to identify gaps between current performance and industry benchmarks (for the most important SCOR metrics identified). Next, based on the gaps, a constructive discussion should lead towards deciding the levels of improvement desired.

Fig. 8 shows the relevant methods and techniques for this stage and its main output.

3.5. *Stage 5 – understanding the process AS IS*

Once a process has been selected and objectives for improvement defined, it is necessary to understand the targeted process. The understanding of a supply chain process should be quite exhaustive to comprehend the diverse elements, interactions, and flows. A number of methods and techniques are recommended in the literature.

3.5.1. *Business process maps*

Trkman, Indihar, Stemberger, Jaklic, and Groznik (2007) recommend business process mapping to understand, visualize, and document a process AS IS. Business process maps are useful in analysing flows as well as in clarifying the relationships and sequence of operations. However they have limitations in showing structure, dynamic elements, and causal relationships (An & Jeng, 2005).

3.5.2. *System dynamics*

One of the obstacles for evaluating business processes is their complexity, consisting of a series of linked activities, which crosses departmental and organizational boundaries as is the case with supply chain processes. Moreover when combined with elements of dynamic complexity (Sterman, 2000), such as feedback, time delays, nonlinearity, accumulation, and dispersal of resources (stock and flows), the task of evaluation becomes even more difficult. The existence of these elements points towards the need to use a systemic and dynamic approach to tackle such complexity. System dynamics (SD) is such an approach, it can be used to generate insight into dynamic behaviour and causal relationships (Towil, 1996; Akkermans & Dellaert, 2005). In SD modelling, a supply chain is represented as a series of stocks and flows where state changes occur continuously over time; individual entities are not specifically modelled, models are generally deterministic and variables usually represent average values (Tako & Robinson, 2012). SD is appropriate for modelling large scale systems and high levels of decision making where aggregation is preferred (Helal, Rabelo, Sepulveda, & Jones, 2007). Although SD is well suited to model complex systems, it has limitations in providing a detailed representation of a supply chain with discrete changes such as high variability, stochastic uncertainties, and discrete disturbances (Pereira, 2009). Failure to grasp the impact of uncertainties is considered to be a major pitfall in understanding supply chains (Tannock, Cao, Farr, & Byrne, 2007). SD has the potential for use in the study of the impact of e-business technologies (e.g., internet tools) on supply chain integration as demonstrated by Crespo-Marquez, Bianchi, and Gupta (2004). Although SD is well suited to model complex systems, it has limitations in providing a detailed representation of a system with discrete changes.

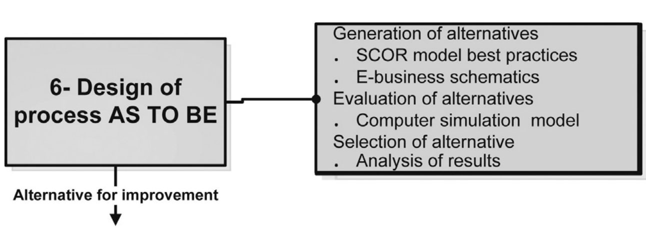

Fig. 10. Stage 6: design of process AS TO BE.

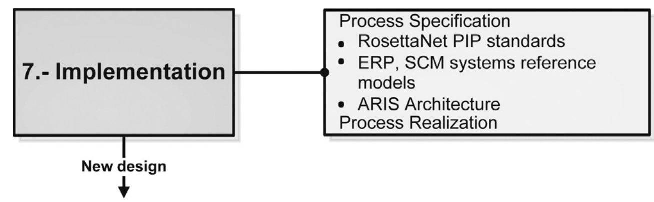

Fig. 11. Stage 7: implementation.

3.5.3. *Discrete event simulation*

Another simulation approach widely used for supply chain analysis is discrete event simulation (DES). DES simulation models are usually built upon process maps or flow chart diagrams. DES is well known for its ability to mimic the dynamics of a real system over time (Moon & Phatak, 2005). DES models systems perform as a network of queues and activities where changes occur at discrete points of time, entities of a system are represented individually; models are generally stochastic in nature where randomness is represented through the use of statistical distributions (Tako & Robinson, 2012). DES tends to be convenient for detailed process analyses, resource utilization, queuing, and relatively shorter-term analyses (Jahangirian, Eldabi, Nasser, Stergioulas, & Young, 2010). Trkman et al. (2007) have demonstrated the use of DES to evaluate improvements in supply chain integration through information sharing.

However, DES cannot capture qualitative relations, such as those between supply chain partners, and it requires a long

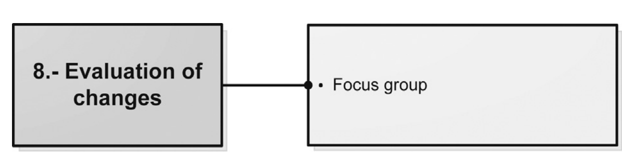

Fig. 12. Stage 8: evaluation of changes.

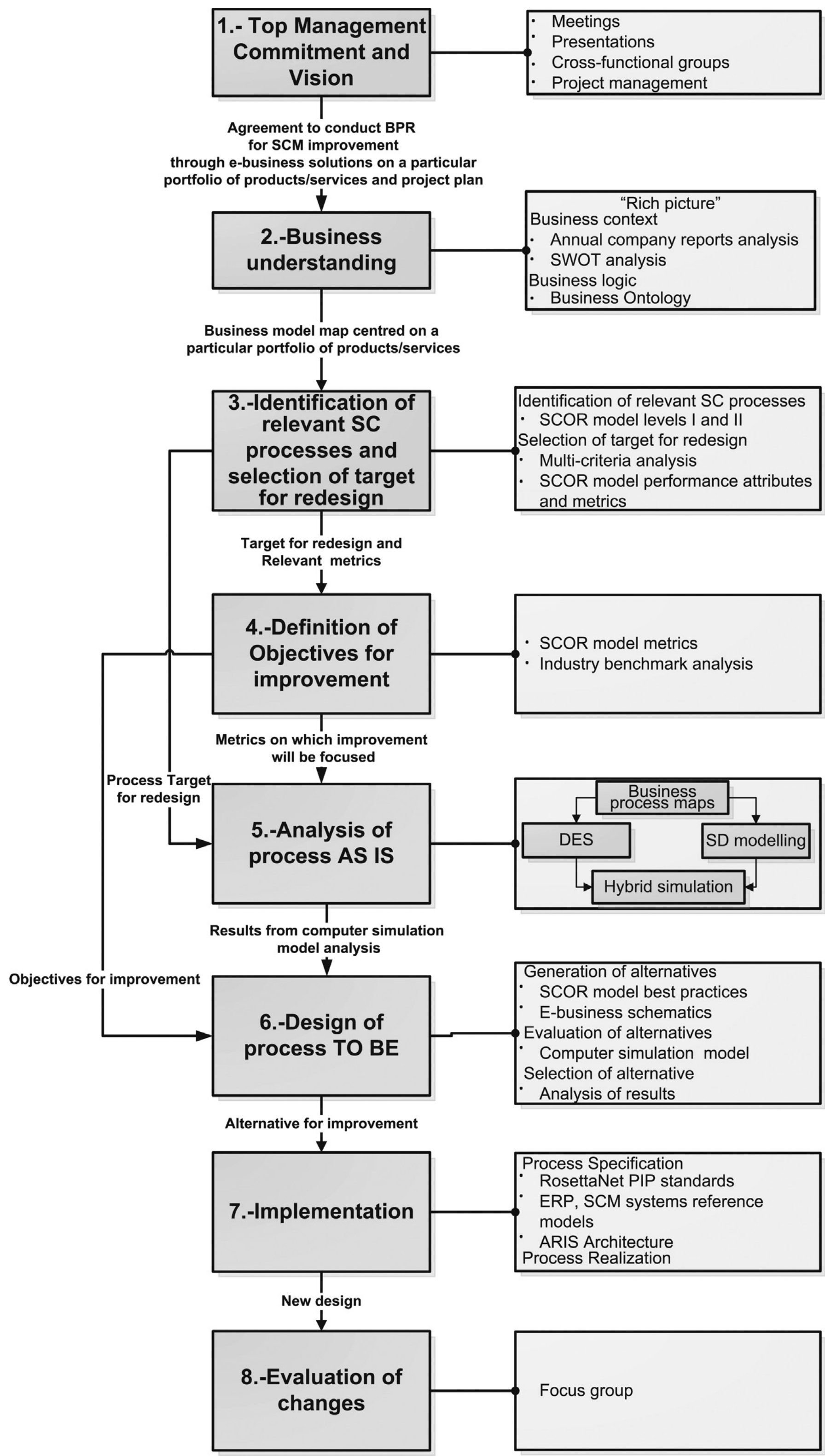

Fig. 13. Business process redesign methodology to support e-business adoption/use for supply chain improvement.

and arduous data gathering. Furthermore, DES evaluations are applied to specific values (Rabelo, Helal, Jones, & Hyeunk-Sik, 2005); thus, it cannot determine the region where the supply chain may stabilize. This is particularly important in supply chain systems with non-linear, time-delay and cause-effect relations (Pereira, 2009).

3.5.4. Hybrid system dynamic – discrete event computer simulation

An and Jeng (2005) suggest that DES and SD are complementary in the analysis of a business process; understanding the sequencing and synchronization of activities through a DES approach is not enough, SD can provide an insight on the hidden factors affecting

Table 3
Differences between the proposed BPR methodology and other methodologies.

Stages	Difference with other methodologies
1. Top management commitment and vision	Similar to other methodologies
2. Business understanding	Integration of the business model ontology into a BPR methodology to map the logic of a business with emphasis on understanding the current roles of SC activities and e-business in the creation of value.
3. Identification of relevant SC processes and selection of target for re-design	Use of a particular AHP structure which uses as criteria for evaluation SCOR model performance attributes and level 1 metrics for the selection of a target for re-design.
4. Definition of objectives for improvement	Use of SCOR model to define relevant metrics for objective definition
5. Analysis of process AS IS	Use of a combined DES and SD computer simulation modelling approach for the analysis of supply chain processes.
6. Design of process AS TO BE	Use of SCOR model to identify best practices in the use of e-business. Use of e-business schematics to represent alternatives for improvement.
7. Implementation	Integration and use of RosettaNet PIP standards, reference models and ARIS architecture in a BPR methodology for process specification.
8. Evaluation of changes	Similar to other methodologies

business performance. According to Jahangirian et al. (2010) hybrid simulation (the combination of SD and DES) is the third most used simulation approach within manufacturing and business as compared to DES (first most used) and SD (second most used). Hybrid simulation has often been conducted using a combination of the two approaches (Venkateswaran & Son, 2005).

For the BPR methodology proposed in this paper, a hybrid computer modelling simulation approach is adopted combined with business process mapping and SD modelling.

Fig. 9 shows the relevant methods and techniques for this stage and its main output.

3.6. *Stage 6 – design of process TO BE*

After achieving a good understanding of the process, what follows is the generation and evaluation of alternatives for process redesign based on the use of e-business technologies.

3.6.1. *Generation of alternatives*

From the analysis of the process AS IS, it should be possible to identify where problems or poor performance, as measured by the relevant metrics defined in stage 4, are located. To generate alternatives for improvement, Kirchmer (2004) suggests a comparison of the existing system with recommended best practices in SCOR model (level II and III). For the proposed methodology the emphasis will be in best practices on the use of e-business for SCI.

E-business schematics provide an additional aid in exploring options for change (Weill & Vitale, 2001). E-business model schematics are used to capture important elements, such as type of actors (e.g., supplier, customer), electronic links, and for depicting the major flows (money, items, and information) in the main transactions.

Thus, SCOR model provides ideas on improvement options. For a more detailed examination of these, e-business model schematics can be used to decompose a particular recommendation into its basic elements. This depiction provides a basis for discussion among decision makers/stakeholders, from which a set of alternatives for improvement is generated.

3.6.2. *Evaluation of alternatives*

Once different alternatives have been generated, it is necessary to evaluate them. The computer model created in Stage 5 to understand the process AS IS can be used/modified to evaluate the alternatives generated, as measured by the metrics defined in Stage 4. From these results it will be possible to select the alternative that offers the best performance.

Fig. 10 shows the relevant methods and techniques for this stage and its main output.

3.7. *Stage 7 – implementation of changes*

The next step is the specification of the new business process design for implementation. This phase is largely neglected or omitted in the methodologies reviewed (Tables 1 and 2); a few of them only mention it briefly in general terms. To tackle the implementation stage, Kirchmer (2004) proposes the use of SCOR model level III, RosettaNet partner interface processes (PIP), e-business solutions reference models, and for detailed process specification, architecture of integrated information systems (ARIS).

3.7.1. *Process specification*

RosettaNet is an industry organization that develops universal standards for the global supply chain; RosettaNet standards provide a common language for transactions and the foundation for integrating critical processes among partners (RosettaNet, 2012). The standards prescribe how to implement collaborative business processes between supply-chain trading partners using networked applications. These specifications include the business process definitions and technical elements for interoperability and communication.

E-business process specification can be complemented by ERP/SCM reference models (e.g., mySAP ERP). Finally the new process specification is constructed using the ARIS architecture (Kirchmer, 2004). ARIS is proposed as a framework to describe business processes. Through ARIS a process can be viewed from five points of view:

- Organization view: who takes part in the process, which companies, departments of people?
- Function view: what is done in this process?
- Data view: what information is produced or needed?
- Output view: which outputs/results/deliverables are produced?
- Control view: how do the four other views interact, and who works on which functions using which data and in which operational logic to produce which deliverables.

The most important attribute, relevant to the methodology proposed in this paper, is that ARIS offers a framework to completely describe information systems within business processes.

Fig. 11 shows the relevant methods and techniques for this stage and its main output.

3.8. *Stage 8 – evaluation of changes*

The final phase is to evaluate the performance of the real process after implementation so that a comparison can be made between performance before and after re-design in order to assess the impact. This could be done by assembling a focus group, composed of executives from the areas affected by the business re-design to collect and discuss the actual change in performance.

Fig. 12 shows the relevant methods and techniques for this stage and its main output.

4. Conclusions

Despite the potential benefits of e-business to supply chain management, the literature suggests a number of challenges preventing its successful adoption: in particular, the need to re-design business processes. A number of methodologies were found that address business process re-design, supply chain re-design, and e-business process design. However, none of these methodologies addressed, in particular, how to redesign business processes to support construction of supply chain integration. Through a literature review conducted in different domains, a methodology has been developed and proposed here to tackle this particular problem. For each one of the BPR methodology stages, relevant methods and techniques were reviewed from the literature, selected and combined. This is summarized in Fig. 13.

By adopting a number of methods and techniques relevant to supply chain re-design and e-business process design, this methodology is distinct from other BPR methodologies, providing specific solutions for adoption at each stage in supporting supply chain integration. Table 3 shows the main differences between this BPR methodology and the ones reviewed.

By nature any SC will include more than one company. Thus, it is desirable that the methodology can be adapted to any company in any sector to undertake a BPR effort to support construction of SCI. This is possible because the techniques and methods employed can be generally applied to any company or sector. The business model ontology (Osterwalder & Pigneur, 2004) can be used to describe any business logic map; the SCOR model (Supply Chain Council, 2012) can be used to map and describe any supply chain regardless of the type of company and/or sector; the AHP structure, used to select a target for re-design, can be adapted to any relevant supply chain processes to be considered; the SCOR model performance attributes and metrics cover all the possible metric combination to measure any supply chain performance; the modelling and simulation approaches used have been applied to different supply chain cases as reported in the literature; SCOR model recommended best practices are applicable and adaptable to any supply chain configuration; RosettaNet PIP standards, provide generic descriptions of collaboration processes among supply chain partners; reference models such as those from SAP describe specifications for different transactions, which can be adopted by any company; finally the ARIS framework can be used to describe any business process in combinations with any information system.

Although it will require further validation, the appropriateness of the methods and structure of this proposed BPR methodology suggests it can guide a business process re-design to support construction of supply chain integration.

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