Issues in Information Systems
Volume 23, Issue 1, pp. 1-12, 2022

DOI: https://doi.org/10.48009/1_iis_2022_101

A business process reengineering method

Delvin Grant, *DePaul University, dgrant2@depaul.edu*
Benjamin Yeo, *Seattle University, benjkyeo@gmail.com*

Abstract

We address the lack of well-defined BPR approaches by developing a practical ten-step UML reengineering method. It starts with identifying sources of customer dissatisfaction and ends with streamlining, surfacing assumptions, and reengineering the business. The study uses BR analysis techniques to analyze business processes strengths, weaknesses, and assumptions and it discusses the use of the value chain to identify business areas in need of redesign. It uses UML activity modeling to represent and analyze As-Is and To-Be business processes. Practitioners benefit from a well-defined BR approach that adds structure, discipline, reduces risks, thereby enhancing the likelihood of project success.

Keywords: business process reengineering, UML, object-oriented

Introduction

The term Business Process Reengineering (BPR) was introduced by Hammer (1990) and has garnered attention over the years. BPR radically redesigns business processes to achieve dramatic and sustained improvement in quality, cost, lead time, service, and innovation by focusing on the business process to cope with increasing competition and customer expectations (Gross et al., 2021). Radical redesign includes clean slate, out-of-the-box thinking, questioning assumptions, and abandoning outdated rules, making it difficult (cf. Aldowaisan & Gaafar, 1999). BPR is a popular change management approach for achieving comprehensive solutions (Goksoy et al., 2012) and streamlining business activities. When complemented by information technology (IT) (Hammer & Champy, 1993), it improves business effectiveness and efficiency. BPR analyzes a business process from beginning to end by challenging existing assumptions, taking a fresh look, and eliminating non-value-added activities. A business process is a logical set of activities that fulfil customers' requests. A common assumption that BPR only applied to processes was debunked by Grant (2002), who provided evidence that communication, technology, people, and structure have been reengineered in the past. This view widens the BPR scope in terms of what can be reengineered. To adhere to Grant's (2002) expanded BPR view, we use the term business reengineering (BR), henceforth.

BR has had limited success transforming and improving organization performance and quality (Ramirez, et al., 2010), yet 70 percent of projects fail due to the lack of suitable frameworks and methodologies (Bhaskar, 2018). Furthermore, BR is challenged by the lack of human and financial resources (Ranganathan & Dhaliwal, 2001). The primary objectives of BR models (Hussein 2008) are to communicate As-Is and To-Be operations (Muthu et al., 1999), enable a common representation, and disseminate information to stakeholders. Clear and simple communication is necessary to avoid ineffective communication that causes BR failure (Cao et al., 2001). Reengineering introduces technical and socio-technical change (Aldowaisan

& Gaafar, 1999) that causes chaos, disruption, and uncertainty that create resistance (Hussein et al., 2013). The resistance stems from learning new systems, technology, processes, behaviors and adapting to new organizational culture, all of which affect BR outcomes. The absence of a well-defined commonly accepted BR method increases organizations' vulnerability to execute, particularly when flawed traditional methods that fail to deliver BR objectives (Hussein et al., 2013), are used (Petrozzo & Stepper, 1994). To benefit from the expanded BR view (Grant, 2002), process redesign must expand BR targets beyond business processes.

This research addresses the lack of a well-defined approach for undertaking BR. We believe BR failures, risks, and resistance to change are reduced by using UML. The rest of the paper is organized as follows: First, we discuss BR analysis techniques; second, process and activity modelling; third, the use of the value chain as a vehicle for identifying BR targets; and fourth, we propose a ten-step UML method for undertaking BR. The paper ends with a summary and discussion.

BR analysis techniques

BR analysis techniques, such as Problem Analysis (PA), Root Cause Analysis (RCA), Activity Based Costing (ABC), Duration Analysis (DA), Benchmarking (BM), Technology Analysis (TA), Outcome Analysis (OA), and Business Process Analysis and Activity Elimination (BPA & AE) (Grant, 2016), are used to analyze existing systems to discern their strengths, weaknesses, business assumptions, effectiveness, efficiency, and the need for BR. Each technique has strengths and weaknesses that should be assessed before use as some are easier to use and more versatile than others, require special skills, and are appropriate for specific problems (Grant, 2016). BR problems require one or a hybrid of techniques. PA helps users understand existing systems, applications, and processes to describe problems and propose solutions (Dennis et al., 2021). Some solutions cause stakeholders to make invalid assumptions, but using RCA helps to tease out root causes by using Fishbone diagrams (Arnheiter & Greenland, 2008; Tan & Raghavan, 2007). DA analyzes each activity completion time, and total process duration (Dennis et al, 2021; Fooladi & Roberts, 2000). The information is used to benchmark internal or industry standards (Anand & Kodali, 2008), best practices (Kumar & Dhakar, 2006), and solve organizational problems (Henderson-Smart et al., 2006; Graham, 2005). OA aids the understanding of process outcomes that provide value or satisfaction to users (Seadle, 2003). It is challenging because the best outcomes are seldom obvious (Dennis et al., 2021), similar to believing that receiving an insurance check for a car accident, is the best outcome. TA identifies each technology, determines how it supports business objectives (Caldeira, 2010), compares it to a baseline, and suggests improvement when technology under performs. Improvements include replacing existing technologies to better support operations and company objectives. BPA & AE is used to discover and eliminate non-value-added activities (Hammer & Champy, 1993) to improve process performance through an analysis of a variety of process-related problems (Tsaih & Lin, 2006; Biazzo, 2000).

Some analysis techniques perform better than others, as suitability varies with BR project characteristics and organizational contexts. For example, processes in financial institutions differ from those in manufacturing because they are more information- and service- intensive (Shin & Jamella, 2002). Chase Bank collaborated with IBM to develop a phased BR approach to solve several organizational problems (Shin & Jamella, 2002). It is unclear what project characteristics and organizational contexts were best suited for the approach; nonetheless, it serves as a blueprint for reengineering banks. However, a specific technique may work better because it is familiar to team members, who possess the skills to use it, or its use is culturally embedded in the organizational (Grant, 2016). Organizational culture is multi-faceted as it includes method choices, and paradigm shifts. Companies may have policies prohibiting the use of third-party methods and tools, which influence the execution, implementation, and success of BR, as some methods are superior. Using agile methods that deemphasize analysis, in addition to process mapping, redesign, and analysis inexperience, increase the likelihood of project failure. BR creates lasting organizational change that alters people's behavior, culture, technology, and processes (Al-Mashari et al., 2001) after the project is completed. Hence, organizations need to be ready and willing to adapt (Bhaskar & Singh, 2014) new values, styles, measures, skills, jobs, technologies, organizational and communication structures (Bhasker & Singh, 2014). Lastly, culture makes it difficult to shatter existing paradigms governing company operations (Hussein et al. 2013).

Limitations of BR methods (Vakola & Rezgui, 2000; Reijers & Mansar, 2005; Adesola & Baines, 2005) such as inability to address resistance to change, change management, linear, static, and inflexible traditional methods (Hussein et al. 2013) and lack of structure (Muthu et al., 1999) can be overcome by meta-methodologies (Abdolvand et al., 2008) or consolidated methodologies (Muthu et al., 1999). Some methods are difficult to use, require special knowledge/skills, and inflexible (Grant, 2016). RCA and ABC are challenging, used sparingly, requiring analysts to be skilled in asking the right questions, and constructing diagrams (Grant, 2016). ABC should be not be applied when its core assumptions do not hold true (for example, costs can be assigned to discreet activities), rendering it inappropriate for continuous flow processes. Siha and Saad (2008) and Zellner (2011) studied BR approaches for business improvement, Hanafizadeh and Osouli (2011) discussed targeting business processes to achieve strategic organizational change, and Valiris and Glykas (2004) use BR approaches to represent IS development, behavioral aspects, and management accounting. BPA & AE and TA require a compatible problem situation; the former is appropriate for reengineering organization structure, technology, communication, or people and used exclusively for business process improvement, and the latter is geared toward improving technology. OA is seldom used because it is difficult to identify novel solutions, expensive, and may reduce short term profits (Grant, 2016). PA and BM are versatile and often used, particularly BM which is simple and effective when best practices exist (Grant, 2016).

Process and activity modeling

BR is relevant only to existing systems and process modeling is used to understand the As-Is business operations strengths, weaknesses, and assumptions. The two types of assumptions are: 1. Management assumptions, e.g., people need to be managed and told what to do, and 2. Process assumptions e.g., the process is complicated and cannot be completed by a single individual. Our research interest is to impact BR practice. Hence, methods of theoretical importance are outside the research scope. We focus on process/activity modeling techniques commonly used in practice and this reduces our choices to Data Flow Diagrams (DFDs), Integrated Definition for Functional Modelling (IDEF0), and Unified Modeling Language (UML).

DFDs, developed in 1970s to improve ad-hoc systems development (DeMarco, 1978), and used for over two decades, were part of structured design methods taught at universities, and quickly became the industry standard. IDEF developed in 1970s by the U.S. Airforce as a tool for recording and evaluating business processes, was less popular among universities. IDEF is a family of fifteen modeling languages (IDEF0 to IDEF14) covering functional and data modeling, simulation, analysis, system design, network design, and information gathering (Edraw, n.d.). IDEF0 is used mostly in manufacturing industries (Shen et al., 2004) to model and improve manufacturing processes and controls. IDEF0 has been used for BR (Aldowaisan & Gaafar, 1999) and DFDs, no longer popular, is replaced by UML activity diagrams. UML, the industry de-facto object-oriented development method, has been successfully applied to BR IT outsourcing and outperformed other methods (cf. Méndez at al., 2006). It reduces the semantic gap between data and programs by enabling use cases to be easily developed into system functions, and its programming-centric nature shortens the development life cycle (Shen et al., 2004).

Analysts' experience dictates the BR method of choice and some are skilled enough to tackle large complex business processes. UML requires familiarity with object-oriented programming, design, and development and may be perceived more challenging than DFDs and IDEF0. In addition, project conditions and assumptions play a role. For example, parallel methods assume projects can be broken into smaller ones, requiring each analyst to model specific VC components. This is only feasible when project assumptions and conditions allow, and project teams are adequately staffed. Even large teams can be under-staffed from the lack of expertise. Font Type & Size: Times New Roman 11, justified text

Business process

Davenport (1993) defines a business process as a set of logically related tasks to deliver business outcomes, products, and services, involves people and technology, and has a beginning and end. Business processes often span departments and functions, can be started, stopped, paused, or continued. They can be redesigned to improve effectiveness and efficiency (Eshlaghy, et al., 2009, Hammer & Champy, 1993). Business processes become bureaucratic over time, as employees focus on department activities, at the expense of redesigning cross functional processes. Naming business processes is important for redesigning them, because names reflect a weltanschauung that may constrain the reengineering effort. Examples, trucking companies may miss opportunities to expand into transportation, as embedded weltanschauung constraints go unnoticed, but are overcome by an expanded view; and process names that are not transparent, such as order to payment process or simply order fulfilment (Hammer & Champy, 1993). The latter best defines the process scope, making it easier to identify weaknesses. Well-defined processes are structured, easily measured, make task execution transparent, and use inputs to produce outputs. Non-value-added activities are identified by being unused, missing inputs and outputs, identical inputs and outputs, and should be redesigned or eliminated. Processes are made visible during reengineering by process mapping or modeling.

Proposed UML approach

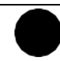
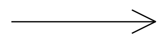
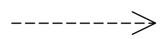
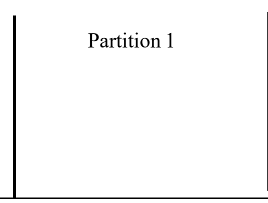
This section discusses UML activity modeling to create As-Is and To-Be models, the role of the value chain, the need for swimlanes, and the proposed ten-step BR method.

UML activity modeling

UML was developed by Booch, Jacobsen, and Rumbaugh in the 1990s as a natural progression from object-oriented programming languages of the 1980s (Dennis et al., 2021). Like all languages, UML has syntax and semantics; syntax are the rules governing the use, symbols, and diagram construction, and semantics are the meaning and interpretation. Poor syntax causes confusion and negatively affects interpretation. UML authors had their own object-oriented methods prior to their unification that led to the creation of the Unified Process method, similar to the Waterfall method. UML has activity, use case, class, sequence, behavioral, and other diagrams, and views the solution space as comprising of objects. By definition, objects consist of attributes (data), and programming code (methods). Attributes store data, and methods enable objects to exhibit behaviors (such as add, update, and find). Object-orientation is different from the traditional view where programs and data are intertwined, and changes to one cause changes to the other, increasing project duration and maintenance. Objects are stored in classes that make up class diagrams and represent a database. They communicate and collaborate with themselves and users to accomplish tasks by sending messages; they inherit attributes and behaviors from other objects, through the class hierarchy. A superclass-subclass structure enables inheritance of subclasses from their superclass, simplifying reuse, object creation, thus reducing development time. Object inheritance and reuse is available in programming environments. Object concepts such as encapsulation, information hiding, polymorphism, and dynamic binding are irrelevant and ignored.

The activity diagram is the only one relevant to this discussion, because it focuses exclusively on process activities. Its primary objective is to aid the analysis and understanding of the As-Is system to discern weaknesses, strengths, and assumptions by examining existing documents, interviewing domain experts, and stakeholders. The relevant BR symbols shown in Table 1.

Table 1: UML Activity Symbols (Dennis et al., 2021)

Name	Symbol	Meaning
Activity		Represents an activity
Initial state		Represents start of the business process
Final state		Represents end of the business process
Control flow		Represents logical process flow from start to finish
Object flow		Represents the direction of an object. If it points to an activity, it's an input, if it points away it's an output
Object		Objects are inputs or outputs such as data, documents, and others
Swimlane		Represents partitions with in the business process

The role of the Value Chain method (Porter & Miller, 1985)

The value chain (VC) (Figure 1) is the set of activities that add value to internal or external customers (Porter, 1985) and has primary and support activities. Inbound logistics are goods, materials, and inventory from suppliers. Operations are activities, tasks, or processes that transform data and raw materials into outputs. Outbound logistics are the storage and transportation of products or materials to end-consumers or middlemen. Marketing and sales market, communicate, deliver, and sell products and services. Service is activities to maintain products and services. Firm infrastructure include accounting, legal, finance, public relations, management, and quality assurance. Technology development pertains to hardware, software, networking, procedures, manufacturing processes, and technical knowledge used to transform raw materials to final products. Human resource management involves recruiting, hiring, terminating, training, managing, compensating, and developing human capital. Procurement is the sourcing, negotiating, acquiring, storing, safe guarding, and managing goods and services from suppliers and vendors.

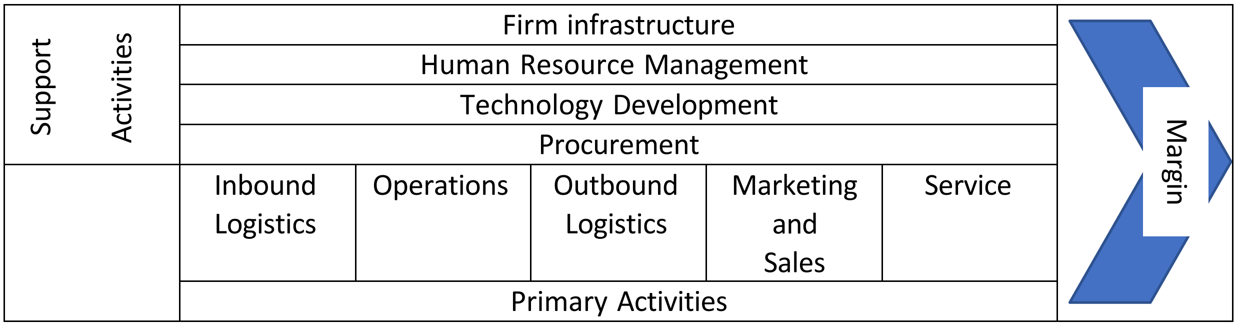


Figure 1: Value Chain

The VC is a vehicle for identifying business activities in UML and may be subject to redesign. Each primary or support activity is treated as a single activity diagram to reduce modeling complexity. An alternative is to treat a specific primary or support activity as a target of reengineering and more targets increase project scope. There are two approaches: 1. Reengineer the entire organization, or 2. Reengineer a part of it. This decision is best made by modeling and analyzing each primary or support activity, starting with the most problematic based on customer and process dissatisfaction data. The higher the dissatisfaction, the bigger the reengineering payoff. BR analysis techniques should be supported by data to confirm the problem.

Use of swimlanes

Swimlanes are a UML concept to partition a business process into a set of associated activities and may provide several benefits. First, as an example, inbound and outbound logistics can be represented by two swimlanes. Second, it delineates the inbound and outbound logistics activities. Third, it identifies information flows between both sets of activities. Fourth, it delineates how activities in a swimlane relate to another and the larger business context. Identifying problematic activities are beneficial but understanding the larger business context, exposes limitations and opportunities for process redesign. Primary and support VC activities can be represented by swimlanes that comprise sub-processes of primary or support activities, such as inflow of goods, materials, or inventory. Guarding against frivolous use of swimlanes is important, and should be used sparingly, when warranted. The decision to use them is influenced by analysts' expertise and experience, process complexity, usefulness in identifying BR targets, and choice of development method.

Proposed method steps

Figure 2 illustrates the 10 steps of our proposed method in the form of a UML Activity Diagram. Step 1 identifies sources of internal and external customer dissatisfaction with the business process. Sources include customers complaints, social media reviews, and user sources of customer feedback. Comparing sources of dissatisfaction, based on the number and severity of complaints, potential business impact, helps to identify Step 2, the reengineering targets. Employee skills, knowledge, competence, modeling techniques and tools, and organization culture influence the choice of BR analysis method, Step 3. Step 4 involves the use of dissatisfaction data to determine how broken the process is and if it is a good candidate for reengineering. Timing, cost, competition, and risk influence this decision. If the reengineering targets are good candidates, the next step is risk assessment – cost, time, disruption, buy-in, management's appetite for change – and the need to proceed, which is Step 5. Step 6 determines if swimlanes are needed. Step 7 develops As-Is activity diagrams to represent current business processes by interviewing domain experts to understand strengths, weaknesses, and business assumptions. Domain experts are managers, users, employees, internal, and external customers. Step 8 identifies non-value-added activities that encumber and complicate the smooth, efficient, and effective business operations. Step 9 utilizes this knowledge to streamline, improve, surface assumptions, and eliminate non-value-added activities, to reengineer the business process. Identifying business process assumptions cannot be overemphasized and is a BR critical success factor. Inappropriate business assumptions impede growth, innovation, reinforce the status quo, and cause BR projects to fail. Recognizing the need for expanded business perspectives, widens the solution space, and enables new ways of doing business. Narrow definitions and views constrain the solution space and reengineering effort. Recognizing a solution space is not confined to trucking, provides opportunities to adopt transportation solutions that increase the chances of success. Recognizing transportation innovations may be applied to trucking, is part of the success formula. After understanding the As-Is, the To-Be model is developed and represents the redesigned business operations.

Figure 2: UML- BR Method shown as Activity Diagram

Summary and conclusion

BR has its share of failures because it is a risky undertaking that lacks a well-defined approach. We address this by proposing a ten-step UML-BR method. An important step is to determine if the target process is appropriate for reengineering, using one or more BR analysis techniques. Some BR problems require one analysis technique and others require a hybrid of two or more. A well-defined approach reduces risks by introducing structure and discipline to the BR process. The Waterfall and traditional life cycle methods fail to deliver BR objectives (Hussein et al., 2013) and are significantly flawed (Petrozzo & Stepper, 1994). Consequently, we propose an UML BR method that is superior to traditional development methods, for several reasons. First, the proposed method addresses the lack of a well-defined approach for undertaking BR, since different companies go about it differently, resulting in dissimilar BR outcomes and failures. Second, objects comprise data and methods, can be reused, thereby reducing development time. Third, activity diagrams represent business processes and map directly to use case diagrams which represent automated functions or features of the To-Be BR process. Fourth, objects are easily developed using object-oriented programming languages that benefit from object reuse and object programming libraries. Finally, objects reduce the semantic gap between real world and digital objects.

A common limitation of this type of research is the challenge of demonstrating the method, so we depend on practitioners to apply it. Scholars have very limited access to companies, due to their unwillingness to trust strangers with their BR projects. This is a common challenge with development methods research and Hammer's BPR method is an example. This limitation should not detract from its research contributions, which include addressing the lack of well-defined BR methods that contribute to BR failures. The second contribution is the proposed ten-step BR approach that adds structure and discipline for undertaking BR. Third, the method improves practice by using UML commonly taught at universities and used in industry, thereby increasing the likelihood of being used. Fourth, object-oriented development is a natural fit with object-oriented programming languages and systems, thus reducing the semantic gap between data, programs, real-world and digital objects. Lastly, the transition from process modeling to system development is seamless, when using objects.

This research benefits practitioners and scholars. First, practitioners benefit from a well-defined method that improves BR structure and discipline. Second, companies and practitioners reduce BR risks and increase project success, which can be illusive as 70 percent of BR projects fail (Bhaskar, 2018). Third, scholars benefit by developing and offering training and certifications on process analysis, BR techniques, development methods, and object-oriented programming languages. Traditional developers unfamiliar with business analysis techniques, object-oriented analysis, design, modeling, development, and implementation stand to benefit the most from training. Future research can leverage the method to address how it may be developed as an information systems (IS) theory that can be categorized as: (1) Analyzing, (2) Explaining, (3) Predicting, (4) Explaining and Predicting, and (5) Design and Action (Gregor, 2006). When the proposed method is applied in practice and tweaked appropriately, it can be developed as an Analyzing theory that provides taxonomies, without explicit explanations of relationships or predictions. Further empirical evidence from practice will enrich the theory toward the Predicting category, thereby broadening its application. Future research can explore receptivity towards BR and our proposed method across different company characteristics. BR projects are complex, involve multiple stakeholders, and include business, manufacturing, financial, and healthcare. While larger companies have the required human and financial resources to undertake these projects (Ranganathan & Dhaliwal, 2001), smaller companies have simpler operations that make BR easier to complete. Nonetheless, most BR case studies in the literature involve large companies (cf. Grant 2002, 2016), the smallest is a private hospital in Saudi Arabia (Aldakhil, et al, 2016).

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