FORMAL MEASUREMENT OF THE BUSINESS GOALS: A QUINTESSENCE REPRESENTATION OF THE PROCESS IMPROVEMENT LIFECYCLE

by Antonio Vera, Universidad Nacional de Colombia | Carlos Mario Zapata, Universidad Nacional de Colombia
avera@unal.edu.co
cmzapata@unal.edu.co
Full paper
Experiential Track

ABSTRACT

Global organizations redesign their processes for enhancing quality in terms of products/services, schedule, and budget. Programs involving business process improvement (BPI) are developed in order to accomplish such redesign. However, project managers hardly transform business processes, and they fail to achieve organizational/departmental goals. Such a fact results in ineffective/inefficient processes delivering poor value to the organization. Lack of practice standardization and theoretical framework lead some projects to failure when executing process improvement programs. In this paper we represent the practice formal measurement of the business goals on top of the Quintessence kernel. In addition, we conduct a case study in a French multinational automotive organization. The practice includes graphical/reusable theoretical constructs in a formal language to be used in multiple disciplines. The solution serves as a guide involving activities/tasks for measuring improvement in the radical/incremental BPI lifecycle.

INTRODUCTION

Modern corporations perform processes for analyzing, supporting, automating, and enhancing their operations (Abou-Zeid *et al.,* 1995; Kim and Ramkaran, 2004; Andersen, 2007; Van der Aalst *et al.*, 2016). Some core objectives in the industry are linked to improving processes for reducing errors, rework, customer unsatisfaction, and tasks/activities time/cost (Bhatt and Troutt, 2005; Vanwersch *et al.*, 2015). Harmon and Wolf (2014) performed a survey of over 300 large companies; 46% of such companies spent at least $500,000 and 26% spent at least $1,000,000 on improvement programs.

Business process improvement (BPI) is oriented to remodeling business programs for efficiently and effectively assembling processes (Bhatt & Troutt, 2005; Vanwersch *et al.*, 2015). Harrington (1991) explains BPI as a "systematic methodology developed to help an organization make significant advances in the way its business processes operate." According to Bhatt and Troutt (2005) corporations can generate accurate improvement in timeliness for maintaining competitivity and succeeding in customer demands by implementing BPI.

Previous authors report between 60–90 percent of unsuccessful initiatives in terms of improving programs (Tetzeli, 1992; Cottrell, 1992; Caldwell, 1994; Macintosh and MacLean, 1999; Karim *et al.*, 2007; Abdolvand *et al.*, 2008; McLean *et al.*, 2017). According to Griesberger *et al.* (2011), improvement programs have insufficient guidelines and structured/ standardized procedures. Zellner (2011) points out the lack of methodological structure for best BPI practices in improvement initiatives. In addition, the lack of heuristic evidence about best BPI practices executed in real industrial environments avoids the possibility to evaluate the viability of theoretical solutions.

In this paper we propose a representation of the practice *formal measurement of the business goals* based on theoretical constructs for supporting unambiguous/unified definitions of the BPI lifecycle. The solution is developed according to the model for a unified definition of practices (Baron, 2019) and the project management Quintessence kernel (Henao, 2018). The literature review performed for constructing the practice involves BPI solutions since 1995. The representation includes the BPI best practice, two activities, ten tasks, and two work products. The solution involves the evolution of the sub-alpha (abstract level progress health attribute) *business goals*. In addition, we develop a case study about the Application Maintenance Service (AMS) department of a French multinational automotive corporation. We implement the solution in such a corporation by compiling the representation on a business intelligence (BI) system.

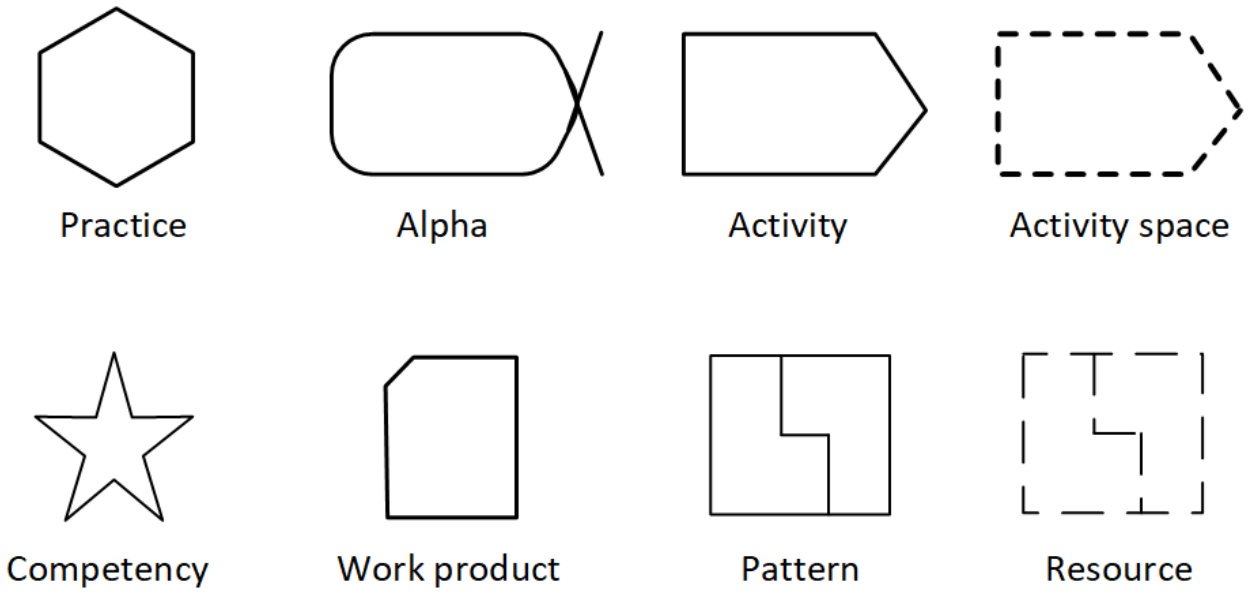
The practice is a formal, graphical, reusable, and adaptable guide of the BPI lifecycle for measuring the business goals of an organization/department/process. The practice is achieved when its completion criteria are accomplished—progress in the output work products and sub-alpha states. Finally, the case study is conducted for verifying/validating the solution in actual industrial environments.

This paper is organized as follows. First, we introduce the theoretical framework. Then, we present the literature review. The *formal measurement of the business goals* practice is proposed after that. Finally, we discuss the case study and the conclusions.

THEORETICAL FRAMEWORK

The project management Quintessence kernel (Henao, 2018) involves universal elements for describing a project endeavor usable in multidiscipline environments. The Quintessence kernel is based on the Essence kernel (OMG, 2018) inheriting its properties. Therefore, the Quintessence kernel can be used as a way to develop reusable practices for achieving goals. Quintessence is scalable, extensible, and easy to use, allowing practitioners for describing the essentials of their existing and future methods/practices so they can be compared, evaluated, tailored, used, adapted, simulated, and measured (OMG, 2018). Several Essence elements/symbols—practice, alpha, activity, activity space, competency, work product, pattern, and resource—are used on Quintessence for constructing practices as illustrated in Exhibit 1.

EXHIBIT 1
PRACTICE, ALPHA, ACTIVITY, ACTIVITY SPACE, COMPETENCY,
WORK PRODUCT, PATTERN, AND RESOURCE SYMBOLS (HENAO; 2018; OMG, 2018)

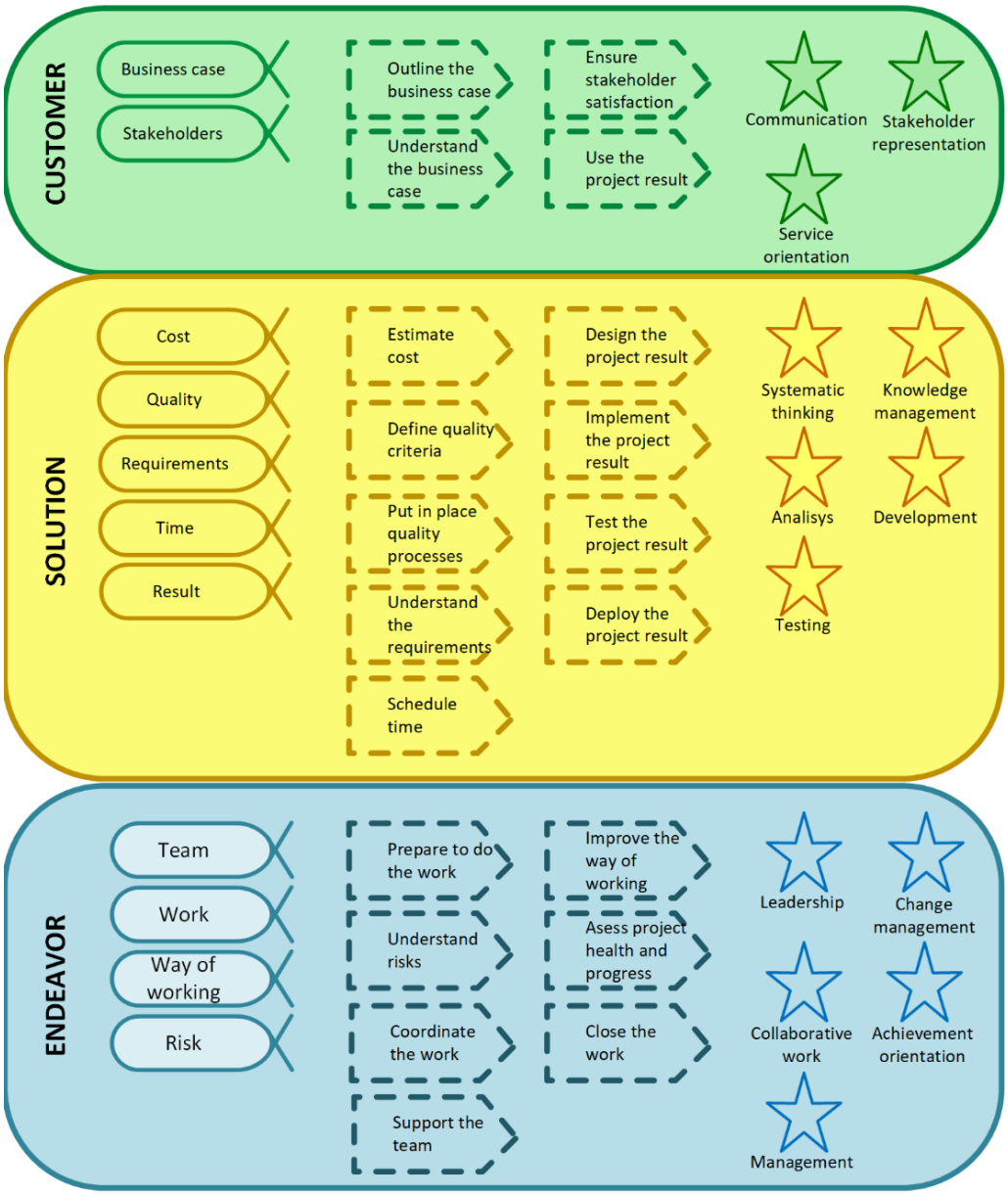


Quintessence includes elements such as areas of concern, alphas, activity spaces, and competencies for representing practices in order to manage projects. The three colored areas of concern—customer in green, solution in yellow, and endeavor in blue—are based on the Essence kernel (OMG, 2018). Alphas are defined in each area of concern as universal elements common to all project disciplines. Alphas represent universal dimensions practitioners should work within project endeavors. Alphas are used for describing things practitioners should manage in order to control the environment where projects run. They allow for tracking health and progress of projects via alpha states. Practitioners should complete a checklist to successfully achieve alpha states. Activity spaces are complements of the alphas and represent things practitioners should do when running a project. Finally, Competencies are capabilities/skills practitioners should have when performing a task. The competencies in Quintessence are based on Durango and Zapata (2019). Areas of concern, alphas, activity spaces, and competencies are shown in Exhibit 2.

Baron (2019) proposes a model for unequivocally and unambiguously defining well-formed and well-named practices based on elements from Essence (OMG, 2018). The model involves entry/completion criteria for establishing conditions when starting/completing a practice/activity. Each alpha/sub-alpha can partially/totally achieve a state. The resulting output work products act as evidence for accomplishing a singular state. The elements included in a practice name involve the following sequence: adjective, nominalized verb, and noun. In Exhibit 3 we illustrate a representation of the model components. (See Exhibit 3)

The coherence, consistency, and sufficiency rules are used for describing relationships between the practice and its activities in order to define a well-formed and well-named practice (see Exhibit 4).

EXHIBIT 2
QUINTESSENCE KERNEL (HENAO; 2018; DURANGO AND ZAPATA, 2019)



LITERATURE REVIEW

Hammer (1990) points out business process re-engineering is analogous to radical improvement and Harrington (1991) concludes business process improvement is equivalent to incremental improvement. Consequently, both expressions are considered for enhancing business processes and they are part of an improvement redesign (Valiris and Glykas, 1999). Therefore, the literature review includes studies from both sources. The systematic literature review (SLR) method is based on the theory-building process developed by Kitchenham *et al.* (2009). Three questions are established for selecting BPI studies:

- RQ1. How much effort in enhancing business process has been made since 1995?
- RQ2. What kind of solutions are being addressed?
- RQ3. What are the limitations of current research?
  - RQ3.1. How many studies include graphical representations?
  - RQ3.2. How many studies are constructed in a formal language?
  - RQ3.3. How many studies are used in multiple disciplines?

EXHIBIT 3
COMPONENTS OF THE UNIFIED DEFINITION OF PRACTICES MODEL
(THE AUTHORS BASED ON BARON 2019)

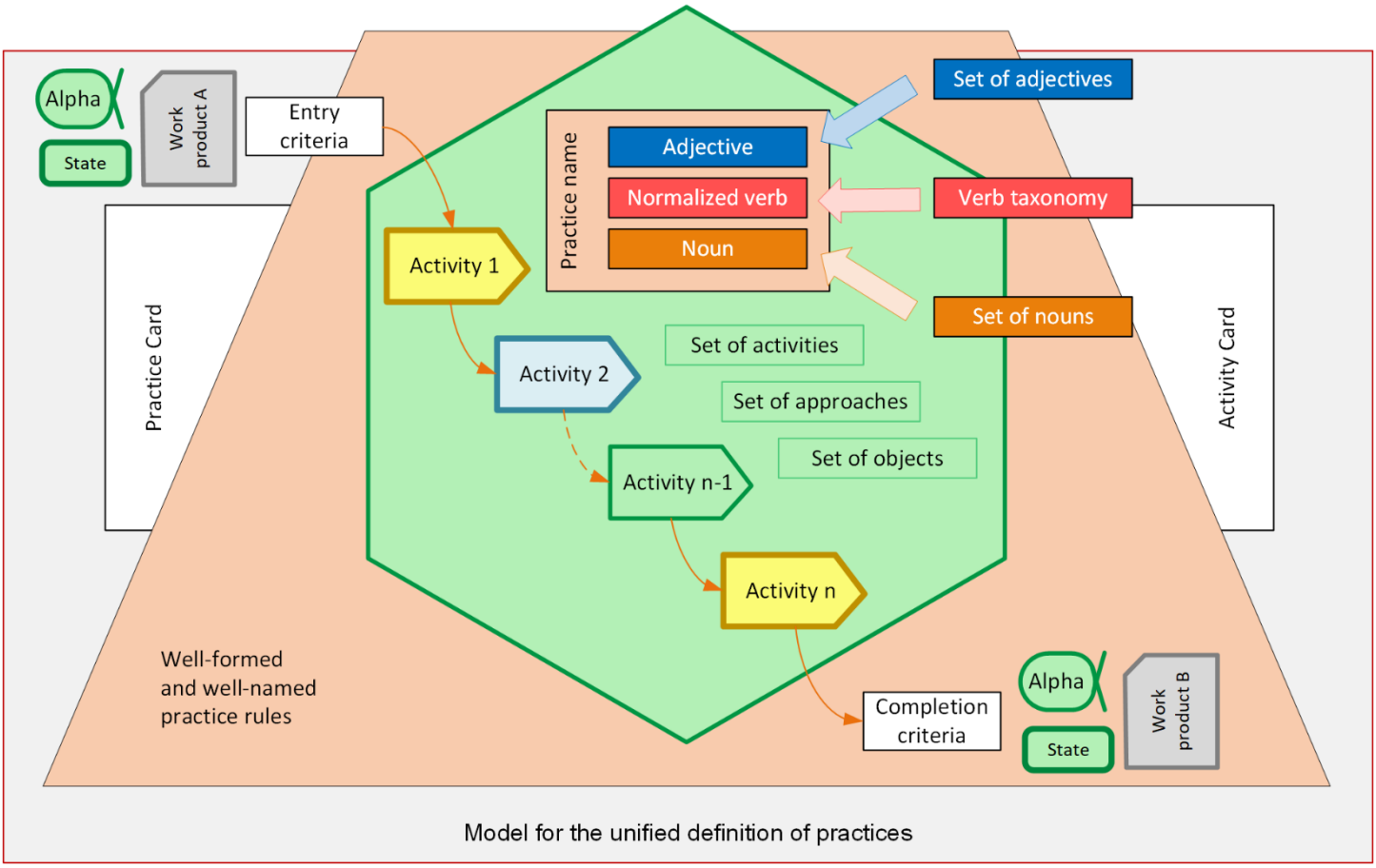


EXHIBIT 4
DEFINITION OF THE RULES OF A PRACTICE WELL-FORMED
(TRANSLATED FROM BARÓN, 2019)

Rule	Definition
Coherence	A set of activities included in a practice is coherent whether the completion criteria of each activity contribute to the progress of the noun towards the practice completion criteria
	R1. There is at least one activity which entry criteria are equal to the practice entry criteria
	R2. There is at least one activity which completion criteria are equal to the practice completion criteria
Consistency	**R3.** For each activity in the set of practice activities, the entry criteria are equal to the completion criteria of at least one another activity or the practice entry criteria
	R4. For each activity in the set of practice activities, the completion criteria are equal to the entry criteria of at least one another activity or the practice completion criteria
	Rules R3 and R4 are valid excluding activities which comply with rules R1 and R2
Sufficiency	A set of activities included in a practice is sufficient whether the completion criteria of each activity allow for the progress of the noun until achieving the practice completion criteria

EXHIBIT 13
WORK PRODUCT: QUALITY METRICS
(SOURCE: THE AUTHORS)

Id	Author(s)	Year	Type	QA1	QA2	QA3	QA4	Score	Graphical representation	Formal representation	Multiple disciplines	Best Practices	Reusable	Heuristic scenarios	Bpi lifecycle
S1	Kock and McQueen	1995	Framework	Y	Y	N	Y	3	X				X	X	
S2	Strandhagen and Skarlo	1995	Method	Y	Y	P	P	3	X			X	X	X	
S3	Lewis	1995	Method	Y	Y	Y	P	3.5			X	X	X		
S4	Mcadam and Mcintyre	1997	Method	P	P	N	P	1.5			X			X	
S5	Motwani *et al.*	1998	Framework	Y	Y	Y	P	3.5	X		X	X	X		X
S6	Povey	1998	Method	Y	Y	Y	N	3				X			X
S7	Braganza *et al.*	1998	Framework	P	Y	N	Y	2.5	X		X		X	X	
S8	Chang and Powell	1998	Framework	Y	Y	Y	P	3.5	X			X	X		
S9	Macintosh and MacLean	1999	Framework	Y	Y	Y	P	3.5				X	X	X	
S10	Katzenstein and Lerch.	2000	Framework	Y	Y	Y	Y	4	X		X		X	X	
S11	Kock and Murphy	2001	Method	Y	Y	Y	P	3.5	X		X	X	X	X	X
S12	Lee and Chuah.	2001	Framework	Y	Y	N	Y	3	X		X	X	X	X	X
S13	Jung	2002	Method	Y	Y	P	N	2.5	X				X		
S14	Marir and Mansar	2004	Framework	Y	Y	P	Y	3.5	X		X	X	X	X	
S15	Adesola and Baines	2005	Method	Y	Y	Y	P	3.5	X		X	X	X	X	X
S16	Adesola *et al.*	2006	Framework	Y	Y	Y	N	3	X		X	X	X		X
S17	Khan *et al.*	2007	Framework	Y	Y	Y	N	3	X			X	X		X
S18	Dalmaris *et al.*	2007	Framework	Y	Y	Y	P	3.5	X	X			X	X	
S19	Hammer	2007	Framework	P	Y	N	Y	2.5			X	X	X	X	
S20	Siha and Saad	2008	Framework	Y	Y	Y	N	3				X	X		X
S21	Damij *et al.*	2008	Method	Y	Y	N	Y	3				X	X		X
S22	Koliadis and Ghose	2009	Framework	P	Y	P	Y	3		X	X		X		
S23	Zhao *et al.*	2009	Framework	Y	Y	P	P	3	X		X		X	X	
S24	Pourshahid *et al.*	2009	Framework	Y	Y	Y	Y	4	X	X	X		X	X	
S25	Buavaraporn	2010	Method	Y	Y	Y	Y	4	X				X	X	X
S26	Delgado *et al.*	2010	Framework	Y	Y	P	N	2.5	X	X	X		X		
S27	Lodhi *et al.*	2012	Framework	Y	Y	P	P	3	X		X		X		
S28	Ma *et al.*	2012	Method	Y	Y	Y	Y	4	X		X		X	X	X
S29	Maaz and Kumar	2012	Method	P	Y	N	N	1.5			X	X	X		
S30	Lee	2014	Method	P	Y	N	P	2	X	X	X		X		
S31	Sohail *et al.*	2014	Method	Y	Y	P	P	3	X		X		X		
S32	Poonun *et al.*	2015	Framework	Y	Y	N	Y	3	X		X	X	X	X	X
S33	Sohail and Iskandar	2015	Method	Y	Y	Y	N	3	X		X		X		
S34	Mashhadi *et al.*	2015	Method	Y	Y	Y	N	3	X		X	X	X		X
S35	Sallos *et al.*	2016	Framework	Y	Y	Y	P	3.5	X		X	X	X		X
S36	Mohapatra and Choudhury	2016	Framework	Y	Y	Y	Y	4			X		X	X	
S37	Hassan and Ahmed	2016	Method	P	Y	P	Y	3	X	X	X		X	X	
S38	Martins and Zacarias	2017	Method	Y	Y	P	N	2.5	X				X		
S39	Zarei *et al.*	2017	Method	Y	Y	Y	Y	4	X				X		X
S40	Torkhani *et al.*	2018	Framework	Y	Y	Y	N	3	X	X	X		X		
S41	Tiamaz *et al.*	2018	Method	P	Y	Y	P	3			X	X	X	X	X
S42	Anwer and Siddiqui—based on Pradabwong *et al.* (2017)	2019	Framework	Y	Y	Y	Y	4	X		X	X	X		
S43	Casebolt *et al.*—based on Crawley *et al.* (2015) and Cameron (2014)	2019	Method	Y	Y	N	Y	3	X	X	X		X	X	X
S44	Abubakre *et al.*	2020	Method	Y	Y	Y	Y	4	X		X	X	X	X	X
S45	Chatterjee *et al.*	2020	Framework	Y	Y	Y	Y	4	X			X	X		X
S46	Fakorede	2020	Framework	Y	Y	Y	Y	4	X		X		X	X	
S47	Johannsen	2020	Method	Y	Y	P	P	3	X	X	X		X		X
S48	Arifin *et al.*	2021	Method	Y	Y	N	P	2.5				X	X		
S49	Fauziah *et al.*	2021	Framework	Y	P	P	P	2.5	X				X	X	
S50	Nkomo and Marnewick	2021	Framework	Y	Y	Y	Y	4	X			X	X		X

- RQ3.4. How many studies involve the identification of best practices?
- RQ3.5. How many studies include elements to be reusable?
- RQ3.6. How many studies are tested in heuristical scenarios?
- RQ3.7. How many studies include BPI lifecycles?

The studies were obtained from conference proceeding papers, journal papers, book chapters, M.Sc. Theses, and Ph.D. Theses. The repositories included Google Scholar, ScienceDirect, BUCM, ACM, IEEE, Citeseer, Rebiun, Redalyc, Scopus, and Worldcat databases. The strings for searching previous studies involved business process redesign/improvement/re-engineering frameworks/methods and business process best practices. The inclusion criteria comprise: (i) peer-reviewed research published from January 1st, 1995; (ii) studies addressing the definition/implementation of a framework/method for improving/re-engineering business process; (iii) discipline-dependent/multidiscipline studies; and (iv) graphically/ theoretically represented studies. The exclusion criteria comprise: (i) papers concerning the same framework/method; (ii) systematic literature review studies; and (iii) case studies and proposals lacking the definition of the framework/method implemented. The quality questions and score categories for assessing primary studies are evaluated in three categories—yes, partly, no—and include the following questions: (i) are the framework/method scope and objectives defined?; (ii) is the framework/method implementation described and appropriate?; (iii) is the literature described covering the most relevant studies regarding previous experiences?; and (iv) were the results of the study adequately presented?

We select 50 studies resulting from the search strings by applying the inclusion and exclusion criteria. In Exhibit 5 we address RQ1, RQ2, and RQ3 by identifying the publishing date, type of solution, and limitations.

BEST PRACTICE: FORMAL MEASUREMENT OF THE BUSINESS GOALS

In this paper we propose some theoretical constructs for representing the practice *formal measurement of the business goals*. The practice is based on the model for a unified definition of practices proposed by Baron (2019) and the project management Quintessence kernel developed by Henao (2018). The solution includes unambiguous definitions covering universal multidiscipline elements. The practice acts as a guide for practitioners when measuring organizational goals. The completion criterion in the practice and activities is complete when the sub-alpha states and the output work products are accomplished. The practice is meant to bridge the gap between industry and academia. The solution includes activities/tasks identified from previous literature in BPI. The practice is part of a larger solution—Business Process Improvement to the ten power (BPI[10])—which is meant to include ten practices for improving business processes in the radical/incremental improvement lifecycle. The lifecycle used for business process re-engineering—radical improvement—is developed by Motwani *et al.* (1998) and the business process improvement—incremental improvement—is defined by Adesola and Baines (2005) and Sallos *et al.* (2016). Both solutions are located at the top score in terms of quality assessment by addressing most of the BPI representation issues (see Exhibit 5). In Exhibit 6 we show the incremental/radical improvement lifecycles and the stage in which the practice *formal measurement of the business goals* is located. Such a practice can be implemented when reaching the stage Redesign-the-process/Programming in the BPI lifecycle depending on whether they are in an incremental or a radical

EXHIBIT 6
PRACTICE LOCATION IN THE INCREMENTAL AND RADICAL IMPROVEMENT LIFECYCLE
(SOURCE: THE AUTHORS)

Incremental Improvement BPI step (Sallos *et al.*, 2016; Adesola and Baines, 2005)	Radical Improvement BPR phase (Motwani *et al.*, 1998)	BPI[10] Practice
Understand the business needs	Understanding	
Understand the process	Initiating	
Model and analyze the process		
Redesign the process	Programming	Structural definition of the business process improvement (Vera and Zapata 2022b)
Redesign the process	Programming	Formal measurement of the business goals
Implement new process	Transforming and implementing	Systematic development of the business process improvement (Vera and Zapata 2022a)
Assess the improvement methodology and review the process	Evaluating	

improvement. Finally, practitioners can use a standardized formal representation which can be adaptable, reusable, multidiscipline, and graphical.

The practice metadata (see Exhibit 7) includes the practice name, the incremental/radical improvement phase, the Quintessence area of concern and activity space, the activity names, and the references used for the tasks.

EXHIBIT 7
PRACTICE METADATA: FORMAL MEASUREMENT OF THE BUSINESS GOALS
(SOURCE: THE AUTHORS)

Practice name		
Adjective	**Nominalized verb**	**Noun**
formal	measurement	business goals
Incremental improvement	**Radical improvement**	
Redesign the process	Programming	
Area of concern	**Activity space**	
Customer	Ensure stakeholders satisfaction	
Activity name		**Source**
Establish the key performance indicators		Adesola & Baines, 2005 Barone, 2011 Horkoff, 2012 Sallos *et al.*, 2016 Nkomo & Marnewick, 2021
Define the indicator performance levels		Horkoff, 2012

The practice card (see Exhibit 8) includes the Quintessence practice symbol—which has the color of the *customer* area of concern—, the practice name, the BPI[10] logo, the practice description, and the entry and completion criteria including the sub-alpha state and the work products.

EXHIBIT 8
PRACTICE CARD: FORMAL MEASUREMENT OF THE BUSINESS GOALS
(SOURCE: THE AUTHORS)

	Name: formal measurement of the business goals	**BPI[10]**
Description: practice for defining the quality metrics		
Entry criteria		
(Business process improvement: Approved)		
Work products associated with the entry criteria 1. Business goal diagram 2. Enterprise environmental factors 3. Organizational process assets 4. Team register 5. Business process improvement design		
Completion criteria		
(Business goals: Defined)		
Work products associated with the completion criteria 1. Quality metrics		

The activity cards (see Exhibit 9 and Exhibit 10) include the Quintessence activity symbol—which has the color of the *customer* area of concern—, the practice name, the BPI[10] logo, the activity name, the approach, the activity space, the activity description, the entry and completion criteria including the sub-alpha state and the work products, and the set of tasks to be performed.

EXHIBIT 9
ACTIVITY CARD: ESTABLISH THE KEY PERFORMANCE INDICATORS
(SOURCE: THE AUTHORS)

	Practice: formal measurement of the business goals	**BPI[10]**
	Activity [1]: establish the key performance indicators	
	Approach: formal	
	Activity space: ensure stakeholders satisfaction	
Description: activity for determining the key performance indicators in terms of measures types, main elements, and measurement relationships		
Entry criteria		
(Business process improvement: Approved)		
Work products associated with the entry criteria		
1. Business goal diagram 2. Enterprise environmental factors 3. Organizational process assets 4. Team register 5. Business process improvement design		
Tasks		
1. Determine a key performance indicator (KPI) for evaluating each goal/subgoal and measuring each process 2. Select whether the KPIs should be quantitative/qualitative 3. Identify the particular features/qualities of the business process elements which act as subject of each KPI 4. Establish whether the KPIs should be either bidirectional, positive, or negative according to the intentions of balancing, maximizing, or minimizing their targets 5. Develop the KPI formulas 6. Specify whether the KPI assignation mechanism will be either extracted at run-time from backend data sources, supplied by users, or calculated by a metric expression 7. Consider the KPI value of an object should depend on the KPI values of objects one level lower in the hierarchy		
Completion criteria		
(Business goals: Measured)		
Work products associated with the completion criteria		
1. Key performance indicators		

The Quintessence graphical representation from two points of view—alphas and activity spaces—is presented in Exhibit 11.

A relational matrix between the incremental/radical improvement lifecycle phases and the Quintessence kernel is proposed in Exhibit 12.

CASE STUDY

In this paper we performed a real-life case study in the AMS department of the Colombian subsidiary of a French multinational automotive corporation. The company has 115 years in the industry with presence in 128 countries and is dedicated to manufacturing and selling vehicles. The organization is the fourth largest automaker in the world with more than 120,000 employees worldwide. The Colombian subsidiary has a dealership network present in 44 cities with 133 workshops.

The Colombian AMS department has been unable to succeed in attending help desk tickets according to the Service Level Agreement (SLA) established by the company due to its reduced number of members. Therefore, a business case proposal was presented including the following improvement: (i) blockages mitigation in local environments of complex processes; (ii) automation of regular/corporate sales reports involving fleets, marked, surveys, and flow failure; (iii) automation/standardization of the support process, Azure DevOps™, management processes, and agile practices; (iv) definition of functionalities and roles of the AMS members; and (v) evaluation/visualization of indicators by using business intelligence. We implemented the practice *formal measurement of the business goals* for identifying/establishing key

EXHIBIT 10
ACTIVITY CARD: DEFINE THE INDICATOR PERFORMANCE LEVELS
(SOURCE: THE AUTHORS)

	Practice: formal measurement of the business goals	BPI[10]
	Activity [2]: define the indicator performance levels	
	Approach: formal	
	Activity space: ensure stakeholders satisfaction	
Description: activity for structuring the performance levels related to the key performance indicators		
Entry criteria		
(Business goals: Measured)		
Work products associated with the entry criteria		
1. Business goal diagram 2. Key performance indicators		
Tasks		
1. Identify performance regions by setting the KPIs structure against a set of three parameters: target, threshold, and worst value 2. Define the interpolation method for constructing the performance scale 3. Define the performance level formula for each KPI		
Completion criteria		
(Business goals: Defined)		
Work products associated with the completion criteria		
1. Quality metrics		

performance indicators (KPI) and setting performance regions of success/failure. We completed the work product *quality metrics* as shown in Exhibit. 13 and evolve the sub-alpha *business goals* to de *defined* state.

The case study was developed during the first semester of 2022 and it started with the identification of the input work products defined in the practice entry criteria. The case study involved the country manager, the information technology manager, the AMS supervisor, five software developers, and three functional analysts. The practice *formal measurement of the business goals* was compiled on a BI system for guiding practitioners when developing KPIs and performance regions (see Exhibit. 14).

The case study involves an interview with the AMS supervisor. The interview includes three questions (Q) about the perspective evidenced in the BPI practice implementation:

- Q1. Do you consider the practice *formal measurement of the business goals* implemented in your organization as a best practice for performing BPI?
- Q2. Do you consider the adoption of the Quintessence representation for best practices as a viable standard in your company when implementing the practice *formal measurement of the business goals*?
- Q3. What are your conclusions about the result of the case study developed?

The interview questions were answered by the AMS supervisor as follows:

- Q1. "Yes, the combination of different metrics of the BPI practice—performance region, KPI, etc.—make it easier to capture results and ease decision-making in the organization."
- Q2. "I can conclude the adoption is a viable/adaptable improvement to any process within an organization after analyzing the results obtained by applying the formal measurement of the goals. It is important to follow up and validate that objectives point out to strategy for a better result."
- Q3. "The practice execution assists for later improvement—time, quality, and cost—translated into productivity and excellent service, always aiming at strategy and continuous improvement of processes."

EXHIBIT 11
QUINTESSENCE GRAPHICAL REPRESENTATION OF THE PRACTICE:
FORMAL MEASUREMENT OF THE BUSINESS GOALS
(SOURCE: THE AUTHORS)

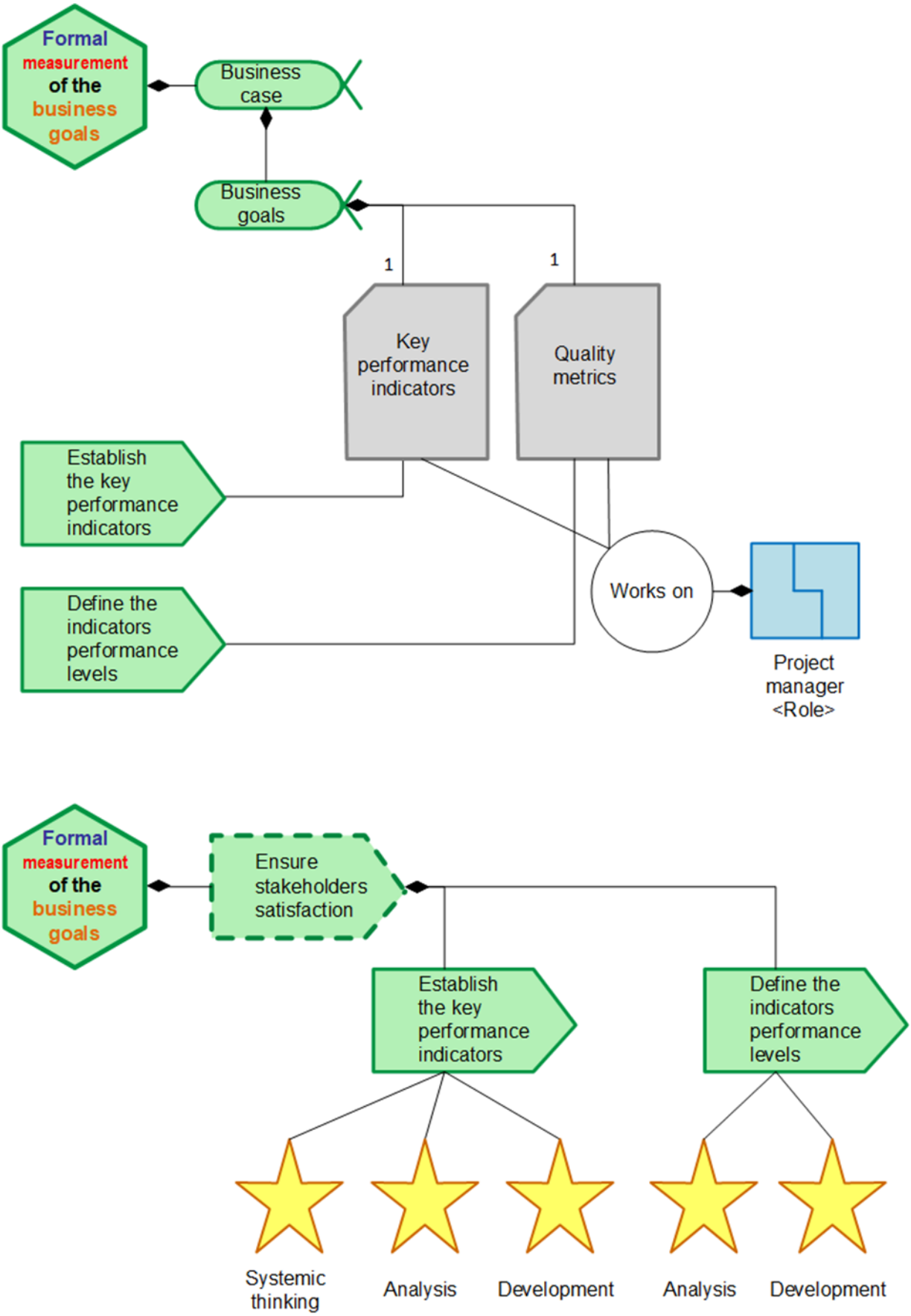


EXHIBIT 12
RELATIONAL MATRIX
(SOURCE: THE AUTHORS)

Incremental Improvement	Radical Improvement	Area of concern	Activity space	BPI Practice	BPI Activity	BPI Activity criteria		Alpha Business Case
BPI steps Sallos *et al.* (2016); Adesola and Baines (2005)	BPR phase Motwani *et al.* (1998)							Sub-alpha Business goals
						Entry criteria	Completion criteria	State
Redesign the process	Programming	Customer	Ensure stakeholders satisfaction	Formal measurement of the business goals	Establish the key performance indicators	Business process improvement: approved	Business goals: measured	Measured
					Define the indicator performance levels	Business goals: measured	Business goals: defined	Defined

EXHIBIT 13
WORK PRODUCT: QUALITY METRICS
(SOURCE: THE AUTHORS)

Process	KPI	Actual value	Expected region	Operation	Priority	Time	Cost	Quality
Increase dealer internet speed by more than 5 Mb	Mb/sec	5Mb	20-100Mb	Level 1	Medium	x		
Macro execution on the server	Execution time/day	30 min	0-5 min	Level 1	High	x		
Previous day sale report automation	Execution time/day	20 min	0-5 min	Level 2	High	x		
Unique national traffic registry report automation	Execution time/day	25 min	0-5 min	Level 2	High	x		
Fleet report automation	Execution time/month	60 min	0-5 min	Level 2	High	x		
Corporate sale report—support pending—automation	Execution time/month	60 min	0-5 min	Level 2	Medium	x		
Corporate sale report—support marked—automation	Execution time/month	60 min	0-5 min	Level 2	Medium	x		
Survey report automation	Execution time/day	90 min	0-5 min	Level 2	High	x		
VIN by VIN report automation	Execution time/month	100 min	0-5 min	Level 2	Low	x		
Client flow failure report automation	Execution time/day	45 min	0-5 min	Level 2	Low	x		
Support process automation	Execution time/month	180 min	0-5 min	Level 2	Medium	x		
Change of Data Steward processes to level 1	Number of people with DataSteward™ knowledge	1	3-4	Level 1	High			x
Establish project management in Azure DevOps™	Number of projects managed in formal platforms	0	3-6	Architecture	Low			x
Definition of functionalities and scope of profiles	Number of functionalities formally registered	0	10-15	Projects	High			x
Automation of the method and standardization of management practices	Number of lifecycles formally established	0	1-3	Projects	High			x
Definition of roles in each project	Number of roles formally documented	0	5-10	Projects	High			x
Training in Quintessence for functional analysts	Number of BPI practices learned	0	10	Projects	Medium			x
Implementation of agility practices	Number of agile practices learned	3	5	All	Medium			x
Evaluation of the service desk system	Number of systems for managing AMS	0	1	All	Medium	x		x
Visualization of KPIs in BI systems	Number of BI dashboards	0	4-10	All	Medium			x
Continuous training for the team	Number of training sessions	0	5-10	All	High			x

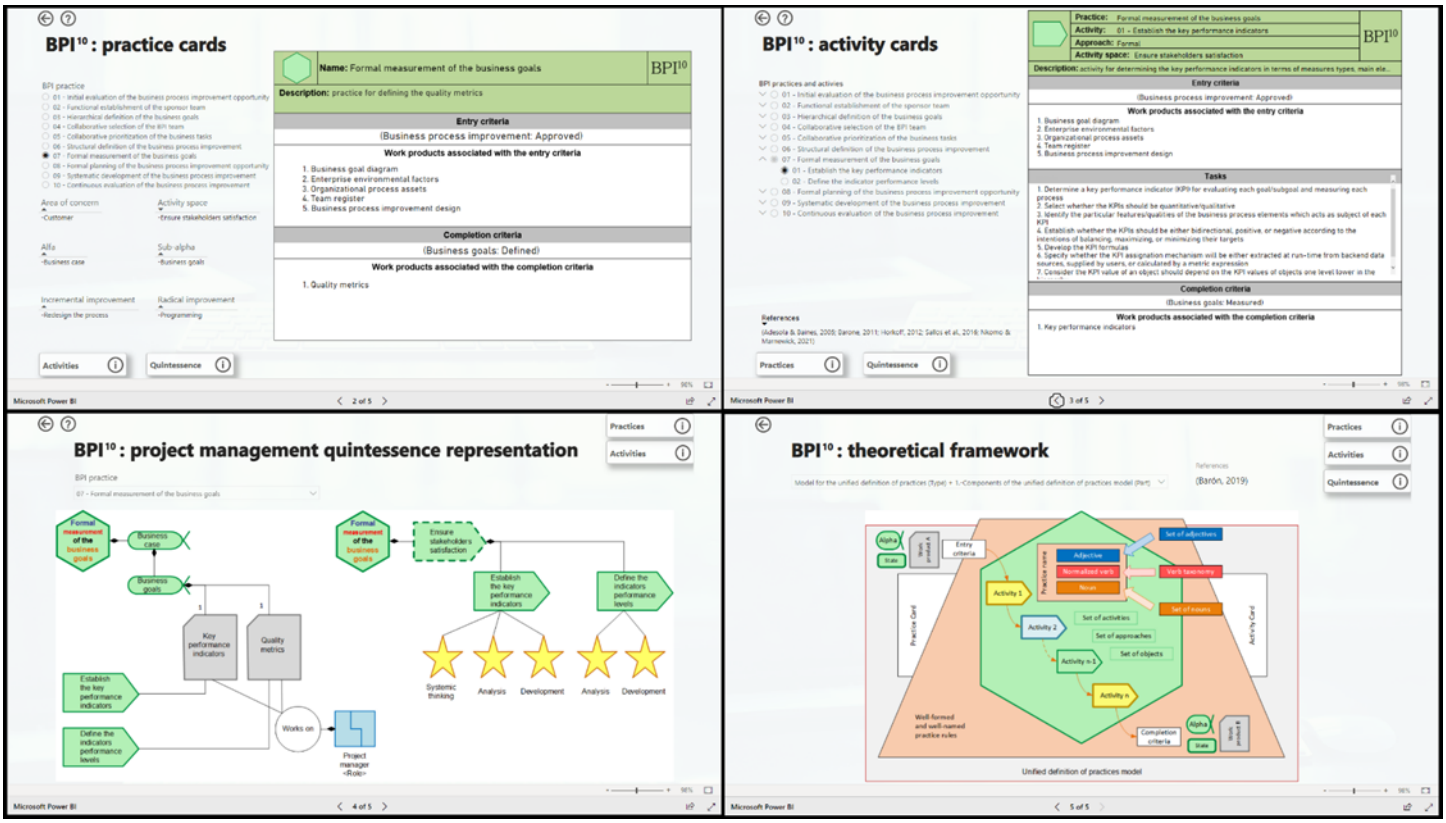
CONCLUSIONS

In this paper we proposed a representation of the practice *formal measurement of the business goals* based on the model for the unified definition of practices and the project management Quintessence kernel. The representation involved a practice for measuring an organization/department/process according to defined goals. A literature review involving BPI frameworks/methods was performed for identifying best activities/tasks. In addition, we developed a case study in a French automotive multinational corporation guided by a BI system.

The benefits involving the practice *formal measurement of the business goals* are presented as follows:

- Best practice in the improvement lifecycle: a systematic literature review of BPI studies has been conducted.
- Multidisciplinary kernel: the Quintessence supports multidisciplinary projects.

EXHIBIT 14
SCREENSHOTS OF THE BPI REPRESENTATION COMPILED ON THE BI SYSTEM
(SOURCE: THE AUTHORS)



- Formal language: the Quintessence kernel is codified as a holistic formal language composed of structural patterns.
- Card/graphical representation: the practice is represented with cards and schemas.
- Adaptable/reusable: complying with the entry criteria is the unique condition for implementing the practice
- Bridge the gap between industry and academia: the Quintessence kernel includes elements for empirical application in industry.

Future work should involve BPI representations based on the Quintessence about different stages in the improvement lifecycle. Besides, the evaluation of sub-alpha evolution states in the BPI lifecycle should be tested. Finally, new case studies should be conducted in corporations with different sizes and types.

REFERENCES

Abdolvand, N., Albadvi, A., & Ferdowsi, Z. (2008). "Assessing readiness for business process reengineering," Business Process Management Journal, Vol. 14, No. 4, pp. 497–511.

Abou-Zeid, A., Russell, J. S., Hanna, A. S., & Park, S. C. (1995). "Data flow model for communications between project participants in a highway bridge project," Canadian Journal of Civil Engineering, Vol. 22, No 6, pp. 1224–1234.

Abubakre, M., Fayoumi, A., & Eleburuike, I. (2020), "Implementing process improvement initiative: the role of visualisation and standardisation methods," Business Process Management Journal, Vol. 27, No. 3, pp. 965–986.

Adesola, S. and Baines, T. (2005), "Developing and evaluating a methodology for business process improvement," Business Process Management Journal, Vol. 11, No. 1, pp. 37–46.

Adesola, S., Baines, T., and Darlow, N. (2006), "MIPIM: Framework for Business Process Improvement," paper presented at the National Manufacturing Conference, London, available at: http://www.abepro.org.br/biblioteca/enegep2000_i0282.pdf (accessed 28 December 2021).

Andersen, B. (2007). Business Process Improvement Toolbox Second Edition. Meinholz, M. & O'Mara, P. (eds.), American Society for Quality, Quality Press, Milwaukee.

Anwer, S. & Siddiqui, D. A. (2019), "Business Process Management Organizational Performance and Competitiveness: The Mediatory Role of Supply Chain Collaboration," Social Science Research Network Electronic Journal (SSRN), available at: https://www.researchgate.net/publication/338612651_Business_Process_Management_Organizational_Performance_and_Competitiveness_The_Mediatory_Role_of_Supply_Chain_Collaboration (accessed 28 December 2022).

Arifin, M., Wiyono, W., & Salma, S. (2021), "Business Process Improvement of SME OM Brekele Chips for fulfillment CPPB-IRT criteria and Halal certification using BPI method," eProceedings of Engineering, Vol.8, No.5, pp. 6851–6861.

Barón, A. (2019). Modelo para la Definición Unificada de la Práctica como Constructo Teórico en Ingeniería de Software (Ph.D. Thesis), Universidad Nacional de Colombia, Colombia.

Barone, D., Jiang, L., Amyot, D., & Mylopoulos, J. (2011). "Reasoning with Key Performance Indicators," Lecture Notes in Business Information Processing, vol. 92, pp. 82–96.

Bhatt, G. D. & Troutt, M. D. (2005). "Examining the relationship between business process improvement initiatives, information systems integration and customer focus: an empirical study," Business Process Management Journal, vol. 11, no. 5, pp. 532–558.

Braganza, A., Price, J., Bytheway, A., and Weiss, O. (1998), "Business Process Redesign in Context: An Empirically Derived Management Framework," Knowledge and Process Management, Vol. 5, No 2, pp. 99–109.

Buavaraporn, N. (2010), Business process improvement methodology adoption for improving service quality: case studies of financial institutions in Thailand (Ph.D. Thesis), University of Nottingham, United Kingdom.

Caldwell, B. (1994). "Missteps, miscues," Information Week, 20 June, pp. 50–60.

Cameron B. (2014), "Functional architecture and operations," MIT Course ESD.411: Foundations of System Design and Management I. Lecture, Massachusetts Institute of Technology, available at: http://systemarchitect.mit.edu/courses.php (accessed 28 December 2022).

Casebolt, J. M., Jbara, A., & Dori, D. (2019), "Business process improvement using Object□Process Methodology," Systems Engineering, Vol. 23, pp. 36–48.

Chang, L. and Powell, P. (1998), "Towards a framework for business process re-engineering in small and medium-sized enterprises," Info Systems Journal, Vol. 8, No. 3, pp. 199–215.

Chatterjee, S., Ghosh, S. K., & Chaudhuri, R. (2020), "Knowledge management in improving business process: an interpretative framework for successful implementation of AI–CRM–KM system in organizations," Business Process Management Journal, Vol. 26, No. 6, pp. 1261–1281.

Cottrell, J. (1992). "Favourite recipe," The TQM Magazine, February, pp. 17–20.

Crawley, E., Cameron, B., & Selva, D. (2015), Systems Architecture: Strategy and Product Development for Complex Systems. New Jersey: Prentice Hall.

Dalmaris, P., Tsui, E., Hall, B., and Smith, B. (2007), "A framework for the improvement of knowledge-intensive business processes," Business Process Management Journal, Vol. 13, No. 2, pp. 279–305.

Damij, N., Damij, T., Grad, J., and Jelenc, F. (2008), "A methodology for business process improvement and IS development," Information and Software Technology, Vol. 50, No. 11, pp. 1127–1141.

Delgado, A., Ruiz, F., García-Rodríguez de Guzmán, I., and Piattini M. (2010), "MINERVA: Model drIveN and sErvice oRiented Framework for the Continuous Business Process improVement and relAted Tools," in Dan A., Gittler F., Toumani F. (Ed.s), ICSOC 2009. Lecture Notes in Computer Science, Service-Oriented Computing. ICSOC/ServiceWave 2009 Workshops, ServiceWave 2009, Springer, Berlin, Vol. 6275, pp. 456–466.

Durango, C. & Zapata, C. (2015). "Una representación basada en Semat y RUP para el Método de Desarrollo SIG del Instituto Geográfico Agustín Codazzi," Ing. USBMed, Vol. 6, No. 1, pp. 24–37.

Fakorede, O. (2020), SNACH a new framework to support business process improvement (Ph.D. Thesis), Bournemouth University, England..

Fauziah, S., Supriyanti, D., and Sulistiawati, W. (2021), "Influence of Business Process Maturity Model as a Business Architecture Planning Proposal," ADI Journal on Recent Innovation, Vol 2, No. 2, pp. 253-264.

Griesberger, P., Leist, S., & Zellner, G. (2011). "Analysis of techniques for business process improvement," In European Conference on Information Systems (ECIS) 2011, Helsinki.

Hammer, M. (1990). "Reengineering work: don't automate-obliterate," Harvard Business Review, vol. 68, no. 4, pp. 104–11.

Hammer, M. (2007), "The process audit," Harvard Business Review, Harvard Business School Publishing Corporation, Vol. 85, No. 4, pp. 111-9, 122–3.

Harrington, H.J. (1991). "Business Process Improvement—The Breakthrough Strategy for Total Quality," Productivity and Competiveness, McGraw-Hill, New York.

Harmon, P. and Wolf, C. (2014), "The state of the BPM market", BPTrends, available at: https://www.bptrends.com/bpt/wp-content/uploads/BPTrends-State-of-BPM-Survey-Report.pdf (accessed 28 December 2022).

Hassan, S. and Ahmed, A. (2016), "Toward Structured Method for Business Process Re-engineering," International Journal of Computer Science and Telecommunications, Vol. 7, No. 3, pp. 10–17.

Henao, A. (2018). Towards a theory for defining a project management multidisciplinary kernel: An approach based on Abstract Level Progress Health Attributes (M.Sc. Thesis), Universidad Nacional de Colombia, Colombia.

Horkoff, J., Borgida, A., Mylopoulos, J., Barone, D., Jiang, L., Yu, E, & Amyot, D. (2012). "Making Data Meaningful: The Business Intelligence Model and Its Formal Semantics in Description Logics," In On the Move to Meaningful Internet Systems: OTM 2012: Confederated International Conferences: CoopIS, DOA-SVI, and ODBASE 2012, Rome, pp. 700–717.

Johannsen, F. (2020), "Towards Tool-Supported Situational Roadmap Development for Business Process Improvement," In 15th International Conference on Wirtschaftsinformatik, Potsdam, available at: https://doi.org/10.30844/wi_2020_i5-johannsen (accessed 28 December 2022).

Jung, D. (2002), "A business process redesign method within an ERP Framework," The Journal of Korean Institute of CALS/EC, Vol. 7, No. 1, pp. 87–106.

Karim, J., Somers, T. M., & Bhattacherjee, A. (2007). "The impact of ERP implementation on business process outcomes: A factor-based study," Journal of Management Information Systems, Vol. 24, No. 1, pp. 101–134.

Katzenstein, G. and Lerch, F. (2000), "Beneath the Surface of Organizational Processes: A Social Representation Framework for Business Process Redesign," ACM Transactions on Information Systems, Vol. 18, No. 4, pp. 383–422.

Khan, Z., Bali, R., and Wickramasinghe, N, (2007), "Developing a BPI framework and PAM for SMEs," Industrial Management & Data Systems, Vol. 107, No. 3, pp. 345–360.

Kim, H. & Ramkaran, R. (2004). "Best Practices in e-Business Process Management: Extending a Re-engineering Framework," Business Process anagement Journal, Vol. 10, No. 1, pp. 27–43

Kitchenham, B., Brereton O., & Budgen, D. (2009). "Systematic literature reviews in software engineering—A systematic literature review," Information and Software, Vol. 51, No 1, pp. 7–15.

Nkomo, A. & Marnewick, C. (2021), "Improving the success rate of business process re-engineering projects: A business process re-engineering framework," South African Journal of Information Management, Vol. 23, No. 1, pp. 1–11.

Kock, N. F. and McQueen, R. J. (1995), "Integrating groupware technology into a business process improvement framework," Information Technology and People, Vol. 8, No. 4, pp. 19–34.

Kock, N. and Murphy, F. (2001), "Redesigning Acquisition Processes: A New Methodology Based on the Flow of Knowledge and Information," Defense Acquisition University Press, Fort Belvoir, VA.

Koliadis, G. and Ghose, A. (2009), "A Conceptual Framework for Business Process Redesign. Enterprise, Business-Process and Information Systems Modeling," in Halpin, T., Krogstie, J., Nurcan, S., Proper, E., Schmidt, R., Soffer, P., and Ukor, R. (Ed.s), Lecture Notes in Business Information Processing, 10th International Workshop, BPMDS 2009 and 14th International Conference, EMMSAD 2009, Amsterdam, pp. 14–26.

Kitchenham, B., Brereton O., and Budgen, D. (2009), "Systematic literature reviews in software engineering–A systematic literature review," Information and Software, Vol. 51, No 1, pp. 7–15.

Lee, K.T. and Chuah, K.B. (2001), "A SUPER methodology for business process improvement - An industrial case study in Hong Kong/China," International Journal of Operations & Production Management, Vol. 21, No. 5/6, pp. 687–706.

Lee, H. (2014), "A Holistic Workflow Modeling Method for Business Process Redesign," World Academy of Science, Engineering and Technology International Journal of Industrial and Systems Engineering, Vol. 8, No. 11, pp. 3675–3678.

Lewis E. (1995), "The Process ANalysis Network Method for Business Process Re-engineering," Proceedings of the 28th Annual Hawaii International Conference on System Sciences, Wailea, pp. 398–405.

Lodhi, A., Köppen, V., and Saake, G. (2012), "Business Process Improvement Framework and Representational Support," Proceedings of the Third International Conference on Intelligent Human Computer Interaction (IHCI 2011), Prague, pp. 155–167.

Ma, J. Y., Kim, B. W., Seo, Y. H., Leem, C. S., and Moon, H. (2012), "An Integrated Method for Business Process Improvement," International Journal of Innovative Computing, Information and Control ICIC International, Vol. 8, No. 7(B), pp. 5237–5250.

Maaz, M. and Kumar, M. (2012), "Structured Method for Business Process Improvement," 2012 Third International Conference on Services in Emerging Markets, Mysore, pp. 183–188.

Macintosh, R. and MacLean, D. (1999), "Conditioned emergence: A dissipative structures approach to transformation," Strategic Management Journal, Vol. 20, No. 4, pp. 29–316.

Marir, F., and Mansar, S. (2004), "An adapted framework and case-based reasoning for business process redesign," ITRE 2004, 2nd International Conference Information Technology: Research and Education, London, pp. 179–183.

Martins, P. V. and Zacarias, M. (2017), "An Agile Business Process Improvement Methodology," Procedia Computer Science, Vol. 121, pp. 129–136.

Mashhadi, F., Azar, A., and Shahin, A. (2015), "Proposing a method for implementing business process re-engineering," International Journal Services and Operations Management, Vol. 20, No. 4, pp. 398–417.

Mcadam, R. and Mcintyre, S. (1997), "A business process improvement methodology which incorporates learning organization concepts," Total Quality Management, Vol. 8, No. 2/3, pp. 221–225.

McLean, R., Anthony, J., & Dahlgaard, J. (2017). "Failure of Continuous Improvement initiatives in manufacturing environments: a systematic review of the evidence," Total Quality Management and Business Excellence, vol. 28, no. 3/4, pp. 219–237.

Mohapatra, S. and Choudhury, A. (2016), "Readiness Framework for Business Process Re-engineering," Strategic Change, Vol. 25, No. 5, pp. 509–524.

Motwani, J., Kumar, A., Youssef M., and Jiang, J. (1998), "Business process reengineering: a theoretical framework and an integrated model," International Journal of Operations & Production Management, Vol. 18, No. 9/10, pp. 964–77.

Pradabwong, J., Braziotis, C., Tannock, J. D. T., & Pawar, K. S. (2017), "Business process management and supply chain collaboration: effects on performance and competitiveness," Supply Chain Management: An International Journal, Vol. 22, No. 2, pp. 107–121.

Poonun, S., Thammaboosadee, S., and Kiattisin, S. (2015), "Function-Oriented Business Process Improvement Framework for Customer Relationship Management Section in Large Scale Organization," International Journal of Knowledge Engineering, Vol. 1, No. 3, pp. 219–222.

Pourshahid, A., Mussbacher, G., Amyot, D., and Weiss, M. (2009), "An Aspect-Oriented Framework for Business Process Improvement," E-Technologies: Innovation in an Open World, 4th International Conference, MCETECH 2009, Ottawa, pp 290–305.

Povey, B. (1998), "The development of a best practice business process improvement methodology," Benchmarking for Quality Management and Technology, Vol. 5, No. 1, pp. 27–44.

Sallos, M., Yoruk, E., and Garcia-Perez, A. (2016), "A business process improvement framework for knowledge-intensive entrepreneurial ventures," Journal of Technology Transfer, Vol. 42, No. 2, pp. 354–373.

Siha, S. and Saad, G. (2008), "Business process improvement: empirical assessment and extensions," Business Process Management Journal, Vol. 14, No. 6, pp. 778–802.

Sohail, A., Dominic, P., and Shahzad, K. (2014), "A Process Warehouse based Resource Suitability Evaluation Method for Business Process Improvement," IEEE 2014 International Conference on Computer, Communication, and Control Technology, Langkawi, pp. 75–79.

Sohail, A. and Iskandar, B. (2015), "Business Process Improvement: A Process Warehouse based Resource Management Method," 2015 International Symposium on Technology Management and Emerging Technologies (ISTMET), Langkawi, pp. 291–296.

Strandhagen, J. and Skarlo, T. (1995), "A Manufacturing Business Process Reengineering Method: Design and Redesign of a Production Control Model," J. Browne et al. (Ed.s), Re-Engineering the Enterprise, Springer Science+Business Media Dordrecht, pp. 187–198.

Tetzeli, R. (1992). "Making quality more than a fad," Fortune Magazine, Vol. 125, No. 10.

Tiamaz, Y., Lahboube, F., and Souissi, N. (2018), "A Business Process Improvement Method," Proceedings of the International Conference on Industrial Engineering and Operations Management, Washington DC, pp. 27–29.

Torkhani, R., Laval J., Malek H., and Moalla, N. (2018), "Intelligent Framework for business process Automation and re-engineering," International Conference on Intelligent Systems (IS), Funchal - Madeira, pp. 624–629.

Valiris, G. & Glykas, M. (1999). "Critical review of existing BPR methodologies," Business Process Management Journal, vol. 5, no. 1, pp. 65–86.

Van der Aalst, W., La Rosa, M., & Santoro, F. (2016). "Business Process Management Don't Forget to Improve the Process!," Business & Information Systems Engineering, Vol. 58, No. 1, pp. 1–6.

Vanwersch, R. J. B., Shahzad, K., Vanderfeesten, I., Vanhaecht, K., Grefen, P., Pintelon, L., Mendling, J., van Merode, G., & Reijers, H. (2015). "A Critical Evaluation and Framework of Business Process Improvement Methods," Business & Information Systems Engineering, Vol. 58, No. 1, pp. 43–53.

Vera A. and Zapata C. M. (2022a). "Best practices of business process improvement: towards a representation on top of the Quintessence kernel", Business Process Management Journal, Vol. 28, No. 3, pp. 876–903.

Vera A. and Zapata C. M. (2022b). "Structural definition of the business process improvement: a practice represented on top of the Quintessence kernel", Latin American Software Engineering Symposium (LASES), Medellín, pp. 1–9.

Zarei, M., Zarei, B., and Ghapanchi, A. H. (2017), "Lessons learned from process improvement in a non-profit organisation," International Journal of Business Excellence, Vol. 11, No. 3, pp. 277–300.

Zellner, G. (2011). "A structured evaluation of business process improvement approaches," Business Process Management Journal, vol. 17, no. 2, pp. 203–237.

Zhao, T., Su, Q., Zhao, C., and Chang, L. (2009), "A four-dimensional framework for broad band business process improvement in HT Company," 2009 International Conference on Computers & Industrial Engineering (CIE39), Troyes, pp. 1160–1164.