PROPOSAL OF AN APPROACH TO IMPROVE BUSINESS PROCESSES OF A SERVICE SUPPLY CHAIN

Houda Mezouar
ENSIAS/Mohammed V University of Rabat, Rabat, Morocco,

Abdellatif El Afia
ENSIAS/Mohammed V University of Rabat, Rabat, Morocco,

ABSTRACT

The purpose of this paper is to develop an approach to analyze and improve business processes of a service supply chain (SSC), through a real case study. Within this framework, the paper suggests an approach based on the DMAIC (Define-Measure-Analyze-Improve-Control) method of Six Sigma - that combined Business Process Management (BPM), Supply Chain Operations Reference (SCOR), root cause analysis tree diagram, and Characteristics of Smart Supply chain - to improve one chosen business process of the Moroccan retirement supply chain. Based on this case study, the paper shows that the suggested approach identifies the malfunctioning causes for the studied business process, improves its behavior and manages its control. The approach is detailed, and it combines methods which are not complicated, so it can be used by academics and organization's managers. More case studies can be used to more thoroughly evaluate the presented approach.

Keywords: BPM, Business process, SCOR, Smart supply chain, Service supply chain

Cite this Article: Houda Mezouar and Abdellatif El Afia, Proposal of An Approach to Improve Business Processes of a Service Supply Chain, International Journal of Mechanical Engineering and Technology, 10(4), 2019, pp.76-87
http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=10&IType=4

1. INTRODUCTION

In the light of the increasing attention on SSC by both practitioners and academics, [1] and [2] defined it as a gigantic supportive subsystem in massive sustainable processes and uses of resources, which induce the management to attention and design on their sustainable service development. In a simpler way, [3] and [4] pointed out that an SSC is a systematic sequence of professional, clerical, and technical services explicitly set up to provide specific services, such as producing a financial product, designing a house, or managing a retirement scheme. In Morocco as in most countries, the retirement is one of the services that attract the citizens’
attention since the beginning of their careers [5]. It is provided by six organizations. The Moroccan Pension Fund (MPF) manages a compulsory scheme for the incumbent employers of the state (civilian and military). The private sector employees benefit from a compulsory retirement scheme managed by The National Social Security Fund (NSSF). The Moroccan Inter-professional Fund of Retirement (MIFR) manages a voluntary supplementary scheme for private sector employees. The Collective Retirement Allowance Scheme (CRAS) manages a compulsory scheme for the staff of public establishments and temporary employees of local authorities. In addition to two internal funds, managed by the Bank Al-Maghrib and by the National Office of Water and Electricity. The schemes provided by MPF are the civil pension scheme, the military pension scheme, the supplementary pension scheme ATTAKMILI, and the non-contributory pension schemes. The service addressed in this paper, is the management of the civil pension scheme provided by MPF. The retirement field faces two main challenges, the first one is the need to make this system last longer. The other challenge is the difficulty of managing the continuity between the salary and the retirement pension, in other words, the difficulty of offering this service (the civil retirement pension) to the customer (the pensioner) at the right time (the first month of the retirement). This work focuses on the second one from a SSC angle, which provides us an overall analysis of this SSC, and consequently enables us to put strategies to address the main causes of discontinuity for the studied SSC. The proposed approach in this work is based on DMAIC which the problem-solving methodology behind Six Sigma that is have been derived from Deming’s improvement cycle namely Plan-Do-Check-Act (PDCA). The reputations of the Six Sigma DMAIC method are gained by identifying defects and insinuate their root cause [6]. In the first phase a modelling method based on SCOR and Business Process Model and Notation (BPMN) is used, this method has been already used to give an overall overview of other supply chains, in [7] and [8] it was used to analyze the supply chain of electricity. In the Measure phase, we simulate the BPMN model of the previous phase using Bonita BPM. In the third phase, we analyze the results of the simulation and present the root cause analysis tree diagram. In the Improve phase, we took advantage of the smart supply chain characteristics presented in [9] to deal with the causes identified in the previous phase. In the last phase, based on the simulation results and the SCOR Key Performance Indicators (KPI), we elaborate a dashboard composed of steering and performance indicators, to maintain the control of the business process behavior. The remainder of this paper is organized as follows. Section 2 gives an overall overview about the SSC, business processes and Six Sigma methodology. The following section clarifies the proposed approach for the performance evaluation of the studied SSC. The obtained results are explained in Section 4. Finally, Section 5 is a conclusion that synthesizes the achieved work.

2. BACKGROUND
With the growing importance of the service sector in economies, the notion of SSC has obtained a more prominent role in contemporary operations management, as more and more traditionally product-based companies like IBM, Cisco and Pitney Bowes garner increasing proportions of their revenues from services [10]. And, in light of the increasing attention on SSC by both practitioners and academics, [11] defines the SSC as “a structured set of competencies that constitute proactive, relational, coordinating people and technology dimensions desired to deliver specific service offerings”. By way of explanation, a SSC is a set of processes involved in moving a service from supplier to customer. Those processes are defined as a set of 7Ts (talents, tasks, teams, techniques, technology, time, tools) arranged in a particular way to transform a set of inputs into a specified set of outputs (goods or services) [12]. In other words, and according to [13] a process is used to represent a set of tasks that are required to occur in an agreed sequence in order to achieve an outcome. The processes can be
categorized into core processes, support processes, and management processes [14]. Moreover, the word “business process” is used when the process accomplishes a specific organizational goal, in this work the service in matter is “the retirement”, and the studied business process is “the management of civil pension rights” of the Moroccan retirement SSC. Business Process Improvement (BPI) encompasses a spectrum of activities, methods and approaches that seek to improve the effectiveness and efficiency of business processes over time and ensure the alignment of business processes with the competitive environment [15]. Numerous methods for BPI projects were proposed including benefit and effort analysis, cost-benefit analysis, Pareto charts, cause-effect matrix, Pareto priority index, theory of constraints, six-sigma analysis, brainstorming [16]. In this work, the adopted method is the six-sigma analysis. The name Six Sigma refers to the proportion of defects, or errors, in a process [17]. It is a well-established approach that seeks to identify and eliminate defects, mistakes or failures in business processes or systems by focusing on those process performance characteristics that are of critical importance to customers [18]. Thanks to its flexibility, Six Sigma application is not limited only to manufacturing but can be extended to the whole supply chain which includes the provision of services [19]. It has been exploited by many world class organizations such as General Electric, Motorola, Honeywell, Bombardier, ABB, Sony, to name a few from the long list [20]. In the service sector, it has been embraced by many big service-oriented companies such as J P Morgan, American Express, Lloyds TSB, Egg, City Bank, Zurich Financial Services, BT, etc [20]. The literature on Six Sigma is entirely consistent regarding the argument that one of the critical success factors for the successful implementation of Six Sigma is project selection [21]. Reference [22], explained the benefits of six sigma in service organizations, by offering as an example the results of a six-sigma pilot survey in UK service organizations, it highlighted the most common challenges and implementation issues of six sigma application in SSC. In fact, the approach is applied in different fields all over the world. It was successfully applied to AV systems resulting in an increase in overall test and sample AV by >90%, improved turn-around time, reduced time for manual verification, and with no obvious compromise to quality or error detection [23]. Reference [24], used six sigma methodologies to solve the problem in oil classification extracted from the complex mixtures of oil spilled dataset. The analysis of six sigma link with the quality engineering improved the organizational performance to achieve its objectivity of the environmental forensics. In medical field, [25] used six sigmas as a tool in saving hospital money, resulting in better patient outcomes, while [26] implemented six sigmas in a radiotherapy department, allowing to redesign the breast repositioning matching procedure. Within the same framework, [27] used six sigmas to guide improvement decisions, in which authors target the reduction of overcrowding in emergency departments with a special attention on the medical equipment utilization and the influence of changing the medical equipment technology on patients’ waiting time and consequently their satisfaction. In the automotive industry, [28] adopted Six Sigma to implement some improvement procedures whose resulted in a significant financial impact on the company’s quality expenses. In Railway Companies, [29] used six sigmas as a quality management tool to enhance the quality of services provided in railway transport. The next section explains the approach proposed in this work to improve the performance of the studied SSC business process.

3. THE PORPOSED APPROACH

The research was developed based on the case study of the management of the civil retirement scheme, of the MPF. The data for this research was obtained from the IT department of the MPF. The performance methodology used is Six Sigma, which helps improve the process through finding the relations between inputs and outputs and controlling outputs using the
identified relations [30]. This methodology brings structure to process improvement by providing the user with a more detailed outline of Deming’s PDCA cycle by guiding the initiative through a five-stage cycle known as DMAIC [31], which actually stands for the phases of the improvement projects Define, Measure, Analyze, Improve and Control [32]. The first phase ‘Define’ is done in [5], the authors models the studied service supply chain according to a methodology in four levels organized in a descending order (that is, from the overall system, to decompose the latter into finer granularity subsystems), the three first levels are done with SCOR and the last one is done with BPMN. The last level represents the modelling of the studied business process ‘the management of civil pension rights’, in this work the same model is cited, because it is the basis of the other phases. The second phase ‘Measure’ represents the simulation of the aforementioned model using Bonita BPM, the used load profile and business subject are detailed bellow. In the third phase ‘Analyze’, the results of the simulation are analyzed and presented in a root cause analysis tree diagram. In the fourth phase ‘Improve’, we take advantage of the principles of Smart Supply Chain presented in [9] to improve the process of the first phase. For the last phase ‘Control’, based on the simulations’ results analysis and the SCOR KPI, a dashboard is elaborated to control the performance of this SSC.

4. RESULTS

4.1. Define phase
This phase of DMAIC analysis was done in [5] according to a top down modelling methodology in four levels. The strategic, the tactical, and the operational levels, are done with SCOR, the last one the real-time level focuses on the business process “the management of civil pension rights”, it’s done with BPMN using the software Bonita BPM as shown in Figure 1. This process is composed of six lanes: “head of career tracking service”, “Dispatching”, “Affiliation”, “Contribution”, “Liquidation”, and “Concession”. It has one start event which is “receive folders”, and three end events: “folder sent to the organization”, “Non-compliant folder”, or “conceded folder”. Once the reception of folders is done, the head of career service assign them to the affiliation officers, and then he designates a monitoring agent to manage the processing of folders, he starts by dispatching the folders to the assigned officers. The affiliation officer studies the folder, if the folder is not complete (all papers are not received) he rejects it, if not he validates it, and then he certifies the affiliation data before printing the certification sheet. And then he sends the certified folder with its certification sheet to the concerned contribution officer and a copy of it to the monitoring agent. Once the contribution officer receives the folder, he verifies the affiliation certification, if it is valid, he certifies the contribution, if not he rejects the certification. The liquidator studies the certified folder (affiliation and contribution), if it is not valid, he rejects the folder. If a folder is rejected before the certification or the liquidation, the monitoring agent establishes a rejection letter to describe the rejection causes; this letter is signed by the head of career service before being send to the concerned organization. For each rejected folder, once it is sent to the organization, the management of civil pension rights ends by executing the error end event “folder sent to the organization”. For the valid certified folder, the liquidator verifies the compliance with the rights, if this compliance is not valid, he rejects the folder, in this case the management of civil pension rights ends by executing the error end event “Non-compliant folder”. For the folders with valid rights compliance, the liquidator validates the legal conditions, and then he runs the liquidation via the system (which will calculate the pension amount and generate a pension number) before printing the liquidation report, then he sends the folder for verification to the verifier. In case the verifier rejects the liquidation, the liquidator reviews the folder and repeats the liquidation operation until it is validated by the
verifier. Once the verifier validates the liquidation, he concedes the folder (which will generate a decision number) and finally generates the decision. In this case the management of civil pension rights ends by executing the end event “conceded folder”.

**Figure 1** the management of civil pension rights’ process of the 4th level of the SSC of retirement

### 4.2. Measure phase

In this step we take advantage of BPM which is both a management discipline and a set of technologies aimed at automating organizations’ key business processes, as defined in [33], to execute the simulation. Simulation can be applied for different purposes, namely prediction, performance, entertainment, training, education, confirmation and discovery [34]. In this phase, it is applied to determine how the process currently performs. When a simulation is run, a specified number of iterations over a specified period of time are run either with simulated data or with assigned probabilities. The load profile used in this work is composed of the start date 01-06-2018 at 08:30 am, the end date 31-12-2018 at 04:30 and 100 instances. The objective is to simulate the case of affiliates who are going to retire in the end of the year 2018. Giving that the affiliate’s administrations have to send their folders six months before their retirement, we choose the start date on June 2018. It is considered that a folder is received late if the reception date is greater than the retirement date minus 3 months, in our case, a folder is late if it is received after September 30, 2018. A received folder may be complete or incomplete (lack of a files), and during its processing, a folder may not be subject to a revision, or it may be subject to more than one revision. In this study we choose five as a maximum possible number of revisions. So, to characterize a folder, we create the business
object ‘dossierState’ (LONG bonitaBPMid; DATE receptionDate; BOOLEAN complete; INTAGER revisionNbr). Six scenarios are considered, as shown in Table 1. In keeping with our profile, we considered a date that meets the deadlines, and one that represents a late reception, we also considered whether the file is complete or not, and the case of a treatment without revision and the other with maximum number of revisions.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Reception date</th>
<th>Complete</th>
<th>Revision number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>01/06/2018</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>01/06/2018</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>01/06/2018</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>01/11/2018</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>01/11/2018</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Scenario 6</td>
<td>01/11/2018</td>
<td>No</td>
<td>-</td>
</tr>
</tbody>
</table>

The simulation is based on a reception of 1000 folders (the average number of received folders in 6 months). The reception respects the period of our simulation profile. The following table (Table 2) presents the minimum, the average and the maximum execution time (by hours) of the main activities of our process, and which are: Certify affiliation, certify contribution, Run the liquidation, Review the folder, Concede the file. (Sc: Scenario, Mi: minimum, A: average, Ma: maximum).

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Certify affiliation data</th>
<th>Certify the contribution</th>
<th>Run the liquidation</th>
<th>Review the folder</th>
<th>Concede the file</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mi</td>
<td>A</td>
<td>Ma</td>
<td>Mi</td>
<td>A</td>
</tr>
<tr>
<td>Sc 1</td>
<td>293.667</td>
<td>250</td>
<td>450</td>
<td>722.083</td>
<td>1239</td>
</tr>
<tr>
<td>Sc 2</td>
<td>293.667</td>
<td>250</td>
<td>450</td>
<td>722.083</td>
<td>1239</td>
</tr>
<tr>
<td>Sc 3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sc 4</td>
<td>293.667</td>
<td>250</td>
<td>450</td>
<td>722.083</td>
<td>1239</td>
</tr>
<tr>
<td>Sc 5</td>
<td>293.667</td>
<td>250</td>
<td>450</td>
<td>722.083</td>
<td>1239</td>
</tr>
<tr>
<td>Sc 6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

4.3. Analyze phase

This phase allows to closely examine the process based on the result of the previous phases. So, according to the BPMN model simulation, we conclude that:

The reception date does not affect the duration of processing, but it does affect the date on which the pensioner receives his first pension. A folder received late, given the duration of the processing, may be paid late (reception on 01/11/2018 in a lot of 1000 of folders: 3000 hours on average).

The scenarios that take more time are 2 and 5, and therefore the revision impact the duration of processing, knowing that 5 was considered as the maximum number of revisions.

When an incomplete folder is received, the activities presented in the table are not executed, and therefore an incomplete folder is not conceded.

Based on these results, we note that the two parameters to be considered in the development of our dashboard are "incomplete folder reception" and "folder revision"
So apart from not receiving the affiliate's folder, the cause tree below presents Figure 2, the reasons behind the discontinuity between the salary and the pension.

![Figure 2 Root cause analysis tree diagram](image)

### 4.4. Improve phase

This phase is about mitigating the root causes of the problem. For this we chose to integrate one of the characteristics of the smart supply chain explained in [9]. According to [9], the smart supply chain has three core characteristics: Interconnected, Instrumented, Intelligent. In this work, the focus is on the interconnectivity characteristic. Besides creating a more holistic view of the supply chain, this extensive interconnectivity will also facilitate collaboration on a massive scale [9]. For this, information flows will be created between the different actors of this SSC, namely: MPF, the affiliate's administration, pensioner. Which will lead us to the 2nd level model (SCOR) presented in Figure 3.

![Figure 3 The interconnected retirement SSC at the 2nd level of SCOR](image)

Concerning the business process 'the management of civil pension rights' of the SSC real-time level, this change is reflected on the BPMN model by the addition of the lane ‘Control’ which groups the activities related to this interconnectivity as shown in Figure 4. At the beginning of each month, the agent of control elaborates a list of affiliates who will be retired in 6 months, then he compares the folders contained in this list with the folders sent by the different administrations. For the received ones, he verifies the content, if no files is missing he sends the folder for processing, if the folders is not complete, he elaborate and send a list per administration that contains missing files per affiliate. Concerning the files not received, as long as the duration of the delay does not exceed 3 months, he elaborates and sends reminders letters to administrations, containing the list of the not received folders. For
affiliates who will be retired in less than 3 months and whose files are not received, he sends letters to affiliates informing them of the files list to provide.

Figure 4 'The management of civil pension rights’ process of the 4th level of the interconnected SSC of retirement

4.5. Control phase
The last phase of Six Sigma’s DMAIC model is the Control phase. This phase allows us to continually verify if the actions created in the previous phase are well maintained. For this a dashboard presented in Table 3 and composed of Steering and Performance indicator was elaborated to be checked monthly. As a part of our goal to evaluate the continuity between the salary and the pension, we are interested in the responsiveness attributes which means in a general way the speed at which tasks are performed, the speed at which a SSC provides services to the customer. SCOR manage performance using two major elements: Performance Attributes and Metrics [35]. To express a strategy, the performance attribute is used as a grouping of metrics. Among those proposed, this work focuses on ‘Responsiveness’ (The speed at which tasks are performed) and ‘Reliability’ (The ability to perform tasks as expected). The chosen metric for responsiveness is ‘Order Fulfillment Cycle Time’. To calculate the ‘Order Fulfillment Cycle Time’ SCOR specifies: [Sum Actual Cycle Times for All Orders Delivered] / [Total Number of Orders Delivered] [36]. Based on this indicator, and
given the context of our case study, the indicator that corresponds functionally to the ‘Order Fulfillment Cycle Time’ is:

‘Rate of pensions conceded before the 25th of the first month of retirement’ and which can be calculated for each trimester as follow: [the number of folders conceded before the 25th of the first month of retirement since the beginning of the period] / [the total number of folders received before the end of the period], for example, for the A trimester ‘January, February, March’ the indicator will be [the number of folders conceded before the 25th of the first month of retirement since the 1st January] / [the total number of folders received before the 31th March].

- Reliability focuses on the predictability of the outcome of a process. The chosen metric is ‘Perfect Order Fulfillment’. To calculate the ‘Perfect Order Fulfillment’ SCOR specifies [Total Perfect Orders] / [Total Number of Orders] [36]. The indicator that corresponds functionally to the ‘Perfect Order Fulfillment’ is:

- ‘Rate of processed folders’ and which can be calculated for each trimester as follow: [the number of folders processed] / [the number of folders that must be processed].

- And based on the simulation results we propose:

- ‘Late folders rates’ and which can be calculated for each trimester as follow: [Number of folders received after retirement] / [the total number of folders received before the end of the period]

- ‘Revised folders rates’ and which can be calculated for each trimester as follow: [Number of revised folders] / [the total number of folders received before the end of the period].

<table>
<thead>
<tr>
<th>The indicator source</th>
<th>The indicator title</th>
<th>The calculation formula</th>
<th>The indicator type</th>
<th>The calculation periodicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCOR - ‘Perfect Order Fulfillment’</td>
<td>Rate of processed folders</td>
<td>[the number of folders processed] / [the number of folders that must be processed]</td>
<td>Steering indicator</td>
<td>A trimester</td>
</tr>
<tr>
<td>SCOR - ‘Order Fulfillment Cycle Time’</td>
<td>Rate of pensions conceded before the 25th of the first month of retirement</td>
<td>[the number of folders conceded before the 25th of the first month of retirement since the beginning of the period] / [the total number of folders received before the end of the period]</td>
<td>Steering indicator</td>
<td>A trimester</td>
</tr>
<tr>
<td>Simulation</td>
<td>Late folders rates</td>
<td>[Number of folders received after retirement] / [the total number of folders received before the end of the period]</td>
<td>Performance indicator</td>
<td>A trimester</td>
</tr>
<tr>
<td></td>
<td>Revised folders rates</td>
<td>[Number of revised folders] / [the total number of folders received]</td>
<td>Performance indicator</td>
<td>A trimester</td>
</tr>
</tbody>
</table>
5. CONCLUSION

The aim of this work is to propose an approach to deal with errors that occurred in automating business processes of a SSC. The chosen service is ‘the retirement’. From the date of retirement, the employee ceases to receive the salary paid by his employer, to start receiving a pension administered by another organization. The suggested approach aims to manage continuity between salary and pension, and to deal with discontinuity in the main business processes of the retirement supply chain of the MPF. Deming’s popular methodology of PDCA Cycle can be effectively adapted in an attempt to achieve six sigma levels. This is generally used for improving an existing process and is further developed into DMAIC methodology. So, in this work the DMAIC methodology is used to deal with the issue aforementioned. The Define phase, was done in [5], in this work we just recite the studied business process of the 4 level of this SSC. In the Measure phase, the BPMN model of the previous phase is simulated using Bonita BPM and a load profile composed of the start date 01-06-2018 at 08:30 am, the end date 31-12-2018 at 04:30 and 100 instances. In the third phase, the analysis of the results of the simulation is done and the root cause analysis tree diagram is presented. In the Improve phase, we took advantage of the smart supply chain characteristics presented in [8] to deal with the problem causes identified in the previous phase. In the last phase, based on the previous one and on the SCOR performance metrics, a dashboard composed of steering and performance indicators is elaborated, in order to keep controlling the behavior of the business process. The methodology presented in this work, which basically combined: Six Sigma, BPM, SCOR, root cause analysis tree diagram and Smart Supply Chain, provides a way to recreate the process so that defects and errors never arise in the first place. It can be used to evaluate the performance of another SSC.

REFERENCES


Proposal of An Approach to Improve Business Processes of a Service Supply Chain


