“Modeling and measuring milestones in business process optimization”

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Modelling and measuring milestones in business process optimization

Abstract

The article develops a method to model and also measure the level in which a business has progressed towards business process optimization (BPO). In cases where tougher competition in business leads to opportunity losses, top managements in organizations tend to blame the operations managers for failure to optimize their processes. The extent to which progress towards ideal optimization has been attained is not noted, which is failure to acknowledge the efforts made or even the milestones already reached towards optimal level. In making it easy to measure the extent to ideal state of optimization, BPO is unpacked into its basic units. Then linear programing and probability measures are applied to enable measuring the level at which efforts already completed are away from the ideal state of BPO. The basic units enable a way to identify stages already completed and those that still remain to reach the BPO. This helps to explain to management that while ideal BPO has not been reached, some successes towards BPO have been attained. Such successes are identified by the completed stages, the level of success is also given as a measure, and incomplete parts are also identifiable.

Keywords: BPO, business effectiveness, LP, profit maximization, risk mitigation.
JEL Classification: C61.

Introduction

In order to be ahead, modern businesses incorporate scientific and engineering (SE) concepts to drive their processes. Some business cases, however, are difficult to convert to SE models, but some approximations can be found. Scientifically sound approximate models for such cases are often acceptable. When applied to business, these SE concepts should in one way or another, help to improve business efficiency and to maximize profits (Gilbert & Devilbiss, 2010). In essence, business organizations customize SE benchmarks in an attempt to maximize business benefits while minimizing the detriments. To maximize benefits while minimizing detriments within the applicable context is to optimize. Companies contest against rivals to have a higher market share. Strategies include scrambling for new clients and a drive to retain existing ones, as well as displacing clients from the competitors. The emergence of new companies has lifted the competition as each competitor fights for an increasing market share (Cranston, 2011). Business process optimization (BPO) is one way to ensure that the company remains focused and competitive. BPO is an important business concept, but in the main lacks properly scientifically investigated models to enable efficient approaches to it.

BPO entails to (re)design the business process for the underlying service composition to find a proper fit a given constraint, i.e. taking into account some constraints for a specific service infrastructure (Leymann & Roller, 2000). It involves optimizing process flows of all sizes, crossing any application, company boundary and connects process design and process maintenance (Papazoglou & Ribbers, 2006). It entails adapting the business process to improve the process execution to reach a higher quality of service level for a specific service composition. As a result BPO is considered a ticket to competitive advantage. BPO has so far been performed from an intuitive perspective. It has, however, components that can be expressed linearly, either directly or by some transformation, and be performed by a mathematical approach of optimization. Due to the perceived linear nature of the relationship with its factors, an attempt is made in the study to model BPO using a statistical approach. This study intends to model BPO using linear programing (and statistical measures), and to find ways to measure the extent to which efforts towards BPO have been achieved.

1. Linear programing and BPO

1.1. Linear programing. Linear programing (LP), according to Komei and Terlaky (1997), is a mathematical technique for the optimization of a linear objective function, subject to linear equality and linear inequality constraints. Its feasible region is a convex polyhedron, which is a set defined as the intersection of finitely many half spaces, each of which is defined by a linear inequality. Its objective function is a real-valued affine function defined on this polyhedron. A LP algorithm finds a point in the polyhedron where this function has the smallest (or largest) value if such point exists (Alevras & Padberg, 2001). Linear programs are problems that can be expressed in canonical form:

maximize : $c^T x$,

subject to : $A\text{x} \leq \text{b}; x \geq 0$,

where x represents the vector of variables, c and b are vectors and A is a matrix of coefficients (Roos, Terlaky & Vial, 2005). The expression to be maximized or minimized is the *objective function* ($c^T x$ in this case). The equations $Ax \le b$ are the constraints which specify a convex polytope over which the objective function is to be optimized (Schrijver, 2003). In this context, two vectors are comparable when every entry in one of them is less-than or equal-to the corresponding entry in the other. Otherwise, they are incomparable. LP is applicable to various fields (Gärtner & Matoušek, 2006).

Interpretation of the LP problem: the problem can be stated in words to imply that we decrease benefits and reduce detriments to the point where it is practically possible.

1.2. BPO. BPO is an effort to make firms more process centric (Vernon, 2004) by reviewing processes mapped in a suitable business framework to make the best outcome from what is available. In most instances areas playing a role cannot all be simultaneously maximized to maximize the worth. Usually, while some areas are maximized, others are only lowered to a point where they cannot reduce item value in a trade-off situation. This intent can be achieved by applying business process re-engineering (BPR) approaches and other suitable practices. BPR entails analyzing and designing workflows and processes within an organization (Davenport, 1992). BPO (Y) components, which are also advantages in BPO, include business effectiveness (X_1), risk identification and mitigation (X_2), and profit maximization (X_3).

Babulall (2011) showed that component X_1 (business process effectiveness) of BPO has 12 attributes, X_2 (risk management) has four and X_3 (success factors and change management) has five. These attributes are defined as:

X_1 = *Business process effectiveness (BPE)*; X_{11} = Time saving; X_{12} = Follow up with resources from other divisions; X_{13} = Work on many systems to complete tasks; X_{14} = Work involves technological processes; X_{15} = Allows for the best customer service delivery; X_{16} = Cost effective processes; X_{17} = Competitiveness in the organization; X_{18} = Ability of organization to attract new clients; X_{19} = Increase in profits; $X_{1,10}$ = Ability to identify new opportunities; $X_{1,11}$ = Launch of new innovative products; $X_{1,12}$ = Serve as a platform for new system selection.

X_2 = *Risk management (RM)*; X_{21} = Business processes mapped in a suitable business framework; X_{22} = Access to these mapped processes; X_{23} = Processes allow easy identification of risks; X_{24} = Risks mitigated through processes updating.

X_3 = *Success factors and change management (SFCM)*; X_{31} = Process change initiatives align with the organization's strategy; X_{32} = Organization has effective mechanisms for managing process change; X_{33} = Business processes continuously reviewed; X_{34} = Process training provided for effecting process change initiative; X_{35} = Staff involved in the process change from start to finish.

2. Model development: alternative approaches

2.1. LP model construction. Consider that X_1 has 12 attributes, X_2 has four and X_3 has five. Intuitively, the model developed will weight these variables according to the numbers of attributes out of a total of 21. Define the 'complete X_i' to imply that each X_i (i = 1, 2, 3) contains all its attributes. To optimize the BPO function (Y), intuitively define the LP model as:

$$\text{maximize } \mathbf{Y} = \frac{12}{21}\mathbf{X}_1 + \frac{4}{21}\mathbf{X}_2 + \frac{5}{21}\mathbf{X}_3, \quad (1)$$

subject to: complete X_i, $x_{ij} > 0$.

Generalizing this model and acknowledging probalistic coefficients, the problem is rephrased as:

$$\text{optimize } \mathbf{Y} = p_1\mathbf{X}_1 + p_2\mathbf{X}_2 + p_3\mathbf{X}_3, \quad (2)$$

$$\text{subject to: } 0 \le p_i \le 1 \ ; \ \sum_{i=1}^{3} p_i = 1.$$

This function is also the expected value to be maximized in Anderson (2002).

2.2. An approach to quantifying BPO. A natural approach to considering achievement of BPO is to have all the attributes of the three BPO components being included in a business process. Section 2.2. shows that BPO has three major components (BPE, RM & SFCM) in which BPE has 12 attributes, RM has four and SFCM has five. This is a total of 21 attributes. When 'users' of a system believe that all these components are included in the systems, then the complete optimal system will have a BPO of measure 1 (= 21/21), said to be 'full BPO'. If there is none of the attributes, then BPO measure of 0 (= 0/21) is achieved. This is 'Void' (or 'Null') BPO. Other values will lead to values between 0 and 1 (known as 'Intermediate BPO'). Closer to 1 values imply high optimization while closer to 0 values imply low optimization. In practice, due to the trade-off acceptance, BPO measures that are too close to 1 are still acceptable for considering a system as optimal.

Interpretation: the frustration of top management comes when they lose business because there is not enough BPO to beat competition. However, middle management and lower rank employees tend to believe that some advances towards BPO have been achieved, and they want to be judged on that achievement. Hence, to say 'there is no BPO in a company' is not a true reflection since the 'intermediate BPO' measure can describe situations of progress towards BPO even when the 'full BPO' has not been reached.

2.3. Quantifying the system attributes. For each user, define $x_{ij} = 0$ when an attribute is not satisfactory and $x_{ij} = 1$ when it is satisfactory. This simply allows each user to rate the attribute as it suits him/her. A pure optimal model will be where all the users rate all the attributes to be present while a totally non-optimal model is where all the users declare that no attribute is present. Since the measure will consider proportions, values close to 1 shall mean high optimality and close to 0 shall imply low optimality. These measures are derived from the relative frequencies of the users who (e.g. in a simple survey) rate the attribute in one of the two ways (satisfactory or unsatisfactory).

3. Estimation

For statistical models, the parameters have to be fitted, and the coefficients should be estimated and tested. The presence of data is often key, and data absence may weaken model development. Data used for this study came from a private service company in Johannesburg, South Africa. Data analysis indicated that five attributes of X_1 were reliably 'achieved', together with two of X_2 and two of X_3, making them nine. Then the estimated BPO achievement in this case was 9/21, or 43%. This can be interpreted to mean that minimizing detriments and maximizing benefits occurred in about 43% of the attributes. In this case, BPO measures 43%, or that 43% of the process in this company are optimized. This also means that the company is 57% below Full BPO, or that 57% of the path towards idea BPO is still incomplete. Management, who are also desperate for full BPO, can be expected to feel that there were compromises in 57% of the BPO attributes.

The attributes that have not been optimized are known. Hence, it will be possible to know where to focus in order to enhance increases in BPO.

4. Model testing

The model being tested in equation (2) is to determine if it fits the proportions in a goodness-of-fit test using chi-square. The hypothesis being tested is given by:

$$H_0 : p_1 = 0.57;\ p_2 = 0.19;\ p_3 = 0.24. \qquad (3)$$

The data, based on a sample of 93 respondents, indicated a BPO of 49 responses allocated to X_1, 21 for X_2 and 23 for X_3. The expected frequencies for the chi-square are obtained by multiplying the H_0 proportions by 93.

The observed and expected frequencies are:

Observed (o_i)	49	21	23
Expected (e_i)	53.01	17.67	22.32

The value of the test statistic (Bless & Kathuria, 1993) is:

$$\chi^2 = \sum_{i=1}^{k} \frac{(o_i - e_i)^2}{e_i} = 0.952\,. \qquad (4)$$

The value of the degrees of freedom (d.f.) of this test statistic is $k - 1 = 3 - 1 = 2$. Thus, from Curwin and Slater (2002, p. 636), the critical value at 5% level of significance with 2 d.f. is $\chi^2_{0.05} = 5.991$. Based on these, the model developed with the hypothesized weights on the components of BPO cannot be rejected.

Conclusion

The study demonstrated that LP modelling can be used to describe a BPO problem. LP enables to determine the extent to which BPO efforts have been attained. The separation of BPO into three components enables detection of which component is lacking more and which one has advanced more in reaching BPO. The attributes of these components provide detail as to exactly which business process input has been satisfied and which is still lacking in reaching BPO. ICT methods are needed in a further study to help in dilation of deficiencies in the efforts of BPO. Further remark is that BPO can be deficient in one of the three components (BPE, RM & SFCM) at varying degrees. It is possible to determine this by studying the attributes of the various components. Consequently, if a case of interest appears, shortfalls can be detected even at component level of BPO.

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