Return on Investment for Technology Supported by Business Process Management

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***Abstract*--Regarding the actual experiences although interest in return on investment -ROI methodology and its use has increased, people from business area argue that the use of this approach for technology application is difficult, which constitutes one paradigm to be broken. On the other hand, the benefits obtained with the use of technology in business process management - BPM have been increasingly in many companies of various sectors. The results from those earning opportunities are generating increased demand for technology application to automated process. , however, in the most of the cases the gain evaluation is qualitative and subjective. This paper aims to present some factors to leave the exercise more clear using BPM approach and use it to prove Losses reduction based on date and facts using ROI methodology, speaking the sponsor's language and avoiding long speeches. The suggested ROI approach was planned be tested in the manufacturing enterprise of household appliances to improve the present practice.**

I. INTRODUCTION

First stage in quantifying business process regarding return on investment -ROI is to agree that implementing an improved process (either in-house or off-the-shelf) and making that process available to the entire organization is something that should be pursued as a value adding initiative for the company. Second stage, which is the basis of this paper, is to identify all the facts and data to quantify a significant amount of measurable process improvement opportunities, so as, to demonstrate the relative benefit of instituting and publishing that process. The third stage, which is beyond the scope of this paper, is to employ organizational change management to overcome people's natural reluctance to change their own behavior.

The remainder of this paper will depict how to demonstrate a process improvement ROI for a fictitious factory. These same techniques can be applied to your organization using a little creativity to spot out cost savings opportunities. In some cases, some benefits of an improved process can be described but not quantified.

Using the approach described here, only the quantifiable portion can contribute to ROI, but the non-quantifiable aspects of process improvements should be documented in the business case nonetheless so as not to be lost as part of the overall process improvement strategy. That said, some experts feel that unquantifiable benefits can always be quantified with a bit of imagination.

One challenge with identifying opportunities for process improvement is to define the right scope for the current effort. There is no need to define the entire process upfront and then start measuring to determine cost savings; that is not a realistic requirement and is rarely an option. What most organizations do is baseline their existing process, afterwards making incremental improvements over time and measure as they go. Running this processes in production have a positive impact on one or more business objectives, such as time-to-market, improved quality, increased innovation, etc., and can therefore effectively be measured and later on.

II. RETURN ON INVESTMENT APPROACH

Return on investment - ROI approach is a performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI one divides the benefit of an investment by the cost of the investment; the result is expressed as a percentage or a ratio [4]. The return on investment can estimate by the formula presented in equation 1:

$$ROI\ (\%) = \frac{Gain\ from\ Investment - Cost\ of\ Investment}{Cost\ of\ Investment} \times 100 \quad (1)$$

During the 1920s, ROI was the emerging tool to place a value on the payoff of capital investments. This reflects the growing demand for evidence of positive returns on investing in programs [7].

As mentioned by ROI Institute the acronym was still a new term in 1996 as many professionals were just beginning to embrace the concept. In recent years, the application of the concept has expanded to all types of investments. The ROI methodology has graduated from a hot topic to a recognized process within many organizations. Is also emphasized by ROI Institute that within the industrial management and industrial engineering context, this method has been used in a variety of applications spanning the entirely organization.

The ROI methodology is a step-by-step process tool for evaluating any program, project, or initiative within any organization. This process is simplified in the ROI process model, which provides a systematic, step by step approach to ROI evaluations that helps users address one issue at a time. The methodology is based on 12 guiding principles, which are necessary for a credible, conservative approach to evaluation through the different levels [7].

1. When conducting a high-level evaluation, collect data at lower levels.
2. When planning a high-level evaluation, the previous level of evaluation is not required to be comprehensive.
3. When collecting and analyzing data, use only the most credible sources.
4. When analyzing data, select the most conservative alternative for calculations.
5. Use at least one method to isolate the effects of a project.

6. If no improvement data are available for a population or from a specific source, assume that little or no improvement has occurred.
7. Adjust estimates of improvement for potential errors of estimation.
8. Avoid use of extreme data items and unsupported claims when calculating ROI.
9. Use only the first year of annual benefits in ROI analysis of short-term solutions.
10. When analyzing ROI, fully load all costs of a solution, project, or program.
11. Intangible measures are measures that purposely cannot be converted to monetary values.
12. Communicate the results of ROI methodology to all key stakeholders

For conclusion, within the industrial management and industrial engineering context, the ROI method has been used in a variety of applications spanning the entire management in an organization, e.g., including ROI for implementation of technology to support operations in a manufacturing plant [8].

In addition, many organizations give high praise to the ROI methodology for its help in relationship building and budget enhancement. Some say that it has helped them earn a seat at the table, change the image of their function in the company, and build key partnerships. Others indicate that their department training budgets increased, even when other company budgets were decreasing. One organization revealed that its budget increased four-fold in two years with the use of this methodology. Another doubled its budget [8].

III. BUSINESS PROCESS MANAGEMENT APPROACH

As defended by [6], business process management - BPM is defined as a disciplined approach that focuses on effectively and efficiently aligning all aspects of an organization, with the vision of constant process improvement, technological integration and increasing customer value. Since a key objective is increasing customer value and subsequently shareholder value, any improvement in a business process (increase revenue/reduce cost) should have its ROI calculated. BPM projects tend to be intangible (the results you cannot collect, but experience), so it is sometimes difficult to “see” the results of a project program and subsequently the value to the organization.

Having explored how to demonstrate the ROI of improved processes, now we define what a good or improved process means. A good process should be articulated in two basic areas: content and processes. Content is described in terms of fundamental elements in four categories: roles, tasks, work products, and guidance. Role definitions help people to understand their responsibilities and the skills they need to perform tasks assigned to them. Tasks are defined as a series of steps with a specific goal and purpose, performed by roles and using work products as inputs.

During a task, inputs are transformed into outputs, the work products, with some value added to the entire process by the completion of the task itself. Work products are the intermediate and final outputs of the process, each of which makes a specific contribution to the development of the delivered product or service. Guidance exists to support roles, tasks, and work products in various ways, and may include policies, templates, examples, standards, checklists, concepts, white papers, supporting materials, etc.

Processes represent a set of content elements to produce an end-to-end sequence of activities in multiple phases to achieve a desired result. Within a particular organization, multiple delivery processes can exist; one for each major type of project executed, with each delivery process referencing only the content, being them roles, tasks, work products, and guidance each one appropriate for that particular type of project.

Value adding processes lead to lower costs, higher revenues, motivated employees, and happier customers. The most dramatic examples of economic value driven by process improvement come from the companies that have led the adoption of the Six Sigma and Lean Six Sigma methodology – most notably, General Electric – GE. Mikel Harry, one of the founders of the Six Sigma methodology, has documented the economic impact of focusing on process improvement. Using the base measure of his methodology – Sigma, Dr. Harry provides a tangible example of how companies like GE have benefited from a commitment to process improvement [9].

With just a one-sigma shift, companies will experience a 20 percent margin improvement, a 12 to 18 percent increase in capacity, a 12 percent reduction in the number of employees, as well as a 10 to 30 percent capital reduction [9]. When you consider that GE achieved multiple Sigma shifts on their core markets, it is clear how they have become a top competitor in any market in which they operate. Their costs are lower and their quality is higher [9].

Of course, GE also made BPM a core part of their corporate culture – from the CEO down. Most groups making the case for BPM cannot assume such commitment – at least not to begin with. Not a problem. Even a basic investment in a BPM suite (BPMS) can yield significant returns. Without any process redesign, Connecticut-based research firm Gartner indicates that companies can still expect to receive significant operational improvements for any given process.

Gartner claims that by simply “making the current-state handoffs, timing, and responsibilities explicit, productivity improvements of more than 12 percent are normally realized”. For many processes, that is just the start of the efficiency gains. Later in this paper, will compared a BPMS investment to other alternatives for driving process improvement. However, can already see that even a basic BPMS investment can drive significant value.

In fact, typical BPMS projects are driving more value – a lot more. In another report, Gartner indicates that of projects see an internal rate of return (IRR) greater than 15 percent.

The same report indicates that these projects deployed quickly (67 percent in less than six months, 50 percent in less than four months). So that, companies are realizing significant value with rapid returns by driving process improvement with BPM [9].

As a result, calculating the ROI for a BPM engagement may be a difficult task, but not impossible. With any change comes a need to sustain it. Early in the implementation, processes must put into place to make ROI evaluation routine and important. Otherwise, it will become a nuisance and an add-on activity that may quickly cease if the ROI champion leaves the organization.

IV. RETURN ON INVESTMENT BY BUSINESS PROCESS MANAGEMENT

When adopting these methodologies one faces a strong resistance from the organization, its executives and key stakeholders, which is natural given the level of compromising that comes from it. As one adopter executive commented, “If my programs are not working, why should I publish a study to let my clients know that?” Still, progress was made as more organizations embraced it and began to use it. To some, ROI became key to both personal and organizational success.

As seen in reference [3], one of the main differences between the current company and the former is the constant search for improvement of its activities. Companies must necessarily concentrate on constant search for improvement, not only with technological innovation but also with the elimination of existing losses in the process.

In the continuous improvement process, elimination of losses is of fundamental importance. To survive in the modern market, a company works continuously to eliminate losses from either input not consumed efficiently and effectively or defective materials and products, as well as unnecessary activities.

Once you understand the need for improvement in the control of losses, it is necessary to optimize processes to avoid it, applying the concept of ROI by using BPM and implementing an information systems technology to support the routine bringing the necessary optimization. Moreover, this way of presenting the benefit will be more effective with the sponsors, based on facts and data and will be very hard for them to “escape the room”. In the context of Fig. 1 we see an example for a hypothetical company with the data capturing process and analysis of statistical control for a fictitious factory with many production lines and application of the concepts of ROI and BPM.

It can be observed the five-step process, each one with its measurement of people and run time (A), a supporting tool (B) Excel without automatic systematization, with annual cost shown in line (C) in all lines of this factory with application of the concept of the methodology of the investment return, as we saw in topic ROI.

Once the process map had built, measured execution time for each activity and the cost of these activities will highlight data and facts based assertive opportunities to reduce losses through automation. In this way, can reduce the subjectivity of the benefit and begin a work to represent directly the benefit "hidden" with evidence of increased operational efficiency.

It can be seen in Fig. 2 the curve of the benefit represented by a slight increase in inefficiency or learning curve represented by axis Y when the project utilization started on point 0 until the point 1 on time axis X.

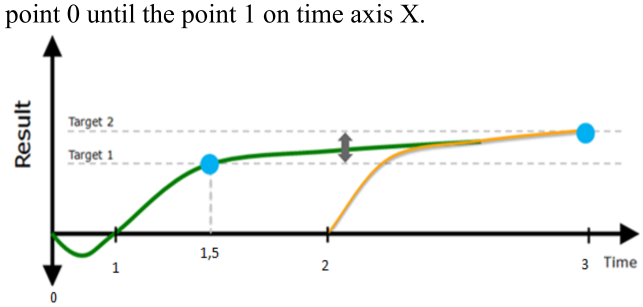

Fig. 2: Gain developments by information system

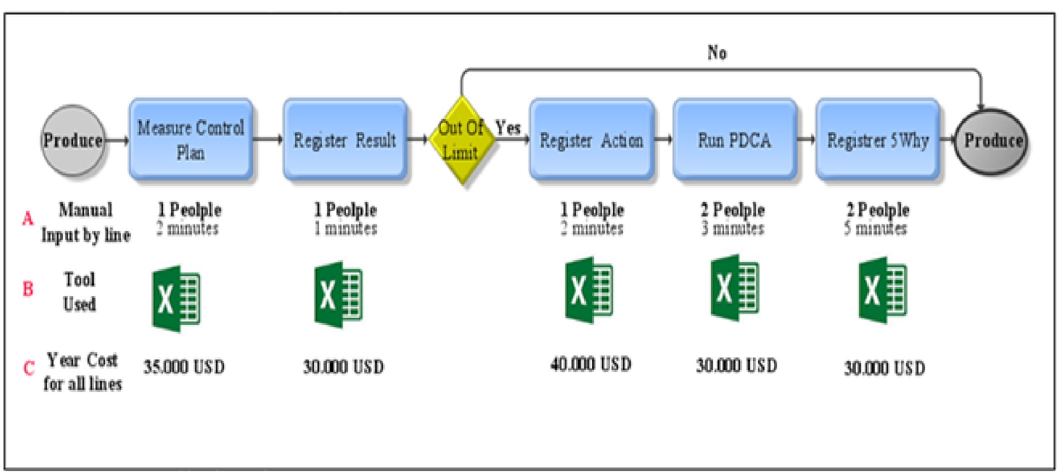

Figure 1: ROI Measure using BPM approach

Source: Prepared by the authors

#	TASK (BPM Approach)	Task without Information Technology Tool	Task using Information Technology tool	Expected gains	Responsible	Estimation	Revenue (US $ *1.00*)	Comments
1	Measure product/process according to define frequency and sample size (Control Plan)	It depends on the operator to follow the frequency and sample size of inspection. Sometimes process keeps without monitoring its quality or operator forget to measure at defined frequency.	System informs the operator about what to measure at the correct frequency and sample size. If measurement results were not recorded, Manufacturing Executions Systems (MES) systems maintain an alert in the screen (warning error proofing).	Less FTE of auditors to check if Control plan is being followed Less hours of operator training in Control Plan SOP Reliable quality control	Operator	Calculate the proportion of time spent each area of stators inspector, machining and assembly on average to validate the Control Plan is following. This ratio is multiplied by *12* (inspectors) * *2,304* (hours per year) by *4.21* (Constant)	*18,752*	
						Calculate the proportion of staff time spent Como area of stators, machining and assembly on average to train in the Control Plan. This ratio is multiplied by *20* (operators) * *2,304* (hours per year) by *4.21* (Constant)	*27,160*	*251* min Total *3* training areas. Total hrs shift (*8* hours x *3* lines) = *251/1440* = *1440* min = Percentage *17.5%*
2	Record defect and quality losses tracking (scrap/rework/ sorting)	Even if indicated defect is informed by machine, usually defect is not recorded in the moment the failure was observed (operator records accumulated rejection) and sometimes operator forgot to record the defect	Machine informs to MES the indicated defect and MES inform the operator. Operator chose a valid option in MES screen and record the defect in one single "click"	More reliable information of quality defects in quantity and description Less hours of operator training necessary since the operation is more simple	**Operator**	Calculate and evaluate benefit design	*7,356*	= *((3.5+3.5)/60)*48*52*4.21*3*2*
		Operator should handwritten record the defect not indicated by the machine.	Operator chose a valid option in MES screen and record the defect in one single "click"			Calculation of hours not worked by the supervisor completing documents (Benefit: Satisfaction)	*5,200*	
3	Record Defect and quality losses tracking (scrap/rework/sorting)	Quality specialist needs to have QSC template form well fulfilled for scrap and rework stratification. Usually this information is not reliable and it is necessary to double check in the factory every time at the beginning of any Kaizen	MES have all information stratified by failure mode, shift, day, product	Less FTE necessary for the specialist for quality losses stratification	Quality Specialist	Calculate and evaluate benefit design	*5,165.29*	*= 87810/17*
4	Activate the Help Chain	Process out of control (QSC and control charts): Operator need record the defects manually in defects control and if surpassed the control limits the Help Chain must be activated	Process out of control (QSC and control charts): Operator need record the defects in MES. If surpassed the control limits, MES will generate and alarm in the screen and also in the Andon	- More stable process and more stable quality delivered - 100% of visibility when process is out of control (Andon + system) - Faster reaction and consequently ↓ scrap and rework	Quality Specialist		*67,000*	*44%* of reduction in rework in 9 months in line. (+*34%* in comparison with 10% reduction in line I in same period) => USD *67*k in *12* months
	Total Revenue						***130,633.29***	

Fig. 3 Revenue using BPM approach with a technology information system (show me the money)

The learning inefficiency curve is unavoidable until achieving point 1 on time axis. As the project advances start capturing benefits until the break even on return of investment is achieved in target 1 (axis y 1.5 with axis x target 1). A long-term benefit is then capitalized from the knowledge gathered from the first step (axis y from 0 to 1.5). After lessons are learned in the use of the new tool and automated methods evolve we reach the return of investment of target 2 (axis y 3 with axis x target 2).

Using actual data to validated that was presented in the Fig. 2, we explore a real case in the company 1 related to quality rework shop floor process in the Fig.3

The columns on Fig. 3 represent the BPM support approach, the effort without system for each task, the result after information technology tool (Manufacturing Execution Systems (MES)), the expected gains for each task, the responsible for execution at shop floor and the calculations method with benefits and comments. When the company uses the correct BPM approach for these work benefits, visibility of change management and the ROI for this kind of investment are easily shown.

V. ANALYZING, RESULTS AND FINDING A WAY TO HAVE FACTS

There are two possible initial situations: (1) The business process is fully new in the company and has not yet executed or (2) it already performed manually without explicit BPM support. Depending on the situation, either exists only a vague expectation of the process—possibly in standard procedure—or even only exists in the personal know how of the employees involved in the process so far. In both cases, the goal of the design step is an explicit business process model as a formalized representation of the business process of interest, represented in a process modeling language.

In the subsequent analysis step, the process model has to be validated. For that purpose, all stakeholders check whether it contains the execution sequences of all valid process instances. Furthermore, the model can be use in simulations in order to collect information about the number of required resources. The analysis step can also comprise an automatic verification, which checks whether the model is free of deadlocks. In the configuration phase, the process model created during the first phase has to implement. This can be done in two different ways: (1) It can be implemented without any software support by a set of policies and procedures which the employees need to comply with or (2) it can be realized using a dedicated software system.

In the latter case, an implementation platform chosen and the process model enhanced with technical information in order to facilitate the enactment of the process by the BPM system. This often comprises the integration of existing software systems (legacy software systems) with the BPM system.

The phase finishes with a test of the implementation. For that purpose, the normal test approaches from software engineering are used. In the enactment phase, which is normally the longest phase of the BPM lifecycle, the different process instances of the business process are executed to finish the quantity task.

In case of the application of a BPM system, it controls this execution according to the constraints and business rules defined in the process model. The BPM system's monitoring component can provide information about the execution status of a process instance. During the whole enactment phase, execution data is collected and stored in some form of a log file. This data is the basis for the evaluation in the next phase of the lifecycle.

In the evaluation phase, the available log data is used to evaluate and improve the process model and its implementation. For these purposes, business activity monitoring and business process mining techniques are used. Business activity monitoring can help to identify, for example, bottlenecks of process model implementations caused by a shortage of required resources. Business process mining—a rather recently developing field of research [1] can be used as a starting point for the development of process models from log files created by traditional information systems, instead of dedicated BPM systems.

These traditional systems support the execution of processes even without the prior explicit definition of a process model. Furthermore, business process mining is helpful for discovering control, data, organizational and social structures of the process execution goals of business process management companies expecting to reach several goals when using the BPM approach. References [10] as well as [2] give an overview of such goals, which BPM is able to fulfill.

Better understanding: The explicit representation of business processes can help a company to get a better understanding of the operations it performs and the dependencies with possible side effects between the different processes [10].

Standardization of business process execution: The explicit representation and the IT supported process execution help to narrow the gap between how a process planned to execute in theory and the way it actually execute in practice. Thus, a more standardized process execution can reach.

Improved communication: The explicit representation of business processes as well as using BPM terminology can improve the communication between the different stakeholders by making it more efficient and effective. Through this, also the collaborative analysis and identification of potential improvements becomes easier.

More flexibility: BPM can improve the flexibility of business processes for a faster adaptation to changing market situations and customer requirements. The explicit modeling of the process and their IT support are important factors to reach this goal. Continuous process improvement: The evolutionary approach of BPM allows a continuous improvement of the business processes. The explicit modeling and IT-based execution enable the analysis and identification of potential for improvements.

Repository of business processes: A company can construct a repository with all its modeled business processes. This is an important asset as it captures the company's knowledge about what and how it performs its operations [10]. Benchmarking: The explicit representation and the IT support enable to collect performance measures at specific points of a process. That way, internal and external benchmarking becomes possible [2].

Enabling cooperation/outsourcing: When a process modeled with all its performed operations and dependencies, it also becomes easier virtually span processes over the borders of companies, or to outsource parts or whole processes are not the core competency of that company [2]. Event driven process chains (EPCs) developed by the Institut für Wirtschaftsinformatik at Universität Saarbrücken. In the 1990s, there was a project together with SAP to define a suitable business process modeling language to document the processes of the SAP R/3 enterprise resource planning system. This project produced two major results: the definition of EPCs and the documentation of the SAP system in the SAP Reference Model [5].

The following formal definition is based on [10]. Yet, it partially uses some terminology from [7] instead. An event-driven process chain is a 5-tuple (E, F, C, m, A) for which holds:

- E is a nonempty set of events.
- F is a nonempty set of functions.
- C is a set of connectors.
- m: C - > {AND, OR, XOR} is a mapping which assigns to each connector a connector type, representing AND, OR or XOR (exclusive or) semantics.
- Let N: = E □ F □ C be the set of nodes. A **C** N x N is a set of arcs connecting events, functions and connectors such that the following conditions hold:
  - G: = (N, A) is a connected graph.
  - Each function has exactly one incoming and exactly one outgoing arc.
  - There is at least one start event and at least one end event. Each start event has exactly one outgoing and no incoming arc. Each end event has exactly one incoming and no outgoing arc. All other events have exactly one incoming and one outgoing arc (intermediate event).
  - Each event can only followed—possibly via connectors—by functions, and each function can only followed—possibly via connectors—by events.
  - There is no cycle in an EPC, consists of connectors only.

Events, shown in Fig. 4a represent their pre and post conditions. Functions, shown in Fig. 4b for the graphical notation, represent the activities of the modeled process.

Connectors are the third node type of an EPC. They used for modeling non-sequential control flows. Connectors can be divided into split (one incoming and several outgoing arcs) and join (several incoming and one outgoing arcs) connectors. Besides, each connector node has one of the three types AND (Fig. 4c), OR (Fig. 4d) or XOR (Fig. 4e). At AND split connectors, all subsequent branches are executed in parallel. At XOR split connectors, exactly one branch taken. OR split connectors are in between, here, at least one (possibly several ones or even all) of the subsequent branches is executed. The execution of an EPC starts when a start event (from possibly several ones) occurs. Afterwards, the arcs between the nodes together with decisions at split connectors define the path of the control flow through the process model. The execution finishes when an end event (from possibly several ones) reached. Fig. 4 shows an example of a small and simple process model modeled as an EPC. The process starts as soon as start event "event A" occurs. Then, "function B" executed first. Based on the outcome of this execution, the following XOR split connector decides which of the two subsequent branches taken. Depending on this decision, the corresponding branch executed. The control flow passes the XOR join connector as soon as this branch has completed. When the end event, "event G," is reached, the process execution is finished.

VI. CONCLUSION

The improved productivity based on reduced task time, translates directly into savings achieved by not having to hire additional people to perform the same work that the first person could have already performed.

Preliminary implementation results of system application, using business process management approach in the shop floor routine with ROI methodology, has surely been demonstrating the lack of effort to prove its value without long speeches and speaking the sponsor's financial language.

Nevertheless, to implement it is required human capital expertise, organizational culture understanding business process experience and project management seniority. The result is tangible: reduced losses, increased focus in cost awareness and capacitating people to add value to the company.

(a) Event. (b) Function. (c) AND connector. (d) OR connector. (e) XOR connector.

Figure 4: Graphical notation of the different EPC components

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