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Process Management and Accounting - An Overdue Take on Measuring the Economic Value of Business Processes

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Imagine that your CEO asks you to report on the economic value of your BPM initiative. Such requests often arise for those who are trying to sell the idea of BPM. Projects must be planned according to investments and returns, and those who run BPM initiatives must demonstrate those initiatives' contribution to corporate value. Could you provide such numbers? Imagine that you approach your CFO to ask for funding for your next investment into process improvements. Do you have the data available to calculate the ROI of the process improvement? What if your CEO is not convinced at all by BPM evangelists' buzz phrases proclaiming that adopting BPM is the best thing to do to manage an organization? How do you convince your CEO that BPM pays off? Finally, as a process manager, ask yourself: "How do I know whether my BPM initiatives walk the talk in terms of economic value?"

This Column presents a basic yet powerful toolkit, the *Process Accounting Model* (PAM), that can help you gather the data you need to make transparent the economic value created or drained by your business processes. This toolkit can help process managers justify their BPM initiatives in a language that sounds familiar to other business people, particularly accountants and decision-makers in the senior management team.

Accounting for the "business" part of "Business Process Management" is overdue, as it has been widely neglected ever since the Business Process Re-engineering (BPR) wave hit organizations in the early 1990s.

The Process Paradox – A Matter of Accounting Data Availability

All too often, **process managers** focus on boosting operational performance, on making the organization lean, or on attaining Six Sigma levels and get lost in the technical details of process implementation, pondering over the suitability of process modeling notations or contemplating whether to add yet another modeling perspective to their process documentation. However, all this ado about process implementation details, business process management systems, quality improvement programs, and BPM methodologies often makes process managers

forget about the one **essential thing** business processes are there for: *doing business to create economic value*.
Even so, the BPM literature pays little attention to the economics of BPM initiatives, so it has produced over the last two decades a vast number of guidelines for achieving operational process improvements and **measurable benefits** without taking into account the **economic consequences** of such "improvements."[1]
However, operational process improvements do not always translate into increased business performance. As Keen (1997) put it, "*Benefits are not value.*"

Many **BPR projects** fail because benefits have been mistaken for value, when BPR projects that sometimes resulted in dramatic efficiency improvements did not improve business performance or even caused business performance to decline. (See exemplary cases in Table 1.) This *process paradox* (Keen 1997), which a considerable number of organizations have experienced as they embarked on business process transformations, might disincline senior management to fund prospective BPM initiatives or incline them to abandon existing initiatives altogether.

Process Improvement Result	Business Result	Paradox Reported in
Cutting the time to issue policies through process automation from three weeks to three hours. (The case company is Mutual Benefit, as presented in Hammer, 1990.)	• Insurance company went broke soon after the BPR initiative.	Keen (1997)
34% cost reduction in a computer company's financial processes after re-engineering	• Operating income stalled despite business process re-engineering.	Hall et al. (1993)
44% reduction in claims processing time at an insurer.	• Profits declined.	Hall et al. (1993)
20% cost reduction, 50% process-time reduction, and 25% quality improvement	• Business unit costs increased. • Profits declined.	Hall et al. (1993)

Table 1. Process paradox – when operational improvements do not translate into economic value

The **central message** of the process paradox phenomenon is that getting some processes right is not important, but *getting the right processes right* is, and that *"the right processes"* are the business processes that can make a difference in terms of economic value creation when they are improved or re-engineered.

How do you spot the right business processes in your organization? Common sense suggests that an organization's **accounting information systems** should be able to provide such information, but the reality is that traditional accounting approaches and current accounting information systems cannot provide the data that process managers need to plan, monitor, and control their business processes.

This observation was made in Harmon's 2011 *BPTrends* Advisor which called for the development of process-oriented accounting approaches that would give process managers "accurate performance data and metrics about processes" and "precise accounting data" that is reflective of business processes' contributions to value. To

[1] Some rare exceptions include Buhl (2011), Gaitanides (2002), Gulledge et al. (1997), Keen (1997), and vom Brocke et al. (2010).

obtain such data and thereby **resolve the process paradox**, accounting has to become process-aware to the same extent that BPM has to become amenable to accounting. Therefore, we suggest an approach by which to integrate BPM and accounting and make *process-oriented accounting* a reality.

Resolving the Process Paradox by Integrating BPM with Accounting

As history has shown, BPM initiatives can lead to paradoxical results in terms of business performance. Although process managers need appropriate accounting data for their **BPM decision-making** processes in order to mitigate the risk of encountering such results, obtaining process-oriented accounting data is a challenging task for most process managers, as current accounting practices and accounting information systems are poorly integrated—if they are integrated at all—with BPM practices and tools (Figure 1).

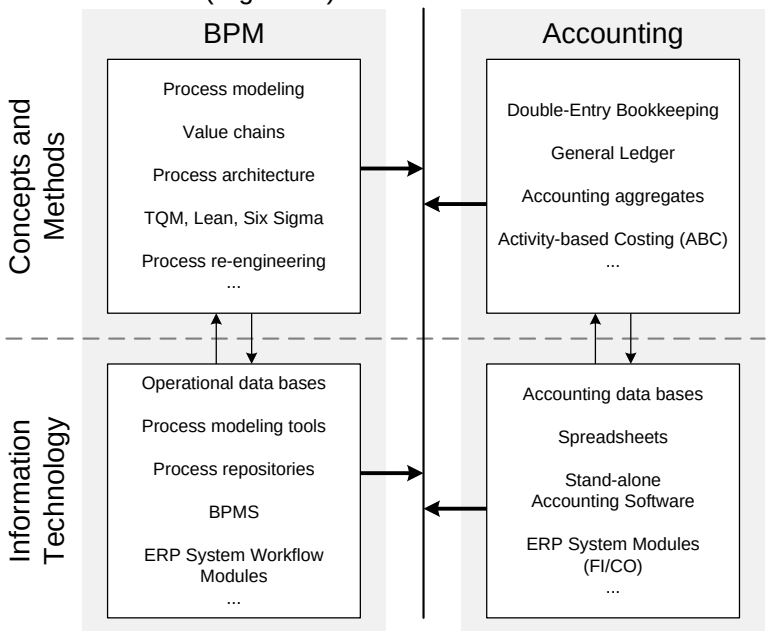

Figure 1. Integration barriers between BPM and accounting

Integration barriers between BPM and accounting on a **conceptual level** emerge because of the two entities' differing understanding of concepts like transactions, activities, processes, costs, and value. Moreover, accounting techniques are seldom integrated into the planning, monitoring, or controlling of business processes.

Occasionally, BPM writers propose some "activity-based costing" methodologies, but these costing approaches often mistake overhead costs for variable costs, confuse standard costs with actual costs, or fail to distinguish between full (absorption) costing and partial costing approaches. Accounting, for its part, is generally unaware of business processes and provides accounting aggregates that cannot be decomposed in a way that discloses in quantitative terms how business processes contribute to an accounting aggregate. The smallest unit to which an accounting aggregate can be decomposed is an account posting.

On the information **technology level** the main barrier to integration between BPM and accounting is that process-aware information systems and accounting information systems are separate entities that have few, if any, communication links. This separation makes it all but impossible to capture precise accounting data in a process context.

Recent research in the field has made substantial advancements in overcoming these barriers on both the conceptual and information technology levels. As described in the **Process Accounting Model (PAM)** (vom Brocke et al. 2011; Sonnenberg & vom Brocke 2014), the key to integration is to focus on the one concept that is commonly understood and exploited in the practice of both BPM and accounting: the concept of *events*.

The Process Accounting Model (PAM)

Basic Idea: Extending Business Event Logs to Process-oriented Accounting

With the proliferation of computerized information systems, it is now possible to detect and document automatically a vast number of **event occurrences** from various event sources. Such event types range from web-page-visit events to sending or receiving emails, receiving or missing telephone calls, completing online orders, creating maintenance and error messages in an onboard car computer, recording position signals with GPS-enabled systems, reading RFID chips, landing or departure events in air traffic control systems, and low-level computer system events like user interface interactions (clicked, touched, dragged) and software events (e.g., exception events, system events). There are also many cases in which event occurrences are manually recorded and stored in computerized information systems (e.g., employee time tracking, patient registration in a hospital).

Dedicated event logs, created to manage and/or analyze the occurrence of particular events, contain records of ***business events***, that is, events that management wants to plan, monitor, or control (Sonnenberg & vom Brocke 2014). Business process management systems (BPMS) maintain event logs in a structure similar to that shown in Figure 2.

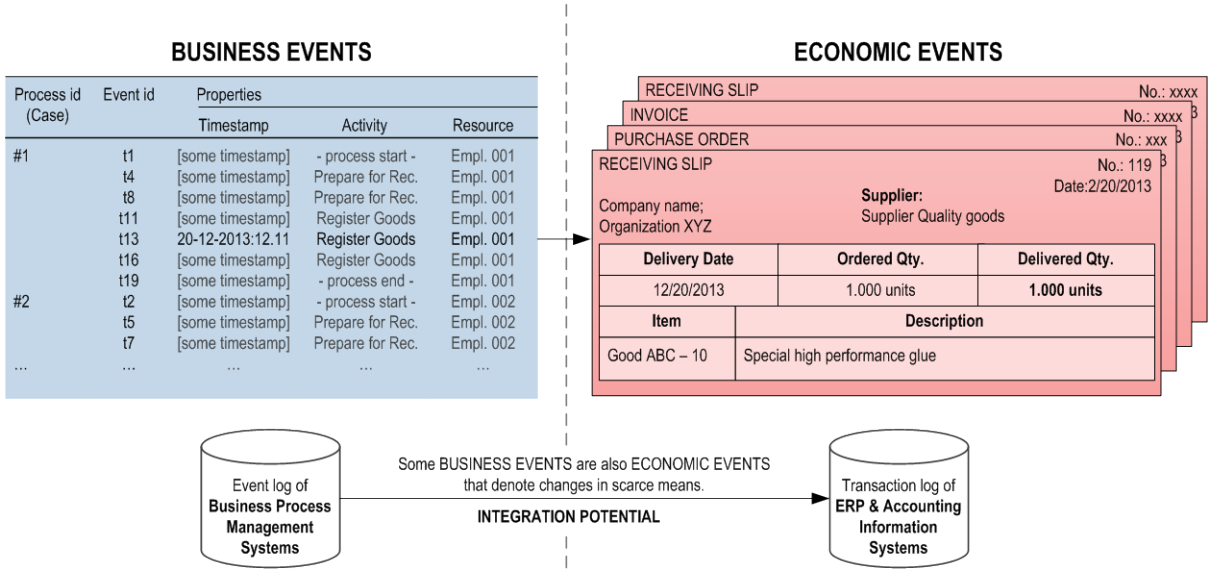

Figure 2. Business and Economic Event logs

Business events that change the availability of economic resources under an organization's control (cf. Sonnenberg & vom Brocke 2014) are called ***economic events*** and are recorded by ERP and accounting information systems (Figure 2). Exemplary economic events are the receipt of a good (increasing the resource stock), payment of an invoice (decreasing the cash account), and consumption of materials within a production process (decreasing the stock of materials).

Unlike those of other business events, records of economic events are spread over multiple database tables or even over multiple information systems, as economic events usually have no centralized or unified event log. For example, upon receiving a good, a company creates a "receiving slip" (event record of a goods receipt) that may be stored in a database associated with an ERP system's logistics or SCM module. The procurement department may have created a related "purchase order" (commitment to purchase a good) through a logistics information system or a materials planning or SCM module. Finally, "invoices" (economic events that fulfill commitments, such as a purchase order) are registered and posted in accounting information systems or an ERP system's "financials" module.

Since they are business events, economic events happen in the context of executing business processes. It is the analysis of these economic events in a **business process context** that allows process managers to explicate an individual business processes' economic impact. If it were possible to maintain a reference from business event logs to economic event logs, process managers could obtain accounting data that was truly process-oriented. To do so, two problems must be overcome:

(1) Traditional business event logs do not refer to economic events.

(2) Economic events are not maintained in a centralized event record, so data related to economic event records are spread over multiple database tables and information systems.

The next section presents a blueprint, the Process Accounting Model, for structuring a centralized **event database** that can capture and maintain the event records of both business events and economic events by integrating BPM and accounting.

The PAM-Meta-Model – A Blueprint for a Centralized Accounting Event Log

The purpose of the Process Accounting Model (PAM) is to provide a blueprint for structuring event logs in order to provide decision makers with process-oriented accounting data. The blueprint is specified as an entity-relationship diagram (Chen 1976) that makes the transition from a conceptual data model to a concrete database implementation straightforward. The PAM, developed as part of research projects that spanned multiple years, has been applied successfully and evaluated in a number of projects in organizations around the globe. A detailed presentation of the PAM's development is provided in Sonnenberg and vom Brocke (2014) and in vom Brocke et al. (2011).

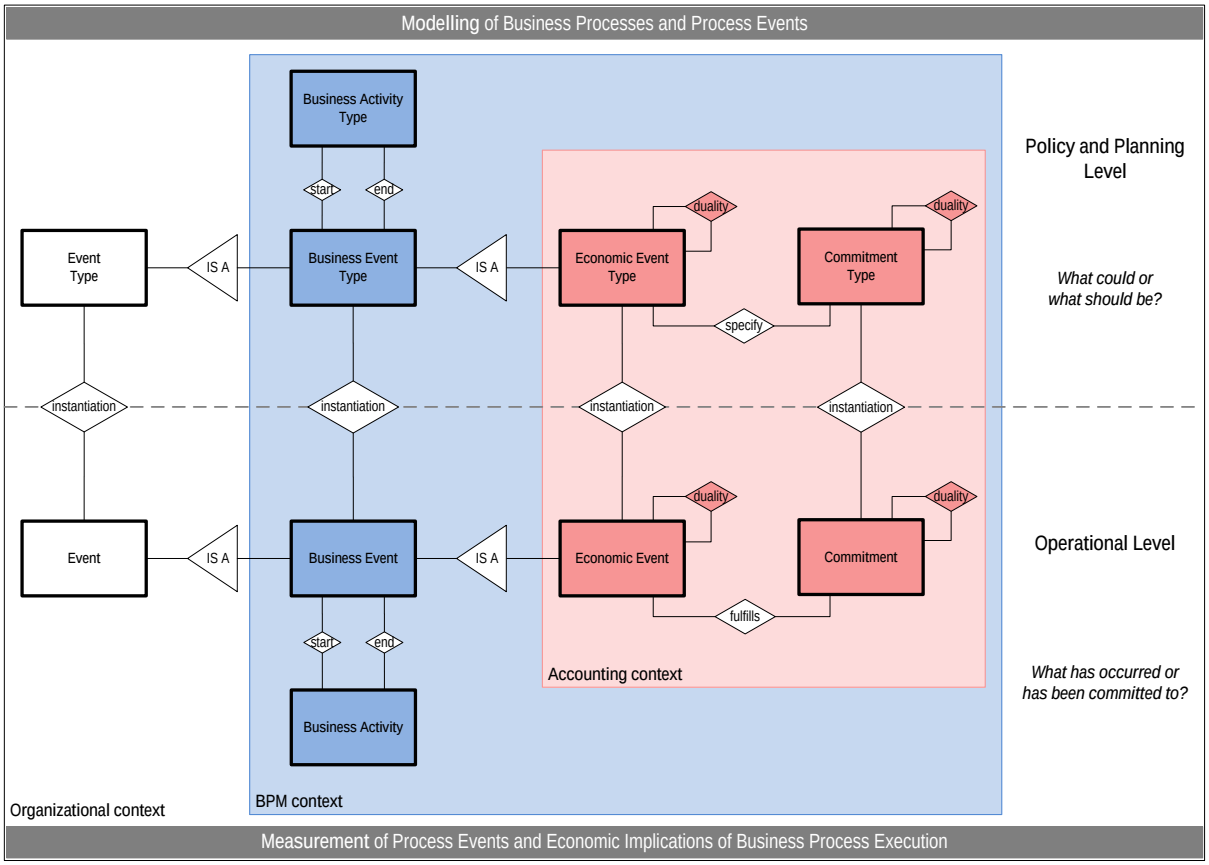

Figure 3. The Process Accounting Model Blueprint (adapted from Sonnenberg & vom Brocke 2014)

The PAM blueprint shown in Figure 3 illustrates four design principles that any PAM-compliant event log must consider:

(1) Data disaggregation
(2) Event classification
(3) Process-relatedness
(4) Economic reciprocity

The principle of **data disaggregation** stipulates that event data should be recorded in a form that is as disaggregated as possible in order for it to be useful in many decision situations. In other words, the disaggregation principle allows event data to be analyzed along multiple dimensions.

The **event classification** principle allows a drill-down path through multi-dimensional event records to be established in accordance with particular decision-making needs. The decision-making need that the PAM addresses is the need to obtain process-oriented accounting data. The corresponding "drill-down path" is established by classifying events into plain events, business events, and economic events (Figure 3). The rationale used in this classification is as follows: *Plain events* are those that are captured from various event sources but no significance for managerial decision making is attached to these events. *Business events* are plain events that management wants to plan, monitor, and control. *Business event records* refer to their original plain event records (disaggregation principle) but add specific business relevant data to them. Finally, *economic events*, which form the end of the

drill-down path in process-oriented accounting, cause changes in the availability of economic resources under the control of an organization, an organizational unit, or an economic agent. Therefore, economic events add additional references to data sets like “economic resources,” “resource flows,” and “economic agents” in the event log (cf. McCarthy 1982).

The **process-relatedness** principle holds that business events should maintain a reference to a process context. This principle is usually implemented in the current event logs of BPMS (Figure 2), but economic events must also be equipped with a process context since they are also business events.

The principle of **economic reciprocity** captures the essence of any economic activity (cf. McCarthy 1982): for every resource that is obtained, one or more resources are usually sacrificed in return. This give-and-take principle is widely neglected in current BPM thinking in favor of postulating that the customer should be the focal point in business process design, which focuses only on the “give” component of economic activities. Forgetting about the “take” in process designs and operational process control is a common mistake, but business processes are designed not only to satisfy the customer (i.e., to realize the “give”) but also to create economic value for the organization that owns the business process (i.e., to realize the “take”). The PAM accounts for give-and-take patterns in economic activities through reciprocal “duality” relationships between economic events and economic commitments[2].

The PAM blueprint also distinguishes between a type level and an instance level in process-oriented accounting. Definitions of relevant process elements and event types on the **type level** are captured within *process models* and describe the intended behavior of business processes (i.e., what could or should be). Actual event occurrences and process instances are recorded on the **instance level**, which accounts for what has happened or is currently happening. Figure 4 shows how the PAM elements on the type and instance levels are put to work in BPM practice.

[2] Economic commitments are promises to execute economic events in the future, made through explicit or implicit contracts. Therefore, economic events fulfill economic commitments.

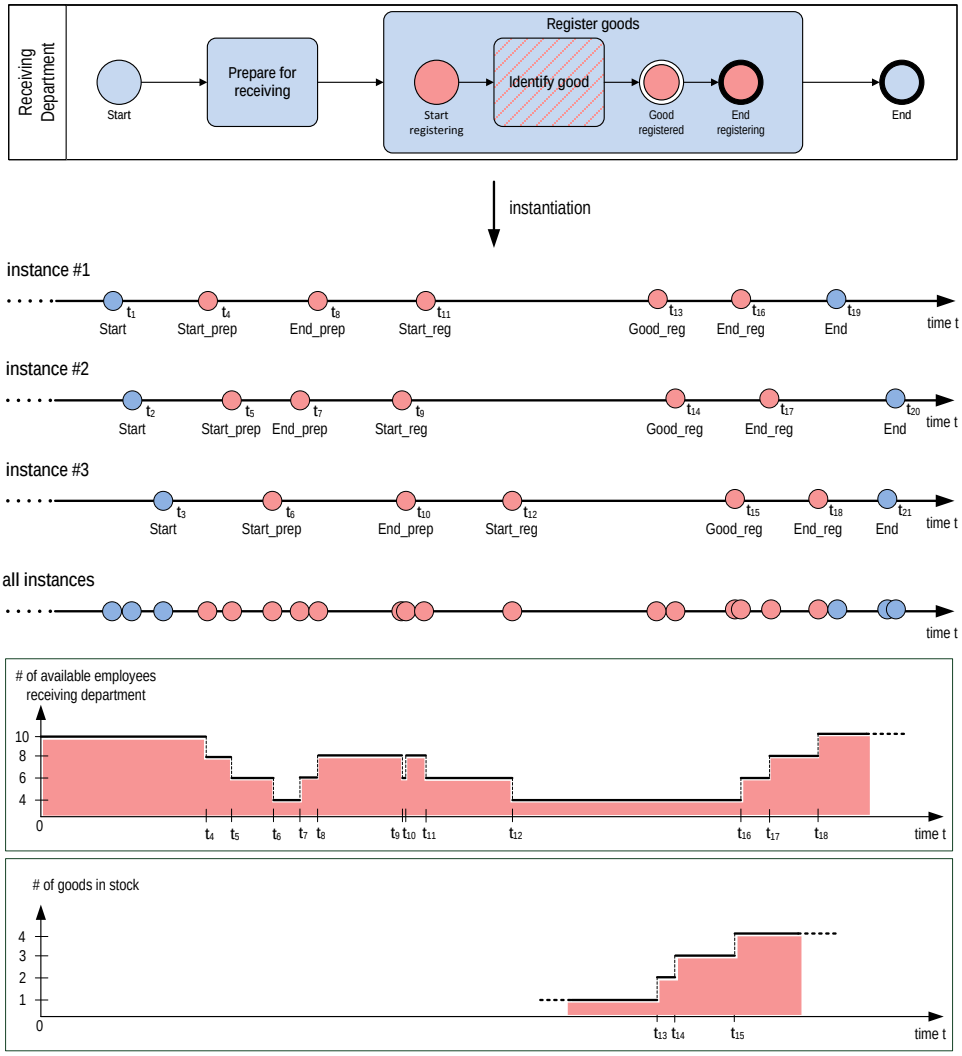

Figure 4. Business processes, viewed from a PAM perspective

Figure 4 shows business and **economic event occurrences** as they unfold over time. The event occurrences correspond to the process model. Business events and business activities (i.e., composite business events) like the "start" and "end" of process executions are filled with blue color. Some business events affect the availability of resources, such as when an activity is executed manually and requires labor time, reducing the availability of labor, and when a good is identified and registered, increasing the stock level of this good.

As Figure 4 shows, **process models** and **stored event occurrences** relate to each other. Process models can specify which events should be recorded in an event log. Moreover, at design time, the events that may also affect resource changes and should, therefore, be classified as economic events can be considered. For example, for the activity "Identify good" in the process model in Figure 4, no economic events have been defined. However, if the activity is intended to be performed manually, then at least one economic event could be defined that indicates that an employee's labor time is consumed. On the other hand, if this activity is performed automatically (e.g., by a bar code scanner positioned on a conveyor belt), then an economic event should be defined indicating the use of technical equipment. The process model could

also be annotated with additional information about how the activity should be performed.

At run-time the event data associated with a business process (model) can be extracted from a **PAM event log** in order to analyze the economic impact of event occurrences in near-real time. Accounting data can even be fed back into process models or modeling tools, thereby annotating process models with additional accounting information (as shown in Sonnenberg & vom Brocke 2014). Process managers can also analyze process models for their implied economic impacts by simulating event occurrences based on process models and then analyzing the event log created by simulation runs.
The next section presents some tools that can facilitate the application of PAM in practice.

Business Process Analysis with a the PAM – The PAM Toolkit

Several analysis tools have been devised to facilitate use of the PAM:
Event selector – Extracts business or economic events according to event attributes (e.g., timestamps, time intervals, events that belong to a process instance, events that correspond to event types defined in a process model, events that affect a particular resource).

Event correlator – Correlates event occurrences, such as all events that are related to a customer order or that belong to the same business transaction. (E.g., a purchase requires the receipt event of an ordered good, which has to be paired with a corresponding payment event.) The event correlator can also be used to reconstruct process models from the event log through *process mining* techniques.

Event simulator – Generates event occurrences for simulation runs according to process descriptions or probability distributions assigned to event types.

Economic value analyzer – Queries the data associated with economic events in order to quantify the economic implications of its occurrences (e.g., costs, cash flows, other resource flows).

Business Activity and Cost Monitoring

The PAM tools may be used to augment traditional **business activity monitoring (BAM)** with cost-monitoring capabilities. For this purpose the information queried from a PAM event log can be presented in **cost-cycle-time charts** (Figure 5) that show the cycle times of process steps and the assigned cumulative costs of a business process. (The chart in Figure 5 refers to the process in Figure 4.). The event selector can obtain the cycle times easily (e.g., by calculating the duration between the event occurrences that pertain to the “goods receipt process” for the time 1-20 December 2013).

Cost-cycle time charts (Harrington 1991) can also be used to visualize cost and time savings from a **process improvement initiative**. Figure 5 shows results from a simulation run. The ability to quantify cost savings can help users to anticipate whether the cost expenditure for a process improvement can be justified by the expected cost savings.

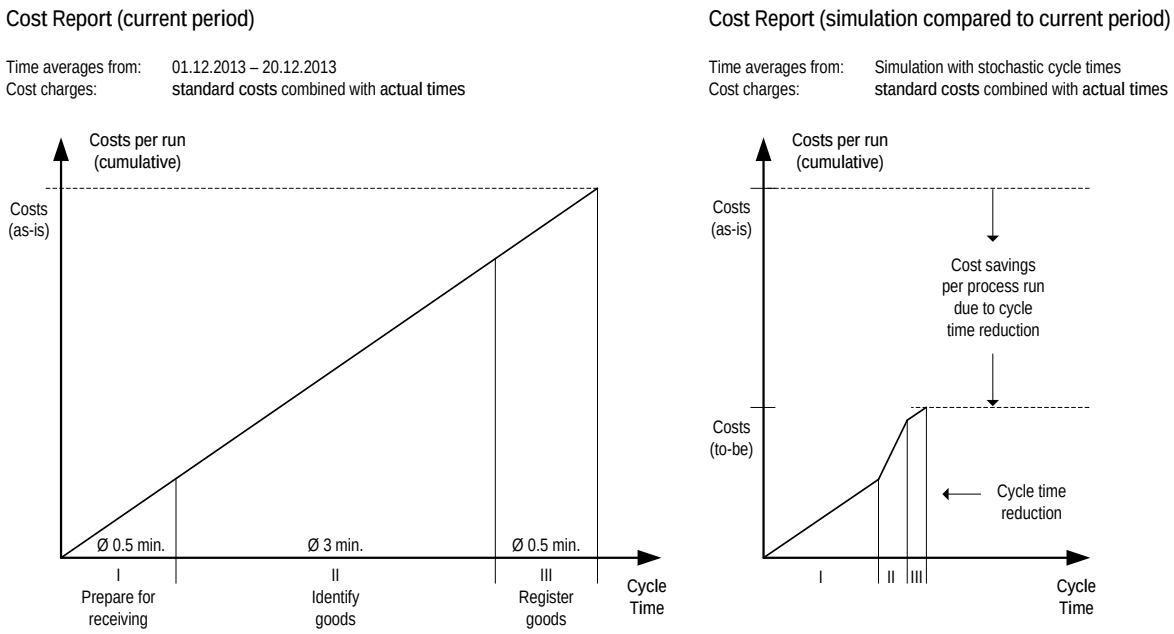

Figure 5. "As-is" and "to-be" cost-cycle time charts of a business process

Customer Profitability Analysis with the Whale Curve

Another use of the PAM toolset is a **customer profitability analysis**, which determines which customer relationships create economic value for the organization. To perform a customer profitability analysis, the user selects all economic events of all business processes that are related to the execution of a customer order (or a set of orders from a customer within a given period) using an event selector and an event correlator to analyze for the order's implied **costs and cash flows**. A typical result of such an analysis reveals that some customer contacts create significant economic value, while most customers add only moderate or no value, and some customer relationships destroy economic value (Figure 6). The customers in the last group tend to place small orders and/or generate extra workload because of specialized processing requirements, which result in process costs that outweigh the revenues generated.

The right **process improvements** can turn unprofitable customer relationships or unprofitable customer orders into profitable ones (Kaplan & Anderson 2004) (Figure 6). Such process improvements might aim at decreasing process costs for specialized customer orders or at negotiating with customers to increase order sizes, standardize order procedures, or increase product prices. Again, the financial effort to improve a process must not be greater than the realizable increase in profit to avoid decreasing business performance. A PAM-event log can provide the relevant accounting data to support such decisions and make clear the economic effects of process improvements under consideration.

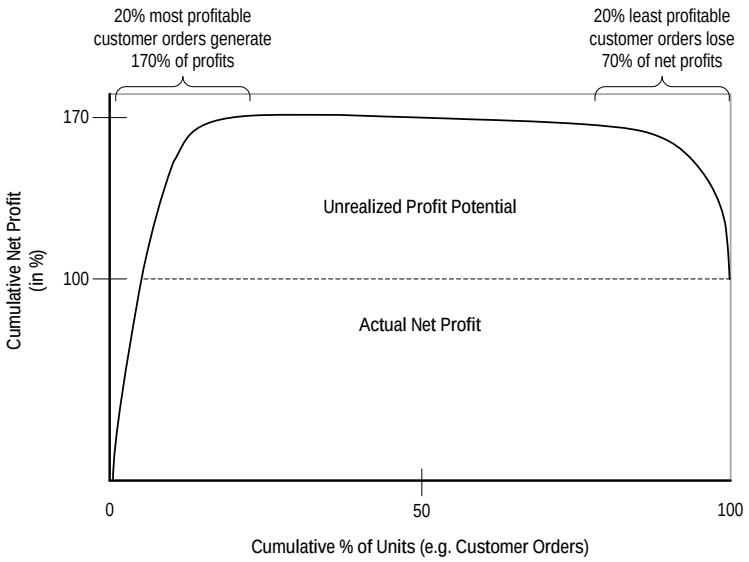

Figure 6. Whale curve for visualizing the cumulative profitability of customer orders (adapted from Kaplan & Anderson, 2004)

Economic-Value Added Analysis

Another way to identify economic value drivers in business processes is to apply an **economic value-added (EVA)** analysis. EVA analyses are best applied to support strategic decision-making in BPM. The EVA of a business process might be calculated according to the calculation scheme shown by:

$$EVA_{process,p} = \left(\sum_{\substack{\text{all } i \text{ in period } p \\ \text{process instance } i}} (Revenue_i - Costs_i) \right) - INVESTMENT_{process,p}$$

The minimum requirement for a business process to increase EVA is that revenues generated by a process are greater than the costs of the process in a given period p. Such revenues result not only from sales but also from cost savings achieved through process improvements. In the case of planned **process improvements**, the contribution of a process to EVA is only positive if the process improvement also "earns" the investment in a given period p.

A **PAM event log** can provide the data needed to calculate the process EVA. Revenues can be calculated by selecting all economic events for a process in a period p that denote sales of a product or service, and process costs can be derived from the event log according to the time-driven activity-based costing method (TD-ABC) (Kaplan & Anderson 2004). Cash flows related to investments can either be calculated separately in dedicated spreadsheets or documented in and retrieved from a PAM event log.

The EVA equation reveals four main **value drivers**: process revenues, process costs, process execution frequencies, and investment payments. Figure 7 represents the economic impact of the first three drivers by showing the EVA of two processes by multiplying the difference between Ørevenues and Øcosts by the process frequency. In this case, the EVAs of the two processes are equal, but they differ with regard to their revenue, cost, and frequency structure because of the differing economic events involved in these processes. To **increase a process's EVA**, management can work to decrease process costs, work to increase revenues, or work to increase the

process frequencies. Investments into process improvements have to be "earned" by the resulting increase of an EVA (ΔEVA). Process simulations, which PAM event logs readily support, can provide insights into whether planned process improvements do, in fact, earn such the investments they require.

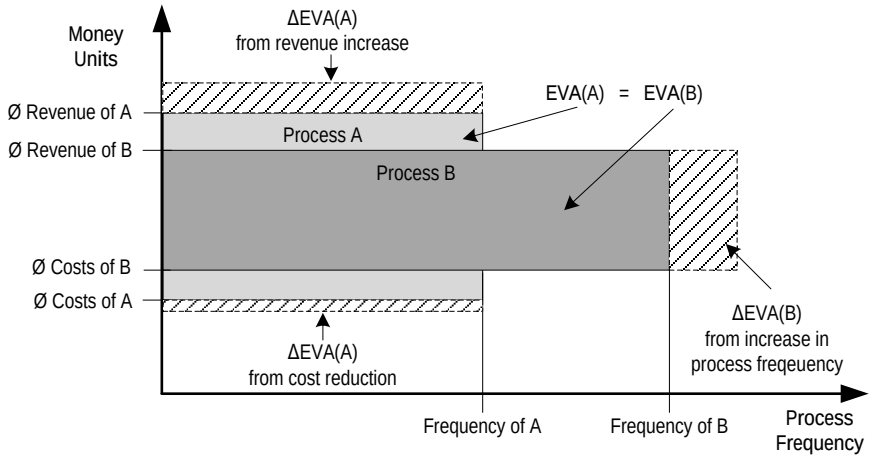

Figure 7. Economic-value-added analysis (adapted from Gaitanides, 2002)

Summing Up – Lessons Learned

This Class Note is a plea to account for the "B" in BPM, that is, to focus on creating economic value through BPM practice by integrating BPM and accounting more closely. Even though BPM and accounting investigate the same phenomena, they cannot use each other's data sufficiently. We identify four conceptual and technical barriers to such integration and present the Process Accounting Model (PAM), which helps to overcome these barriers by conceptually integrating BPM and accounting. We also present tools with which to apply PAM in practice, along with exemplary results.

A Call to Get Engaged

PAM is part of ongoing research to which we invite practitioners and researchers to contribute, as improved management of the economic value of process-related work needs contributions from many angles and sources. Such contributions are much needed to further our ability to demonstrate the impact and importance of process-related work and to improve how we plan and manage our initiatives in order to delivering demonstrable value.

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