Building a Process Performance Measurement System: some early experiences [1]

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ABSTRACT

In order to gain a competitive advantage many companies are engaging in the reorganization of their business processes and implementing process-based management. However, the effects of such change programmes are often not readily apparent. To deal with this shortcoming Process Performance Measurement Systems (PPMS) can be used. The authors argue that modern process-oriented organizations need to establish a system which provides comprehensive and timely information on the performance of business processes. Based on the authors' experience with several enterprises, an approach to composing a sound PPMS is described and conclusions are drawn.

1. INTRODUCTION

"Measurements are key. If you cannot measure it, you cannot control it. If you cannot control it, you cannot manage it. If you cannot manage it, you cannot improve it."[1] And further on, the same author writes "Measurement is fundamental to our way of life. We measure everything. (...) When we were babies, the doctor measured our height and weight to be sure that we were healthy. When we started school, our teachers measured us to understand our weaknesses and help us progress."[1] Although these statements made by James Harrington — one of the early proponents of business process restructuring — are almost ten years old and have been repeated quite often, they have not lost their relevance. Even a short examination shows that many

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organizations have been undergoing business process reengineering (BPR) programmes in the last few years.[2] Despite the large expenditures on reengineering programmes, few companies are able to assess the current level of performance of their processes. Performance measurement at the process level still plays a minor role. Additionally, those few enterprises which do have a process-oriented measurement system in place usually take only financial and time-related aspects into consideration.

An organization which is implementing a process-based organization, either through a radical or a stepwise approach, should be able an answer the following two questions: (1) Is the current performance of the business process better than it was yesterday? (2) To what degree are the to-be values fulfilled? In order to answer these questions, a so-called Process Performance Measurement System (PPMS) is needed.

The paper is structured as follows: the main components of process management are presented in section 2. In section 3 an overview of the state of the art in the field of performance measurement is given. Section 4 outlines the functional requirements for a PPMS. Section 5 presents a nine-step approach – applied in the project PROMOSYS – to compose a PPMS. Finally, section 6 concludes with some lessons learned. (An earlier version of this paper has been published in the proceedings of the BITWorld conference.[3])

2. THREE COMPONENTS OF PROCESS MANAGEMENT

In the past, Taylorism made it possible to build up organizations along functional lines. While this sort of organization was an effective way to increase productivity during the industrialization era, it was later recognized that core competencies lie in cross-functional processes. Therefore business process management was introduced which includes the following components:

- ***Process design***: Since many corporations are organized along functional lines, they usually have little knowledge about their processes. Thus, establishing a process-oriented organization starts with the identification of the processes needed. In order to design, communicate, and implement business processes, process models can be seen as an essential prerequisite. Kueng and Kawalek[4] describe a goal-based approach to business process modelling. It is composed of the following steps: 1. Definition of business process-related goals. 2. Derivation and definition of business activities. 3. Description and assignment of roles. 4. Modelling of objects.
- ***Business case execution***: After composing and implementing the new established processes, business cases (i.e. instances of a process such as 'loan application no.

5971') are carried out. The execution of business cases relies upon the coordination, control, and communication of activities (working steps). As the capabilities of information technologies have improved considerably, the deployment of so-called CSCW (computer-supported cooperative work) tools is becoming more and more common. Put simply, two categories of CSCW tools can be distinguished: *workflow systems* that can be effectively used for highly structured, pre-defined processes, and *groupware tools* which are aimed at supporting rather unstructured, ad-hoc processes.

- ***Process measurement and improvement***: BPR projects usually stop after implementing the newly designed processes. If no further activities took place, the enterprises and their process managers would face several shortcomings: no information on the actual performance of business processes would be available, decisions about effective resource allocation could not be made on a sound basis, diagnosing the weaknesses of business processes would be hard, and decision-making regarding corrective actions would be exceedingly difficult. Dealing with these aspects is the aim of a Process Performance Measurement System.

3. PERFORMANCE MEASUREMENT: STATE OF THE ART

Performance measurement systems have been around for quite some time. The intellectual roots of today's measurement systems can be found in the period of movement towards scientific management at the end of the 19th century. For a long time, the most popular measurement system was the so-called DuPont scheme, introduced in 1919 by the DuPont company. Even though the DuPont scheme (which had as its main measure 'return on investment' ROI) has been criticized heavily, it is still being taught in its original or in a slightly modified form. Much more importantly, in many enterprises, the controllers still assess performance mainly through financial measures. Moreover, to the extent that managers do focus on financial parameters, they have a strong incentive to manipulate the figures they report.[5] A further aspect is raised by Letza: "... traditional measurement systems have a control bias, that is, they specify the particular actions they want employees to take and then measure to see whether or not the employees have taken these actions – they try to control behaviour."[6]

During the 1980s and 1990s the situation changed in a significant way: self-assessments, quality awards, benchmarking, activity-based costing, capability maturity model, balanced scorecard, workflow-based monitoring, etc. were the buzzwords which dominated discussions in the field of performance evaluation. These approaches are

discussed below and their main characteristics are summarized in table 1.

3.1 Activity-Based Costing

Activity-Based Costing (ABC) was developed in the mid 1980s within the framework of Cost Management System-Programs by Computer Aided Manufacturing-International, Inc. Their conception came from the following considerations: Modern manufacturing, logistics and information technologies change, to a considerable degree, the process and cost structures. Instead of direct, value added manufacturing activities more and more planning, monitoring and controlling activities, in the indirect ranges, dominate in enterprises. As a consequence this activity shift has substantial effects on the operational cost structure. The growing importance of fixed overhead costs leads to the desire for better cost transparency by developing ABC. In other words, ABC systems assign the costs of an organization's activities more accurately to its products and product lines. ABC systems are designed by first identifying the activities performed by each support and operating department and then computing the unit costs of performing these activities.[7, 8]

3.2 Balanced Scorecard

The Balanced Scorecard (BSC), developed by Kaplan and Norton[9], was developed to describe an organization's overall performance using a number of financial and nonfinancial indicators on a regular basis. For this purpose a framework with four perspectives has been suggested: the financial, the customer, the internal business, and the learning and growth perspective. According to the originators, the application of this tool can be seen in three areas: for the purpose of strategic performance reporting; to link strategy with performance measures; to present different perspectives. An important characteristic of BSC is that the tool is concentrated upon corporations or organizational units such as strategic business units. It looks at business processes only in as far as they are critical for achieving customer and shareholder objectives. [10]

3.3 Self-Assessment

The roots of the so-called self assessments can be seen in the quality movement which started in Japan. In 1951, Japan awarded the first quality-driven enterprise with the so-called Deming Application Prize. Encouraged by the Japanese success the USA launched the Malcolm Baldridge National Quality Award (MBNQA) in 1988. Finally the European Foundation for Quality Management (EFQM) followed in 1992 with the European Quality Award (EQA). In the American approach the criteria used belong to the following seven categories: leadership, strategic planning, customer and market

focus, information and analysis, human resource development, *process management*, and business results.[11] The EFQM model on the other hand applies the following nine categories of criteria: leadership, people management, policy and strategy, resources, *processes*, people satisfaction, customer satisfaction, impact on society, and business results.[12] These criteria can be used separately, i.e. without applying for an award. From this it follows that a self-assessment, based on the approaches discussed, may help to assess *process performance*,[13] but one has to keep in mind that the primary focus is upon organizations, and not on processes.

3.4 Competitive Benchmarking

"... we realised that benchmarking could be applied to all aspects of our business, and comparing ourselves against companies outside our immediate competition", This is a statement from two Xerox employees, Cross and Iqbal.[14] It is not accidental that a quote from Xerox has been chosen, since Xerox was the company that introduced the now widely applied concept of benchmarking. In addition to a systematic evaluation of business performance, benchmarking seeks to achieve a second goal, the identification of the best practices; but this is beyond the scope of this paper. What is the relevance of competitive benchmarking within the field of process performance measurement? The benefits are twofold. First, it can be used to stimulate the discussion of performance measurement. Knowing the process performance levels of an excellent company may motivate not only chief executives, but also lower-level managers and ordinary staff. Second, competitive benchmarking can be used to set targets for the process performance level a company wants to achieve.

3.5 Statistical Process Control

According to Juran and Gryna statistical process control (SPC) can be defined as "... the application of statistical methods to the measurement and analysis of variation in any process"[15]. The essence of SPC is to take as much variation as possible out of the process. In other words, the main objective of SPC lies in the achievement of stable processes through a reduction of process variation. Stability in a process, i.e. a state of statistical control, makes it possible to predict the behaviour of the process. To this end, making reliable predictions regarding product quality (i.e. predicting whether the product specifications will be met) has become an important tool of competition.[15]

3.6 Capability Maturity Model for Software

The Capability Maturity Model for Software (SW-CMM), was developed by the Software Engineering Institute (SEI) of the Carnegie Mellon University in Pittsburgh.

The underlying premise of SEI's maturity model is that the quality of software is largely determined by the quality of the software development process applied to build it. By means of a questionnaire, an organization can assess the quality (maturity level) of its software process. The five stages, defined by SEI, are as follows: (1) *Initial*, i.e. the software process is characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual effort and heroics. (2) *Repeatable*. (3) *Defined*, i.e. the software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. (4) *Managed*. (5) *Optimizing*, i.e. continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.[16, 17] One of the most important strengths of the CMM model is that each maturity level (except level one) is decomposed into several key process areas that indicate the areas an organization should focus on to move from one level to the next.

3.7 Workflow-based Monitoring

During the past few years workflow systems have been given considerable attention, both in research and in practice. Workflow systems support automatic or semi-automatic execution of process instances, coordination between process activities, and the communication between process actors. As a by-product of this support masses of data are gathered. They can be evaluated automatically and may offer useful information regarding activity-related costs, queuing time of process instances, workload of process participants, etc. While traditional measurement covers the firm in its entirety, workflow-based monitoring concentrates upon business processes. A further difference lies in the time period reported. Traditional control offers a post-hoc view, whereas workflow-based monitoring has the character of real-time reporting.[18] The merits of workflow-based monitoring lie in the fast reporting procedure as well as in its focus on business processes. Its limitations, on the other hand, are that qualitative performance data and performance data about activities carried out manually, can hardly be taken into consideration. A technical view is given by the Workflow Management Coalition which defines the term Workflow Monitoring as "... the ability to track and report on workflow events during workflow execution. Workflow monitoring may be used, for example, by process owners to monitor the performance of a process instance during its execution"[19].

3.8 Comparison of Measurement Approaches

As we have seen in section two, process-oriented organizations need a process management which is able to measure the current level of process performance.

Therefore a measurement system is needed which is *focused upon processes* — and not on organisational units such as departments. Since business processes may cross departments or even divisions, this aspect is central. Additionally, effective process management requires a *broad spectrum of performance-relevant data*. Thus, financial and nonfinancial data are needed as well as quantitative and qualitative data. From table 1 we can see that none of the measurement approaches fulfil these two criteria. The aim of a PPMS is to fill this gap.

Criteria / Approach	Objects measured	Frequency	Type of measures	Recipients of results
DuPont scheme	enterprise	recurring	financial	middle and top management
Activity-Based Costing (ABC)	activities and processes	recurring	financial	finance department
Balanced Scorecard (BSC)	enterprise or organizational units	recurring	financial and nonfinancial, quantitative and qualitative	mainly top management
Self-Assessment (e.g. by the EFQM model)	enterprise or organizational units	nonrecurring or recurring	mainly nonfinancial	middle and top management
Competitive Benchmarking	enterprise, organizational units, processes	nonrecurring or recurring	mainly nonfinancial and quantitative	middle and top management
Statistical Process Control (SPC)	processes	continuously	mainly nonfinancial and quantitative	middle management and process actors
Workflow-based Monitoring	processes	continuously	mainly nonfinancial and quantitative	middle management and process actors
Capability Maturity Model (SW-CMM)	software processes	recurring	nonfinancial	middle management and process actors
Process Performance Measurement System (PPMS)	*processes*	*recurring or continuously*	*financial and nonfinancial, quantitative and qualitative*	*middle management and process actors*

Table 1. Characteristics of selected measurement approaches

4. PPMS: THE CONCEPT

In general, a PPMS can be seen as an information system which supports process actor and their colleagues to improve the competitiveness of business processes sustainably. It is a tool to visualize and to improve process performance continuously. Thus, it assists both a total quality management philosophy and a process-based approach. One of the main characteristics of a PPMS is that it wants to present an integral and holistic view of the performance of business processes. In order to guarantee a sound view, we apply a stakeholder-driven approach. The stakeholders we take into account are the following: money lenders/investors, employees, customers (suppliers and buyers), and society. Each group of stakeholders is represented by an aspect or a dimension of performance. Thus, the aspects of performance we are looking at are as follows: (1) financial aspects (to measure the degree of satisfaction of the money lenders/investors), (2) employee aspects, (3) customer aspects, and (4) societal aspects. As innovation is an essential driver of future performance, a fifth aspect has to be added – innovation; see figure 1.

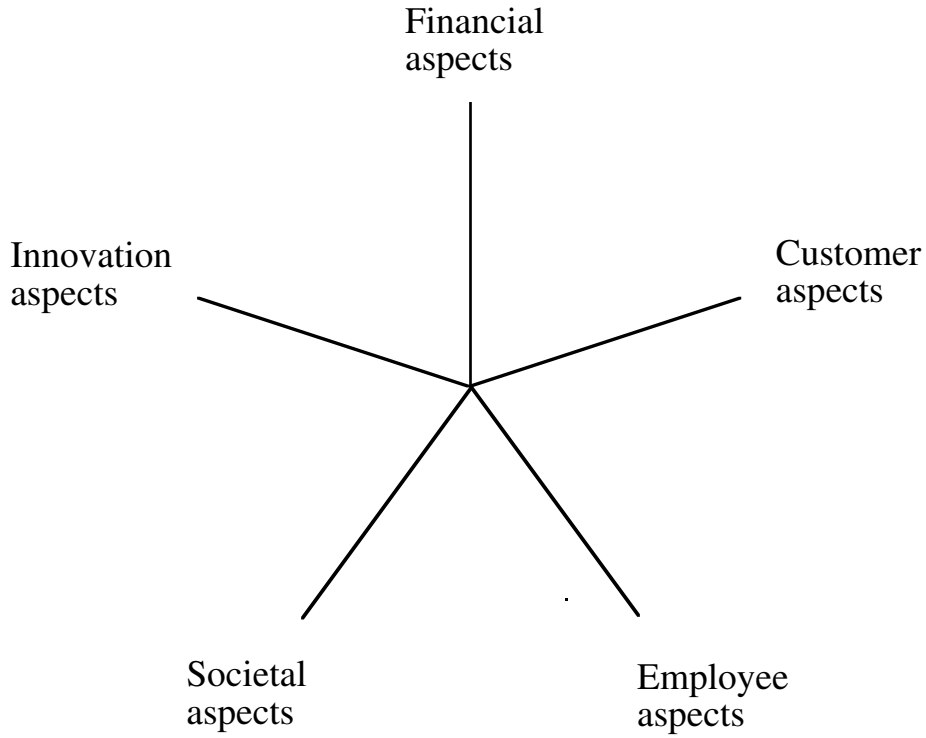

Figure 1: Five performance-relevant aspects

The main functionality of a Process Performance Measurement System is the following (cf. figure 2):

- The PPMS collects the current values (as-is values) of individual, process-specific performance indicators. (The elicitation of the indicators is discussed in section 5.)
- The PPMS compares current values against target values (to-be values) and historical values. It calculates the trend; i.e. it establishes whether the gap is widening or narrowing.
- The PPMS calculates 'cause-effect' relationships between the applied performance indicators. It shows the dependencies between the indicators and gives hints as to whether a certain indicator could be used as a lead indicator or an early-warning indicator.
- The PPMS disseminates the results (current values, historical values, target values, and trend) to the process actors. They can use the information provided in order to identify corrective actions (e.g. process modification, stronger IT support, training, rearranging information flow, etc.) which should lead to a higher level of process performance.

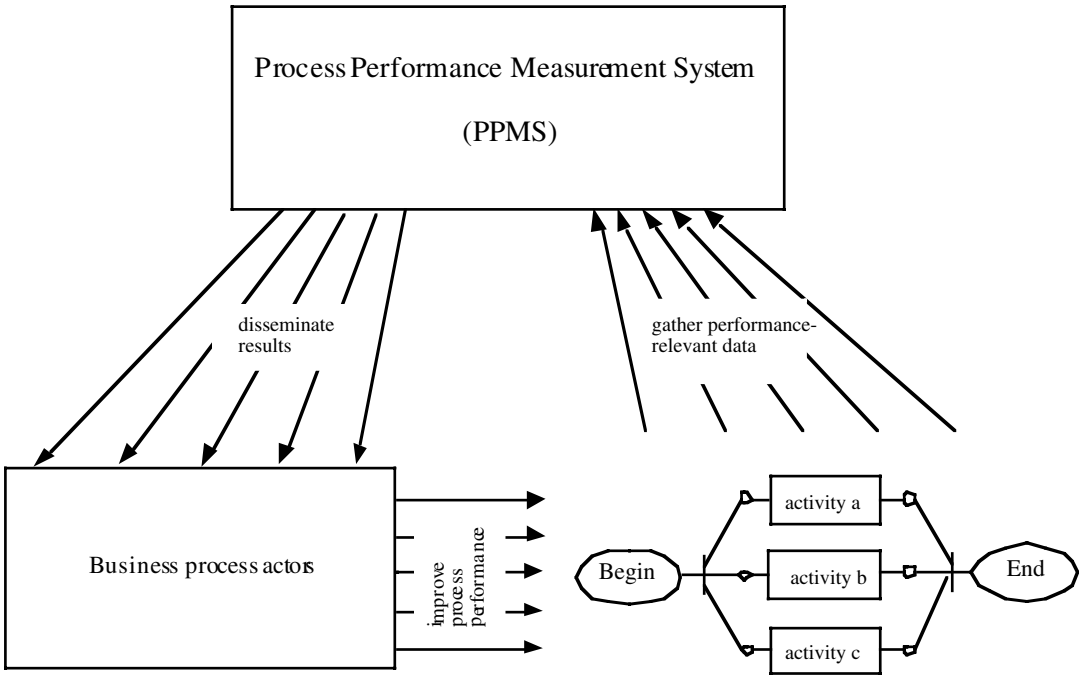

Figure 2: A PPMS from a conceptual view

5. COMPOSING A PPMS: 9 STEPS

Taking into account the conceptual view and the functionalities required as presented above, it becomes obvious that a PPMS cannot be bought in the form of pre-packed, off-the shelf software. Although popular enterprise resource planning (ERP) systems like Baan, PeopleSoft, or SAP have facilities to generate performance reports, they have substantial shortcomings: firstly, the measures collected do not take qualitative aspects into consideration. Secondly, since most ERP systems were built before business processes became regarded as a central organizational concept, the objects measured are not always processes. Thirdly, the reports generated comprise too much detail which can lead to a losing one's bearings.

In order to reduce the shortcomings of process performance measurement, Fribourg University (Switzerland) launched the project PROMOSYS in 1996. In co-operation with four enterprises, we composed enterprise- and process-specific PPMS prototypes. The four participating enterprises can be characterized as follows: one is a multinational pharmaceutical company; the PPMS to be built has to support various processes within the area of 'finance'. The second enterprise is a medium-sized Swiss commercial bank; the process to be supported is called 'managing mortgage applications'. The third enterprise is a small wholesaler which operates mainly in Switzerland; the process to be supported is called 'acquisition of new customers'. The fourth enterprise we are working with produces electronic components and has manufacturing sites in four countries; the PPMS will support the ordering process – it starts with 'order entry' and ends with 'checking customer's payment'. The size of the participating enterprises varies from 50 to 60,000 employees.

What is the approach we have chosen in order to compose a PPMS? The approach consists of nine steps.

Step 1: Identifying business process goals. Business processes and their activities have to make a contribution to the process goals. Therefore process goals (sometimes referred to as process objectives) have to clarify what is to be achieved for a business process to be competitive in the long term. In this first step, process goals are established through a collaboration between the various process participants, e.g. process manager, the process actors, the management of the enterprise, and the process customers (suppliers and buyers). As indicated in figure 3, potential process goals are 'little working capital', 'high customer satisfaction', or 'good working atmosphere'.

Step 2: Defining indicators for each process goal. Through the use of indicators it may be judged to what extent the process goals have been fulfilled. In order to find possible indicators for a certain goal, the following question can be asked: Which

indicator(s) can be used in order to measure (or to get an indication of) the extent to which a certain goal is fulfilled? It is obvious that many goals cannot be measured sufficiently by a single indicator. For instance, in order to measure the goal 'high customer satisfaction' the indicators 'proportion of orders delivered on the date wished by the customer' and 'proportion of complaints and returned orders' could be used; cf. figure 3.

Step 3: Broadening goals and indicators. As traditional management information systems and performance measurement systems used to be focused primarily on *financial* aspects, it is not surprising that practitioners put this category of goals in the foreground and do not take further aspects – which are not less important – into consideration. To broaden the scope towards the five aspects mentioned in figure 1, we supported the discussion through a list of possible goals and indicators for each of the five areas.

Step 4: Ensuring acceptance. One of the crucial requirements for the effective use of a PPMS is the acceptance of the chosen indicators – by the managers as well as by the other process actors. Hence it is essential to ensure that process participants can express whether or not they consider the proposed goals and indicators to be useful. Based on this feedback (obtained through a questionnaire, face-to-face-communication, or group discussion) goals and indicators can be changed to meet the customer's requirements more effectively.

Step 5: Defining data sources and target values. For each indicator one has to define where data (input) come from and how these data can be accessed. Potential data sources are: databases of ERP systems, workflow management systems or customer surveys. Furthermore, target values (to-be values) have to be determined for each indicator. Omitting the definition of target values would not only make it impossible to determine the degree of goal fulfilment, it would also lead to a PPMS without motivational effect. In order to set realistic but challenging target values the concept of competitive benchmarking can serve as a helpful instrument.

Step 6: Judging technical feasibility and economic efficiency. To assess the current performance level of the selected indicators, different data sources have to be accessed. Through the identification and definition of data sources, hints concerning feasibility and costs can be obtained. By comparing the costs for gathering the necessary data against the potential value of an indicator, economic efficiency can be approximated. If the number of indicators has to be reduced, economic efficiency criteria (potential value vs. costs) can be applied. What should be done if data on a certain performance indicator are extremely hard to access? Unfortunately, there is no clear answer. As Austin[20] points out, many important (critical) performance indicators

are difficult and expensive to measure, and it is tempting not to take them into consideration. On the other hand it would not be wise to measure all critical indicators. In short, the benefits of an indicator must exceed the costs.

Step 7: Implementing the PPMS. Once indicators, target values and data sources are defined, the instruments for data collection, the data management, and the calculation procedure should be determined and implemented. For the technical part of the implementation a client/server system – with an underlying relational data base management system – is usually appropriate. Today's operational information systems can deliver some input, but they are not suited to give sound, process-oriented information. Therefore, additional tools and instruments (e.g. to support employee surveys on a regular basis) have to be designed to gather the necessary information.

Step 8: Using the PPMS. Using a PPMS means measuring the current values of given indicators continuously or regularly, comparing these current values against target values, and feeding back the information gained to the process participants. Some of these functions can be automated but others have to be carried out manually by personnel who have the necessary domain knowledge.

Step 9: Improving business processes and modifying the indicators continuously. Business processes have to be competitive in the sense that the market with its customers and its suppliers is satisfied. A PPMS aims to achieve this. For that purpose one has to keep in mind that the market is dynamic: business processes which are valid today may be obsolete tomorrow. From this it follows that business processes as well as indicators have to be adapted frequently. Through this adaptation historical comparability may suffer "(...) but this is a minor loss. What matters is how a company is doing compared with its current competitors, not with its own past"[5].

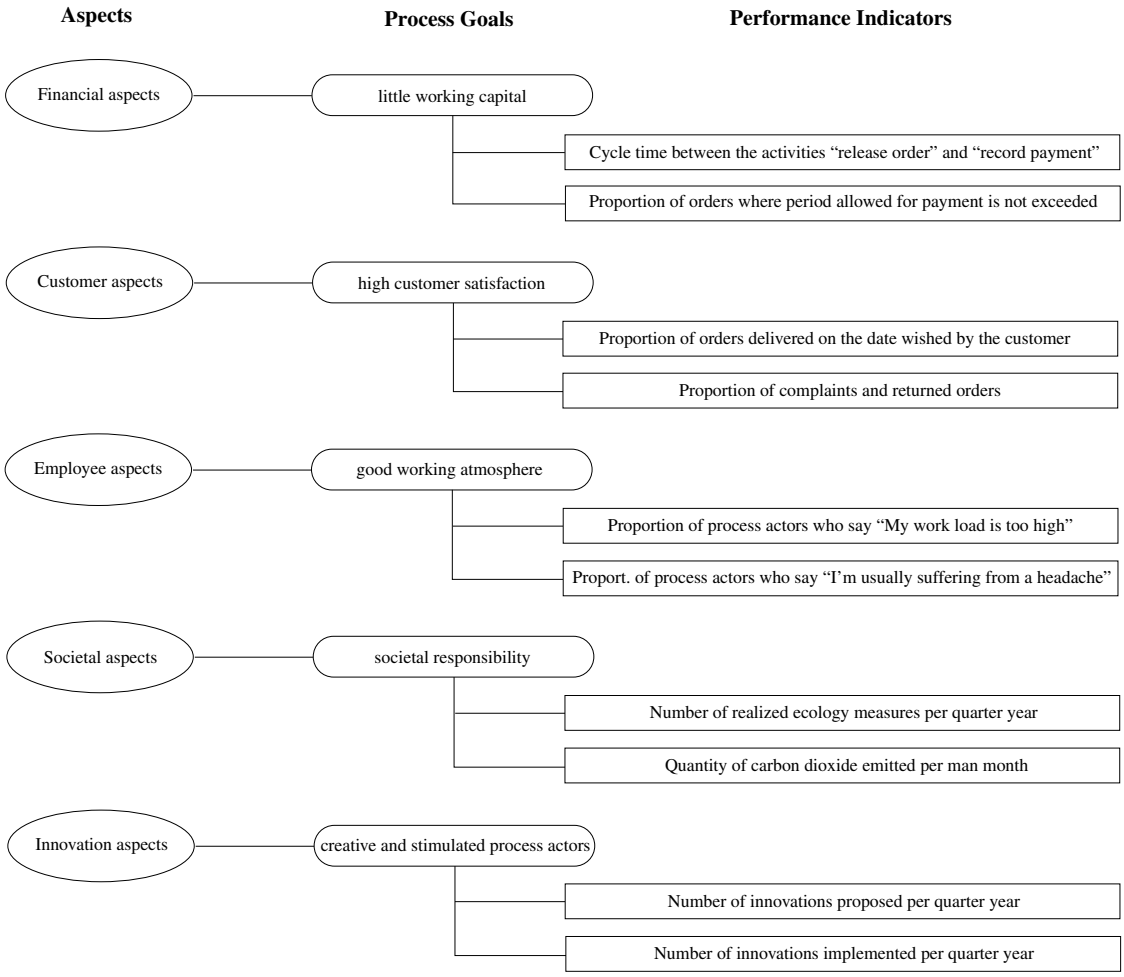

Figure 3: An example of goals and performance indicators for a business process

6. CONCLUSIONS AND LESSONS LEARNED

Having worked two years on the conceptualization and implementation of Process Performance Measurement Systems, we can draw some early conclusions:

- The role of a business process manager, or process owner, is essential. He or she has to play the role of a leader, an entrepreneur and a negotiator. If his or her competence is narrowly limited and decision-making power is restricted it will be very time-consuming to implement a PPMS, and, additionally, a PPMS cannot be deployed effectively if the necessary changes cannot be realized by the process team.

- If a PPMS is perceived as a system dedicated to managers, resistance to feeding the system (i.e. not entering needed data) may result. In other words, a PPMS must offer a benefit for each process participant – an incentive to do the job better and to be more goal-directed.
- In order to compose a PPMS, communication within the process team and communication with different organizational units (e.g. the IS department) is key. To facilitate communication, the business process should be documented graphically.
- One of the crucial aspects in the process of building a PPMS lies in the identification of the appropriate performance indicators. Generally speaking, two possibilities exist: (1) pre-defined, generally valid indicators can be applied; or (2) indicators have to be fitted exactly to a given enterprise and its business processes. As mentioned above, in all four participating enterprises, the second approach was chosen – and we are convinced that this approach was appropriate.
- From our experience we can also conclude that process goals were a good starting point for gathering the right indicators. However, it turned out that the identification of the business process goals was often very time consuming. This may be connected with the fact that until recently, in most enterprises, goals were defined only at the enterprise or division level, but not at the business process level. Thinking in terms of process goals helps both the process owners and the process actors to put forward the idea of a 'process management'. The definition of indicators was also time consuming. Especially difficult was finding quantitative measures for aspects which are rather qualitative in nature (e.g. customer satisfaction, social aspects, etc.).
- Process indicators have to be accepted not only by the process owner and his/her colleagues but also by the next higher management level. If this is not the case performance-relevant data from the PPMS will not be regarded as a solid basis, a basis to initialize or to promote broad corrective actions. In order to improve acceptance, the process actors were involved in the task of defining the indicators: workshops have been organized and questionnaires have been used to get feedback from process actors.
- In contrast to the other measurement instruments, such as Balanced Scorecard, PPMS measures the performance of business processes – and not of corporations or organizational units. As a PPMS may offer a holistic view on processes, it may effectively support a process-oriented organization, or an organization which wants to become process-oriented.
- The implementation of a PPMS requires a lot of resources and is therefore expensive. While the costs for hardware and software (e.g. interfaces to existing software, software for presenting the results) might be moderate, the labour cost for the

conceptual part of the implementation can reach a level where it becomes difficult to claim that the benefits of a PPMS clearly exceed the yield.

- Managers and business consultants quite often see performance measurement systems as a 'cockpit'.[9] Using this metaphor the process manager is seen as somebody who has to check various instruments (where the level of performance for selected indicators is shown) constantly. As soon as an unexpected signal appears, or a light switches to red, the process manager queries his information system to find the source of trouble. It is certainly difficult to describe the way in which a PPMS should work, but a purely mechanistic approach would definitely be inappropriate.
- Successful deployment of a PPMS requires organizational and social infrastructure. A corporate culture with a trusting environment is needed where process actors participate in designing and measuring their own tasks.

To conclude, this paper has shown that today's performance measurement systems still lack effective measurement of nonfinancial aspects and that they are not focused upon business processes. We believe that process performance measurement is a necessity for a modern process-oriented organization. Based on the authors' experiences with several enterprises it seems very unlikely that a universal set of performance indicators can be applied successfully to all business processes. Thus, performance indicators must be process-specific and have to be derived mainly from process goals. This also implies, that it will not be possible for an off-the shelf software to support the measurement of process performance fully.

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