

The Enabling Role of Information Technology for Business Performance Management

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Abstract

As a consequence of various shortcomings of traditional, isolated support concepts, the IT industry has developed several new concepts and tools to meet business requirements for a highly integrated, low-latency, adaptive performance management support. In this paper, recent trends in the IT market are analysed. Certain convergence trends are identified which contribute to an appropriate IT support for business performance management. As a conceptual foundation of performance management system implementations, it support processes for business performance management proposed. All findings are based on a large-scale cooperation project of a business school and five large service companies.

Keywords

Real-Time Enterprise, Business Performance Management, Process Management, Business Intelligence, Enterprise Application Integration, Data Warehousing

1 INTRODUCTION

Today's organizations are confronted with rapidly changing market conditions, indicated by high churn rates and strong competitors (Creelman 1998, p. 319). Under these conditions, traditional management approaches that focus on financial figures and on centralized, analytical planning methods are considered to be insufficient for effectively steering the organization in a dynamical environment (Gomez and Wunderlin 2000, p. 426; Hoffmann 2002, p. 2). Recent management support approaches like intellectual capital or particularly the balanced scorecard aim at providing a broader view of organizational performance. They combine both financial and non-financial aspects and comprise activities not only to monitor but also to plan and influence organizational performance (Hoffmann 2002, p. 337). Their success demonstrates the strong demand for this so-called comprehensive performance management (Brunner 1999, p. 15).

Performance is defined as valued contribution to reach the goals of an organization. Contributions can be made by individuals or groups of employees as well as by external groups (Hoffmann 2002, p. 8). In the past, the measurement of performance was usually restricted to a financial perspective, resulting in various limitations like e.g. a focus on the internal aspects of the company, a limited transparency of the roots and causes of corporate performance, as well as late availability of performance-related information. In order to overcome these limitations performance has to be considered as a multidimensional phenomenon (Hoffmann 2002, p. 20).

Performance management aims at the systematic generation and control of an organization's performance. From a management perspective, a performance management system consists of four main activities (Spangenberg 1994, p. 14):

- Performance planning
- Taking action to control performance (management in the narrower sense)
- Performance measurement
- Performance rewarding

Performance requirements are derived from the company's strategy or vision as well as from its stakeholders, e.g. customers, suppliers or shareholders (Klingebiel 1997).

However, it is not sufficient to focus only on the management perspective of the performance management concept. Like other management approaches, performance management can only be implemented successfully, if strategic planning is tightly linked to operational execution. Therefore, the integration of strategies, organizational structures and business processes by the use of specialized information systems is considered a vital part of performance management concept. It has to be ensured that strategy changes trigger modifications on the business process level and the supporting information systems, and that innovations on the IS or the

process level initiate the adjustment of the company's strategy. Due to different life cycles and varying actor groups, the alignment of strategy, business processes and information systems support often turns out to be difficult and expensive (Österle 1995). Although this topic is not new at all, its discussion is intensifying again, mainly influenced by recent work of IT analysts and consultants who discovered the close relationship between current business requirements and newly developing IT enablers. In order to express the novelty of the approach, the new label 'business performance management' (BPM) was coined, sometimes designated as corporate performance management (e.g. Geishecker 2002; Moncla and Arents-Gregory 2003). BPM is used as an umbrella term for "methodologies, metrics, processes and systems that monitor and manage the performance of an enterprise" (Geishecker 2002; see also Brunner and Dinter 2003).

Integral BPM support is enabled by the convergence of the well-adapted, so far isolated support technologies Business Process Modelling (BPM), Business Intelligence (BI) and Enterprise Application Integration (EAI). Figure 1 illustrates this interpretation. The convergence developments that enable BPM are explained in the following subsections.

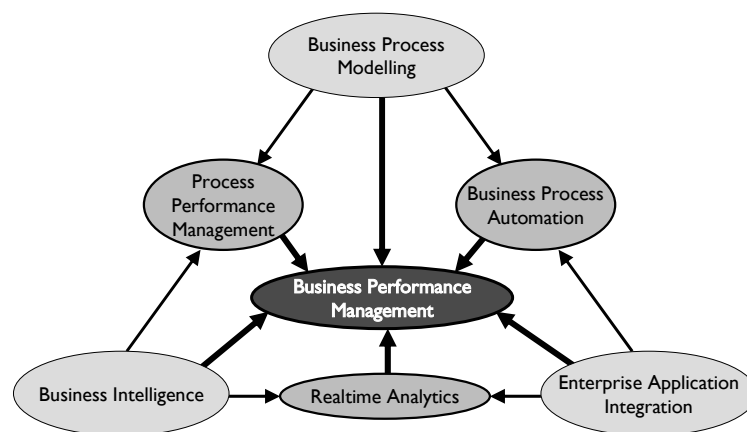


Figure 1: Converging technologies for Business Performance Management

1.1 Process Performance Management: Convergence of Business Process Modelling and Business Intelligence

Initiated by the works of Hammer and Champy (1993), Davenport (1993) and others, companies have redesigned their organizations around business processes. Appropriate business process specifications have been implemented either by adjusting existing information systems or by adapting standardized business software packages. In order to create, maintain and communicate business process specifications, most companies and/or consultancies deploy specific business process modelling tools.

As a consequence, the resulting IT architectures of those companies are optimized for supporting business processes. In order to adequately support management decisions, the operational data from different IS components have to be collected, integrated and prepared for data analysis. Today, this is mainly achieved by using data warehouse systems (including appropriate extraction/transformation/load tools, database management systems, and tools for metadata management) and business intelligence tools (e.g. reporting tools, managed query environments, online analytical processing tools, and data mining tools). In most cases, the management information systems are not targeted primarily on measuring the performance of business processes but on fulfilling traditional reporting requirements (e.g. financial reporting) (cf. Fitzpatrick 1994, pp. 30 ff.). With process orientation gaining importance, the need for effectively controlling all business processes is increased. Responding to that need, a convergence of systems for Business Process Modelling and Business Intelligence can be observed under the label 'Process Performance Management' (e.g. IDS Scheer AG 2002). By collecting and reconciling all operational data related to a certain business process in special process data warehouse, these tools enable the measurement of process performance and the identification of process improvement opportunities.

1.2 Real-time Analytics: Convergence of Business Intelligence and Enterprise Application Integration

In order to increase their competitiveness, companies always strive towards reducing the time needed to react to relevant business events. An ideal state would be reached if reactions could be conducted in real-time, i.e. without any latency between recognizing a relevant business event and taking an appropriate action.

A major enabler for the reduction of latencies can be seen in the concept of real-time information integration, for which Enterprise Application Integration (EAI) suites provide a popular IT solution. Acting as communication

middleware, an EAI suite integrates heterogeneous applications in or near real-time by seamlessly publishing any kind of data updates to every subscribing ('listening') application (Linthicum 2000). However, this kind of integration has been used mainly to interconnect operational systems and involves only little data consolidation. When it comes to extensive data analysis, BI software will be used to produce the information that is necessary to make a decision and take appropriate action. By using a data warehouse as data source of the BI solution, it becomes possible to analyse actual and historical data, which is usually not possible with analysis based on data gathered from an EAI infrastructure only. The main drawback of traditional BI solutions is that they do not work on real-time data as the data warehouse as their primary data provider is only updated periodically (Schiefer, Bruckner 2003).

With real-time decision making becoming more important to companies, the vendors of BI and data warehousing solutions tend to enhance their products by mechanisms for real-time data integration and real-time analysis. This leads to the convergence of EAI and BI solutions aiming at providing so-called 'real-time analytics' functionality by two different strategies (Martin 2003): Firstly, data integration platforms are extended by a connector that allows the event-based population of EAI data into the data warehouse (Schiefer, Bruckner 2003). Secondly, vendors of BI software offer new mechanisms for providing true real-time analysis or for doing real-time exception reporting.

1.3 Business Process Automation: Convergence of Business Process Modelling and Enterprise Application Integration

The IS architecture of an organisation usually comprises a large number of heterogeneous applications, each one of which specialized on supporting particular business processes. Three different reasons may account for this development:

- The available business software packages usually do not support all processes of an organization. As a consequence, organizations have to rely on different solutions. In order to get the best support for each type of process, many organisations follow a best-of-breed strategy and implement systems from different specialized software manufacturers.
- Usually the development of an organization's IS architecture is a continuous process, driven by the changes in the business. As soon as an application is not capable deliver adequate of the changing business, it is replaced by a better application. This leads to an evolving IS architecture, that comprises of both existing and newly implemented information systems that have to be integrated.
- If two organizations A and B decide to merge, they have to integrate both their business processes and their supporting information systems in order to reduce costs and improve productivity. On the IS level this integration effort usually leads to a situation, where some systems of organization A and some of organization B are selected for further usage and hence, have to be integrated.

As most business processes have to be supported by more than one application, interfaces between applications have to be established in order to support process execution. This has led to the proliferation of bilateral interfaces, each one of them contributing to increased complexity and maintenance effort. In order to overcome these integration problems, many companies implemented dedicated EAI middleware that provides a common integration infrastructure, allowing any connected system to communicate with any other connected system over just one dedicated interface to the integration infrastructure.

While the term EAI usually refers to integration on the IT level, corresponding integration needs also occur on the IS architecture and especially the business process level. The need for a close alignment of business process integration and integration capabilities on the IT level has lead to a convergence of business process modelling and enterprise application integration software in the shape of 'business process automation. Operational specifications derived from business process modelling can be transformed into more technical workflow specifications which are executable using an EAI framework that is enhanced with a workflow engine (IDS Scheer AG 2003). Taking this idea a step further, it becomes imaginable that applications provide their functionality through well-defined services with standard interfaces to an EAI platform. This would allow for a dynamic integration of application services based on the logic of individual business processes.

On the software market, the depicted convergence trend between process modelling and EAI can be observed in two different flavours: On the one hand, traditional EAI platform vendors enhance their products by mechanisms for application and process level integration, e.g. workflow engines and workflow modelling tools (cf. e.g.). On the other hand, large vendors of standard business software packages like SAP or Siebel have realized the growing importance of integration issues and have started to provide dedicated application integration platforms that allow for the dynamic business-process-driven integration of well-defined application services (Genovese, Hayward 2003).

1.4 Business Performance Management Enablers and Article Overview

Based on the above analysis of convergence directions on the IT market, three enablers for an integrated BPM conception can be identified (see figure 1):

- Business Process Automation links process design to application integration services to in order to foster the automation of business process implementation and to allow for the execution of workflows that involve multiple heterogeneous applications.
- Real-time analytics allow for the reduction of latency times in decision support by combining the integration capabilities of EAI with the analytic capabilities provided by Business Intelligence, thereby moving analytics closer to the operative business.
- Process performance management closes the loop between process design and business intelligence by enabling the comparison of process execution data with data of previously designed-to-be processes in order to identify potential for process improvement.

The IT enablers could provide sufficient support for integrating strategies, organizational structures, business processes and information systems in order to adequately support performance management of the organization. By combining the different IS support facilities for process modelling, application integration and business intelligence, it becomes possible to dynamically reflect changes on the business process level to the IS level and vice versa.

The following section 2 provides an overview over latest developments in the IT industry that drive the depicted evolution of BPM. Since IT enablers can only be deployed usefully based on an appropriate conceptual foundation, support processes for BPM are proposed in section 3. Section 4 concludes the paper and suggests areas for future work.

2 IT ENABLERS FOR BUSINESS PERFORMANCE MANAGEMENT

In coherence with the structure of the introduction, this section will depict recent concepts and tools in the information systems area that have the potential to enable the dissemination of BPM in organizational practice.

2.1 Business Process Automation

The growing importance of business processes orientation in organizations has fostered the usage of business process modelling suites during the last years. While the main reason for starting process modelling usually is documentation – typically in the context of business process reengineering or improvement projects – many organizations later recognize that process models play an important role in the realization of adequate IS support for business processes. In this regard, a process model can be used as blueprint for the design of a workflow that coordinates activities, resources, and data according to the underlying business process (zur Muehlen 2004). In order to avoid discrepancies between documentation and execution of business processes, a tight integration of process modelling and workflow definition is required in the first place. Hence, process specifications have to be transferred from process modelling to workflow management tools. Open standardized formats for business process definitions like e.g. the Business Process Modelling Language (BPML, cf. BPMI 2000) can facilitate this information exchange.

The defined workflows can be executed using a workflow management system (WFMS), the functionality of which is nowadays – due to close relationship between application integration on the technical level and activity coordination on the process level – integrated into many EAI solutions. By using an EAI solution with a standard interface for process definitions, it becomes technically possible to use a process model not only as a blueprint for workflow design but also for building the application integration scenario necessary to execute the workflow. This holds true especially for workflows representing so-called software processes, i.e. processes that can be automated using software applications (Becker et al. 2002).

Besides the theoretical feasibility of process-model-driven EAI, the task of integrating applications usually involves a great deal of manual configuration or even programming work. To allow for further automation of the integration tasks, functionalities of applications have to be provided as services, i.e. self-contained software modules, which can be connected more easily through well-defined standardized interfaces. This approach is usually denounced as service-oriented architecture (SOA, cf. Natis and Schulte 2003). Standards in this area are already available, like e.g. the Business Process Execution Language for Web Services (BPEL4WS, cf. OASIS 2002). They can serve as a foundation for true process-driven application integration.

On the software market, vendors like SAP, Siebel and Sun follow the idea of service-oriented integration architecture by introducing application server concepts such as SAP Netweaver, Siebel Universal Application Network or SunOne (Genovese, Hayward 2003). From a business process automation point-of-view, the

integration of process modelling and applications is fostered by approaches like ARIS Process to Application, which allows to use business process models for the configuration of workflow-enabled EAI software (ARIS P2A, cf. IDS Scheer AG 2003). The announcement of the strategic cooperation of SAP and IDS Scheer in the area of business process management solutions indicates the convergence of SOA and BPM, for which Gartner coined the term 'Business Process Fusion' (Hayward 2003).

2.2 Real-time Analytics

Real-time analytics aim at shortening the period of time between the occurrence of a business event that requires an appropriate action by the organization and the time the action is finally carried out. According to Hackathorn (2003), the additional business value of an action decreases, the more time elapses from the occurrence of the event to taking action. The elapsed time is called action time and can be seen as the latency of an action (see Figure 2). Action time comprises three components:

1. *Data latency* is the time from the occurrence of the business event until the data is stored and ready for analysis.
2. The time from the point when data is available for analysis to the time when information is generated out of it is called *analysis latency*.
3. *Decision latency* is the time it takes from the delivery of the information to taking the appropriate action. This type of latency mostly depends on the time the decision makers need to decide and implement their decisions.

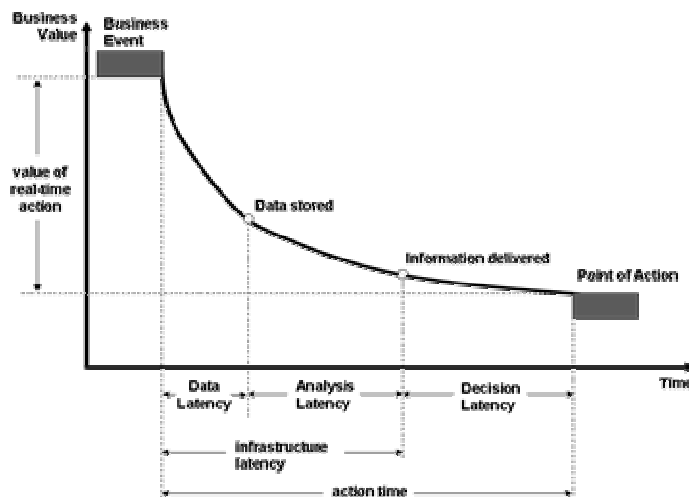


Figure 2: Value of reducing the action time (Hackathorn 2003)

In order to reduce action time, latency has to be reduced in all of the three components.

Data latency is usually mainly influenced by the refresh cycle of the data warehouse system in which the data is stored for analysis purposes. Data warehouse systems are widely accepted as a middleware layer between transactional information systems and decision support systems, thereby decoupling systems focussed on efficient handling of business transactions from decision support focussed on efficient support of business decisions. Such a middleware layer is necessary because the direct, individual access of decision support systems to data of operational, transaction oriented information systems has proven to be technically or economically infeasible: Data quality problems and complex integration requirements usually make it impossible to supply consistent, integrated data in real-time to a large number of decision support systems. Even if technically feasible, the development and maintenance of $m \cdot n$ interfaces between m decision support systems and n transactional systems cannot be economically useful. As an intermediate integration layer, the data warehouse system is decoupling decision support systems and transactional information systems, thereby reusing integration mechanisms and derived data for various decision support applications and allowing maintenance to be focussed on few, well-defined adapters. A main drawback of the data warehouse concept is the time consuming and resource-intensive process of extracting data from operational systems, transforming it and loading it into the data warehouse database. Due to this fact, the so-called ETL processing is often executed in batch mode at non-peak times (e.g. over night), causing time-lags between the recognition of a business event and its delivery for analysis purposes.

A widely adopted approach to reduce data latency is the deployment of operational data stores (ODS). In contrast to the data warehouse system that requires extensive data cleansing, data consolidation and data quality

management, ODS store a limited scope of data with only basic (or even none) consolidation and only basic (or even non) data quality management, thereby allowing real-time or near real-time updates and faster data distribution (Kimball et al. 1998; Imhoff 1999).

Another way of reducing data latency is to change from a periodic batch-oriented to an event-driven update of the data warehouse by using EAI technology. By doing this, data representing a certain business event will be populated into the data warehouse as soon as the event is recognized in an operational system. With EAI platforms becoming more important to organizations, many vendors of ETL software tools react by offering corresponding interfaces that allow the extraction of data from popular EAI solutions.

A third alternative might be seen in the concept of business activity monitoring, which mainly deals with the direct analysis of data collected via an EAI platform, hence avoiding the additional data storage in a data warehouse or ODS (Nesamoney 2004).

Analysis latency is mainly determined by the time it takes to inform the person in charge of data analysis that new data has to be analysed, the time needed to choose appropriate analysis models and the time to process the data. Latest approaches that deal with the reduction of analysis latency can be summarized by the term business intelligence, denoting different concepts for a goal-driven analysis of business data that is provided through a central data pool (Chamoni, Gluchowski 2004). A prominent BI approach is the concept of Online Analytical processing (OLAP), which concentrates on reducing the time needed for analyzing the data. Time reduction is achieved by providing powerful user-interfaces that let the analyst explore the data along previously defined analysis dimensions (Codd, Codd, Salley 1993). In contrast to the fixed dimensional structures necessary for doing OLAP, Data Mining as a more flexible BI approach allowing the application of different data exploration techniques to a large amount of data in order to discover unknown relationships between variables or single data items (Berry, Linoff 1999). While pure data mining is mainly focused on reducing the time for data processing by applying efficient data exploration algorithms, data mining software tools like SPSS or IBM intelligent miner also facilitate the choice of appropriate data mining techniques. In order to reduce the time for notifying the analyst of business events, the approach of exception reporting can be used. It allows the automatic check of predefined exception conditions by a specialized reporting tool that is able to notify an analyst, if the conditions are evaluated true.

To sum it up, BI tools can help to significantly reduce the analysis latency and the limit of this reduction can be seen in parts of the analysis process that require manual intervention. Further improvements in this area can be achieved by automating additional analysis activities. An example could be the reuse of data mining techniques that were specifically tailored to the analysis requirements of the organisation. To allow for a better tool support, analysis processes have to be documented in a standardized manner, e.g. by using the eXtensible Business Reporting Language (XBRL) to formulate financial reports or the Predictive Modeling Markup Language (PMML) to document data mining models (Schwalm, Bange 2004).

The least IT support can be identified in the area of *decision latency*. In most cases the interpretation of analysis results and the derivation of appropriate actions are seen as manual processes that have to be carried out by knowledge workers and are therefore time consuming. Newest advances especially in the area of Business Activity Monitoring try to improve this situation by automating certain decision processes with the help of rule-based decision engines. Based on the real-time analysis of data from an EAI platform, the decision engine checks for predefined business rules and notifies responsible people or triggers other tools for conducting further actions (White 2002).

2.3 Process Performance Management

The main idea of process performance management is to control the execution of business processes by comparing process models (i.e. to-be models of business processes) with data collected during process execution (i.e. as-is-models of business processes) in order to identify potential for improving process execution and to recommend the appropriate modifications to the processes. In order to make this concept work, two mechanisms are needed:

Firstly, a mechanism for measuring process performance has to be established. Kueng and Krahn recommend a nine-step model for getting from a process model to a process performance management system that automatically collects both financial and non-financial performance-relevant data from operational information systems, populates them into a dedicated process data warehouse and provides mechanisms for flexible analysis of business processes (Kueng, Krahn 1999). A very important part of this nine-step process is the definition of performance indicators and process goals for each process that is to be analysed (e.g. Österle 1995). State-of-the-art business process design (and maybe simulation) tools allow for the integration of performance indicators in process models. The model database should be accessible via an integration platform using a specific adapter that transforms the tool specific process specifications into a standardized format like e.g. the Business Process Modelling Language (BPML, cf. BPMI 2002).

Secondly, a mechanism has to be installed that allows for the translation of process analysis results into recommendations for appropriate improvements of the process design. Improvements are implemented by refining the respective process models, which in turn trigger another design-automation-analysis cycle.

The above described concept of process performance management is exemplary implemented in ARIS Process Performance Management by using the modelling suite ARIS toolset and a special purpose process data warehouse (ARIS PPM, cf. IDS Scheer AG 2002).

3 PROCESSES FOR BUSINESS PERFORMANCE MANAGEMENT

The preceding sections dealt with recent developments on the IS sector, which might foster the diffusion of the business performance management concept. This section is to examine the business requirements that have to be fulfilled to establish an IT-enabled BPM system in organizational practice. As framework for the analysis we use the business engineering approach (Österle 1995; Winter 2000), which proposes the following three phases to transform an organization based on certain innovations which have been identified as having enabling potential for new or improved business solutions:

- (1) (re-)formulation of appropriate business strategies (if applicable / necessary)
- (2) (re-)design of appropriate business processes and appropriate organizational structures and finally
- (3) (re-)development or (re-)adaptation of information systems according to the business specifications.

As BPM is a support concept for existing management strategies phase (1) is not applicable in this context. In order to create business requirements as a conceptual foundation for BPM implementation, step (2) is regarded in this section. The presented findings are conceptual rather than empirical. They are generalized from workshops with several large Swiss and German service companies and respective case studies. These banks, insurance companies, telecommunications providers, utility providers and consultancies participate in the competence centre 'Business Performance Management' and partially in previous research projects.

3.1 Process Categories

The design of BPM process specifications is based on the St. Gallen management model. In this model, three categories of processes are differentiated: (Rüegg-Stürm 2002, pp.38ff., see also Ulrich 1984 and Österle 1995)

- *Business processes* cover all activities resulting in a result or benefit for external customers.
- *Support processes* enable an effective and efficient execution of business processes. Support processes incorporate operating an adequate infrastructure and offering internal services.
- *Management processes* cover all activities for designing, steering, controlling and enhancing the organization (Ulrich 1984). Management processes apply to business processes as well as to support processes.

According to Ulrich (1984), management processes can be further categorized into processes for normative orientation, strategic development processes and operational management processes. Since BPM and IT enabling do not focus on normative orientation, the following discussion is limited to strategic development processes and operational management processes.

3.2 BPM Processes

Although a large number of approaches exist to specify management processes (Rüegg-Stürm 2002, pp.81-82; Ulrich 1984, pp.53-54), most of them are based on a cybernetic interpretation of management systems. According to the St. Gallen management model, a strategic development process cycle and an operational management process cycle are differentiated. These two cycles are interlinked by monitoring and communication processes. As a consequence, (a) operational management can be interpreted as control path of strategic management and (b) business / support processes can be interpreted as control path of operational management. Both operational and strategic management processes comprise the same activity types, but they differ regarding cycle time, frequency of execution, processed information and responsible organizational unit. The activity types of these two cycles were designed assuming homogenous requirements concerning the support processes (see section 3.3). Figure 3 illustrates the aggregate process model of business performance management.

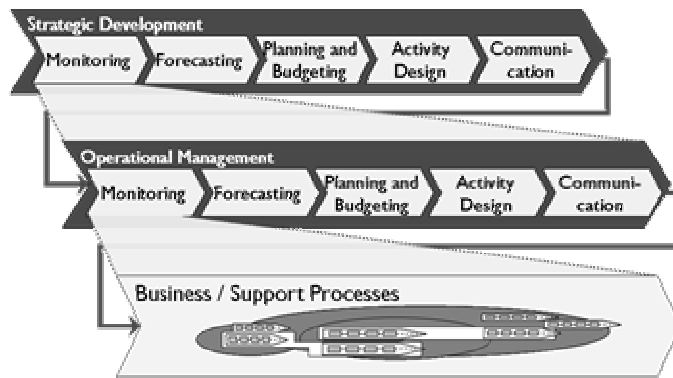


Figure 3: Aggregate process model of business performance management

In the following, the activity types found both in strategic development and in operational management are outlined:

- *Monitoring* identifies upcoming problems by observing the company as well as its environment (Gluchowski et al. 1997, pp.75-76). Potential problem indicators are e.g. deviation from targets or changes in the market (e.g. a competitor launches a new product, legal regulations change). Information supply – and particularly the access to relevant information sources – is therefore a core requirement of the monitoring process. For reasons of efficiency and effectiveness, information has to be filtered, individualized, properly structured and presented in an adequate form. This means that for recognizing a problem by a human being, information should be presented in an ergonomic way and deviations have to be emphasized respectively. Alternatively, if problems are to be detected by computers, the information has to be structured in a way that a problem recognizing algorithm can process it.
- *Forecasting* uses information from the monitoring activity to project future states by calculating or simulating predictive models. Hence, in this phase predictive and / or simulation models describing the company and the markets have to be developed / adapted and their utilization has to be supported. With regard to model orientation, forecasting has similar requirements as planning and budgeting. Analysis of a company's actual situation also includes forecasting its future considering the current management assumptions. Therefore monitoring and forecasting are tightly coupled.
- *Planning and budgeting* uses information created by the two preceding activities. Potential actions and / or measures are identified, and their consequences are evaluated considering different restrictions to find a solution for the identified problems. Budgeting focuses on monetary restrictions and measures, which is one of the most important factors for many companies. One approach to solve planning problems is to create quantitative models which then are simulated based on alternative assumptions for certain measures. In many cases, experience and knowledge can be used to solve a planning problem. For structuring and modelling Problems, methods and models have to be developed, managed, used and re-used. Gluchowski et al. (1997, p.77) call this requirement 'decision-making support'. In order to support experience re-use, scenarios as well as measures and solutions have to be archived and made accessible.
- The planning and budgeting activity results in a set of measures, which have to be elaborated in the *activity design* phase.
- Depending on whether strategic development or operational management are regarded, the *communication of measures* activity affects operational management or business / support processes and employees, respectively. Without appropriate communication (i.e. publishing tasks, targets, figures), a closed-loop management can not be realized. In addition to communication support (Gluchowski et al. 1997, p. 77), this activity requires manual or automatic generation, preparation, distribution and presentation of information.

In addition to the requirements resulting from specific activities outlined above, phase independent requirements like coordination support and workflow support have to be met (Gluchowski et al 1997, p. 77).

3.3 BPM Support Processes

Based on the requirements resulting from the strategic development and operational management activities outlined above, three major categories of BPM support processes can be differentiated: Information logistic processes, processes for problem solving and decision making, and processes for collaboration and communication support. Figure 4 illustrates the interactions between BPM support processes and BPM processes.

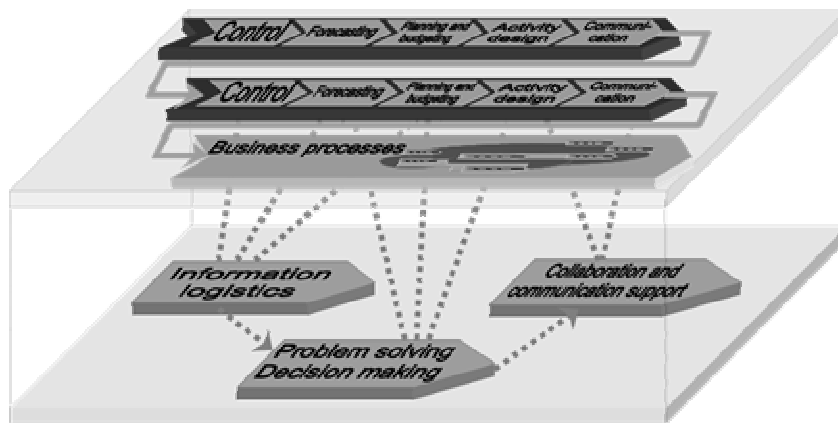


Figure 4: Aggregate BPM support processes and aggregate BPM processes in the context of the business engineering framework

In the following, the BPM support process categories are outlined:

- *Information logistic processes (ILP)* make task-specific and relevant information from business processes (e.g. transactional data), from management processes (e.g. target or strategy information) and from external sources (e.g. market data) accessible to BPM processes. ILP interlink BPM process cycles and support mainly the monitoring and communication activities.
- *Processes for problem solving and decision making (PDP)* help the BPM process actors to find solutions for their planning problems. PDP manage and access experience, models and methods, and PDP support the design of models and methods. Their purpose is to make methods and models easily applicable and to improve problem solving competencies of the actors. PDP mainly support the planning and budgeting and the forecasting activities.
- *Processes for collaboration and communication support (CCP)* control the sequences of activities in the BPM process cycles, e.g. the coordination of dependent planning activities and the assignment of tasks (ad hoc workflows). In conjunction with ILP, they support communicating BPM results between the BPM process cycles and the business / support process layer.

We select ILP as an example to illustrate the tight connection between IT enablers for BPM and an appropriate BPM (support) process concept. ILP comprises all BPM support processes for the acquisition, integration, structuring, filtering, individualization, presentation and distribution of information. *Information acquisition* is mainly needed in the monitoring phase of BPM to access problem-relevant information, regardless of its structure or origin. It also has the character of knowledge explication when acquiring models and methods from a human actor in the planning and budgeting process. *Information integration* delivers a unified, reconciled and semantically linked view on information by aligning terminology, representation and technical formats. Tightly coupled with information integration is *information structuring*. This process restructures information for a certain purpose, e.g. by enriching weakly structured information like documents with metadata or by transforming it to a multidimensional view for analysis. *Information filtering* helps to find or focus the relevant information in the amount of the available information. A quite similar purpose fulfils *information individualization*, which filters and adapts the presentation of information according to the context of an actor in a certain BPM phase. *Information presentation* adapts the presentation of information, e.g. transforming it into a certain textual or graphical representation. *Information distribution* in cooperation with CCP forwards information to where it is needed, both within a BPM cycle and either between BPM cycles or between operational management and business / support processes.

4 CONCLUSIONS

This article shows that several recent developments in the IT market converge into an infrastructure that meets business requirements for an integrated, flexible business performance management. In the first part of the article it is depicted how the long-time technical and conceptual boundaries between standardized business software packages, workflow engines, business process modelling tools, business intelligence tools and integration frameworks begin to be surmounted by means of service orientation, integration middleware, standards for process specification and execution, as well as reference models for metrics and standardized process repositories. It is shown, how this trend of convergence can build the foundation for a better alignment of strategic decision making and operational business process management in the shape of a new management support concept denounced as business performance management. As IT can only be an enabler of a new

management concept like BPM, a clear understanding of the organizational processes driving both execution and IT support for BPM has to be established in the first place. While BPM has already been discussed from a management perspective, the second part of the article proposes an aggregate model of IT support processes that could build the foundation for the effective implementation of the discussed IT innovations. The process model resulted from discussions with several large service companies and can therefore only be seen as a first idea of what IT support for BPM could look like. Many more case studies and discussions will be necessary to develop this early proposals and others into BPM reference models for certain industries or business scenarios.

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