

White Paper

Analytics meets ESA

Enriching Business Processes by Analytics

An analysis of the



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1 Management Summary

Winning and loosing in the global market depends on innovation and adaptability of business models¹. Quick responses and proactive moves enlighten customers and beat competitors. Agility is key for success in today's economical challenges. Faster and faster market dynamics is the driver. Other drivers – cost and compliance! So this makes up the winners in business:

- **Adaptability.** Business does not stop at the border line of an enterprise. Indeed, the challenge is to link the customers of the customers with the suppliers of the suppliers. What is needed are world-class business processes boosting collaboration across networks of enterprises.
- **Innovation.** Business effectiveness has to be continuously examined, and creativity is needed for inventing mind breaking new products and services fostering customer profitability and loyalty, and leapfrogging competitors.
- **Optimization.** Business processes have to be continuously optimized for improving business efficiency. Budgets become tighter and tighter. Indeed, taking wrong decisions today ends in disasters. Identifying potentials for profit, rigorously cutting cost as well as precisely calculating where to optimally spend the remaining resources are key issues not only for top management. Geopolitical uncertainties make planning and decision taking much more difficult, but more important than ever.
- **Compliance.** New regulations like the Sarbanes-Oxley Act in the US, the International Financial Reporting Standards (IFRS) in the EC, for banking Bale II, and for insurance Solvency II impact financial reporting and consolidation. There is no alternative to transparency and traceability.

This is why leading and winning enterprises have put focus on implementing their strategy by end-to-end, intelligent, industrialized business processes. Processes become the new focus of management. A **Business Process Platform (BPP)** is the requirement for managing the life cycle of business processes by a closed-loop system, from modeling and execution to planning, monitoring and controlling. A BPP enables automated, reliable, audit-proof and adaptable processes across business functions, departments and even across enterprises. This cuts cost and boosts revenues. A BPP makes processes independent from the underlying IT systems and applications: Business can change processes with the speed of market dynamics and customer needs. You keep sailing close to the wind. And moreover, a BPP enables „intelligent“ processes: Analytics can be embedded into processes. Analytics is key for planning, monitoring, and controlling of both, processes and their performance. The mission is:

- *You can only manage what you can measure.*
- *You must identify and resolve problems before they arise.*

An *example* from day-to-day life explains how embedded analytics works: In a department store, the sales areas are stocked up at the right time, before products are out of stock. This avoids the situation where a customer wants to buy a product and finds himself standing in front of empty shelves.

Embedded analytics is the next step beyond business intelligence for decision making. Traditional business intelligence tools (reporting, adhoc querying, OLAP – online analytical processing, data mining etc.) failed to deliver the right information to the right location in the right time for the right purpose. Traditional business intelligence tools did not meet management expectations: results to be applied to processes and

¹ Source: Economist Intelligence Unit Survey

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strategy for turning information into value. Information remained a privilege in many enterprises. Only a handful of experts (the power users or business analysts) were in a position to exploit information via the classical tools. Management decisions and actions were based on guesses, much less on facts. Embedding analytics into processes via a BPP overcomes these problems.

In a process oriented enterprise, Business Performance Management is the model enabling a business to continuously align business goals and processes and keeping them consistent. The BPM technology is embedding analytics in a BPP enabling intelligent business processes.

Business performance management is the new approach based on business intelligence for optimally planning, monitoring and controlling business processes and their performance on the level of operations, tactics, and strategies. It is based on metrics acting like sensors to watch process performance. It starts when designing and engineering processes: metrics have to be derived simultaneously and in parallel with the process model. Strategy drives both: process model and metrics. Indeed, metrics must be part of the process model. Goals have to be metricized. Achievement of goals has to be continuously monitored. Actions must be taken for controlling the performance of processes.

But business has also to comprehend: a BPP is designed by an “**architecture**”. Architecture is the art and science of designing structures. It is a translation between the business requirements and IT’s building instructions. Architecture has characteristics and consequences.

Example: In medieval times, a cathedral built by a Romanic architecture has a completely different look and feel and different properties than built by a Gothic architecture.

Architecture matters when moving to a BPP with embedded analytics. Today, the state-of-the-art architecture for a BPP is service-oriented. The advantage for the business? A 100% protection of investment in the existing operational and analytical applications combined with the potential to make the next step towards a BPP. An Enterprise Service Architecture (ESA) enables adaptability by separating process logic and flow from application logic. It is service oriented, plus it includes a common business vocabulary across all services. ESA enabled processes can act, not only react. Events can drive process logic and flow.

Example: Product availability should control product publication in a web shop. This prevents customers to order products that are out of stock and helps business to retain customers and to keep revenues by offering substitute products in the shop.

An ESA is the design of a BPP, and as we have seen, architecture matters. Enterprises have to carefully select their BPP before moving to process-orientation with embedded analytics and reaping the benefits of process management, event-orientation, and performance management. For the next 10 years, there will be no alternative.

Goal of this White Paper on Analytics meets ESA

Enterprises moving to process-orientation will have to decide which basic platform and infrastructure to choose for implementing an adaptive business model for innovation, optimization, and compliance. Here, one of the key questions is the comprehension of analytics in an enterprise service architecture for developing intelligent processes that anticipate problems before they occur and performance management that puts decisions and actions on facts and information. The focus of this White Paper is to assist any decisions in the described environment.

Business Performance Management (BPM) provides clear benefits to an enterprise:

- It is a methodology to link strategy and goals to results.
- It turns data into actionable information.
- It empowers all staff by delivering information not only to power users and business analysts, but to everybody inside and outside the enterprise by embedding analytics into processes.
- It delivers high degree of accuracy and consistency of audit-proof information.
- It provides transparency and traceability to management and enhances the bottom line.
- It delivers the right information to the right information consumer to the right location in due time (“right-time” instead of “real-time”).

BPM is implemented via composite analytics that access and aggregate data, turn data into information by analysis, and turn information into action by guided decisions and collaboration.

2 Process-Orientation: Driving for Adaptability and Innovation

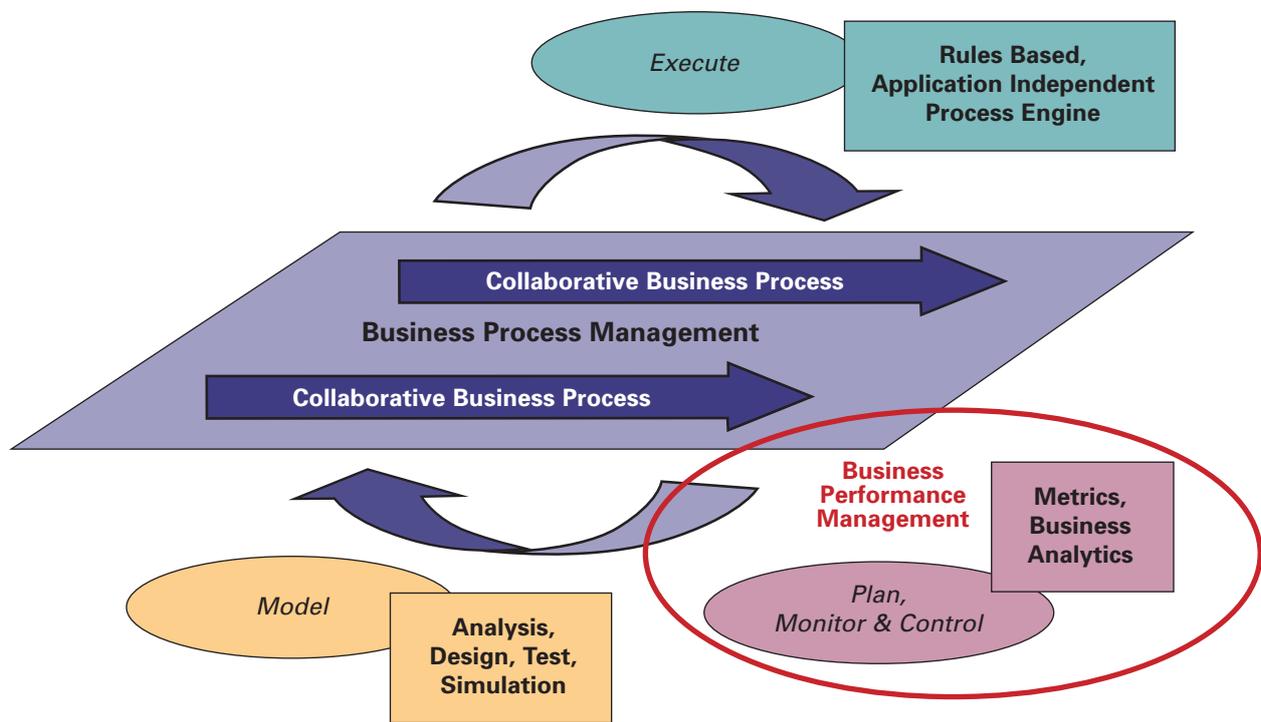
In the 90s, it was common belief that enterprises could run exclusively on a single instance application. Ideally, all business-relevant data was meant to reside in a single database and all business functions were meant to have been supported by standard (ERP) functionality. Unfortunately this ideal world was never achieved. The majority of enterprises run an average of 50 mission critical transactional/business systems. The huge number of interfaces necessary to link applications drives up costs for implementing new applications. The budget for maintaining these interfaces killed IT innovation since most IT budgets were diverted to just “keeping the ship running” rather than innovating. This makes information management impossible. Timely access to business information across application islands becomes a luxury enterprises can’t afford. The price of not having access to business information is even higher. Traditional business intelligence (BI) tools do not provide the right information in the right place at the right time for the right reason due to the insufficient infrastructure and due to their lack of process-orientation. At best, they can give you a look into the ‘rear view mirror,’ but they are not designed for driving the business intelligently with predictive models and forecasts. They are difficult to master, creating a situation where information becomes privileged. Only a handful of experts (the power users or business analysts) are in a position to exploit information with these old tools. Furthermore, we are not only faced with application islands, we also have BI islands. BI solutions have been mainly built with departmental focus. Different departments created different, inconsistent meta data for their analytics and used different tool sets from different vendors. This makes consolidations of BI islands extremely difficult, indeed impossible in many situations. So, even if an enterprise has certain insights by BI, a consistent top down view on what is really going on cannot be achieved.

How can the enterprise be transformed to process-orientation? The answer is a business process platform. Closed-loop management of business processes enables that execution and exception management be synchronized with continuous and comprehensive planning, monitoring, and controlling. This synchronization keeps business processes optimized in line with real time events and intelligent planning and forecasting. Business processes are becoming the common communication platform between business and IT people. **For the first time we can create a genuine dialogue between business and IT.** The benefits of process-orientation are obvious:

- **Processes become the common communication platform between business and IT.** The specification of business requirements is now based on a common language jointly understood and spoken by the two parties, business and IT. Technical design of executable processes and back-end services providing application logic becomes straightforward when based on a common business design of processes.
- **Processes are enabled by applications.** Collaboration makes enterprises shift to end-to-end processes across applications and platforms that are executed by rules-based process-engines running on a business process platform, the infrastructure for business process management and service management. An important point is that we are now dealing with cross-functional, cross-departmental, and even cross-enterprise processes that exploit the application logic of the existing application landscape.
- **Processes benefit from the advantages of service-orientation.** An ESA is business-driven. The granularity of the process model determines the granularity of business services managed by the BPP. Furthermore, the BPP maps technical services from existing back-end applications to business services. This is 100% protection of investment in the existing IT architecture. With service-orientation we do the next step and build on top of the existing IT investments.

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Managing Business Processes



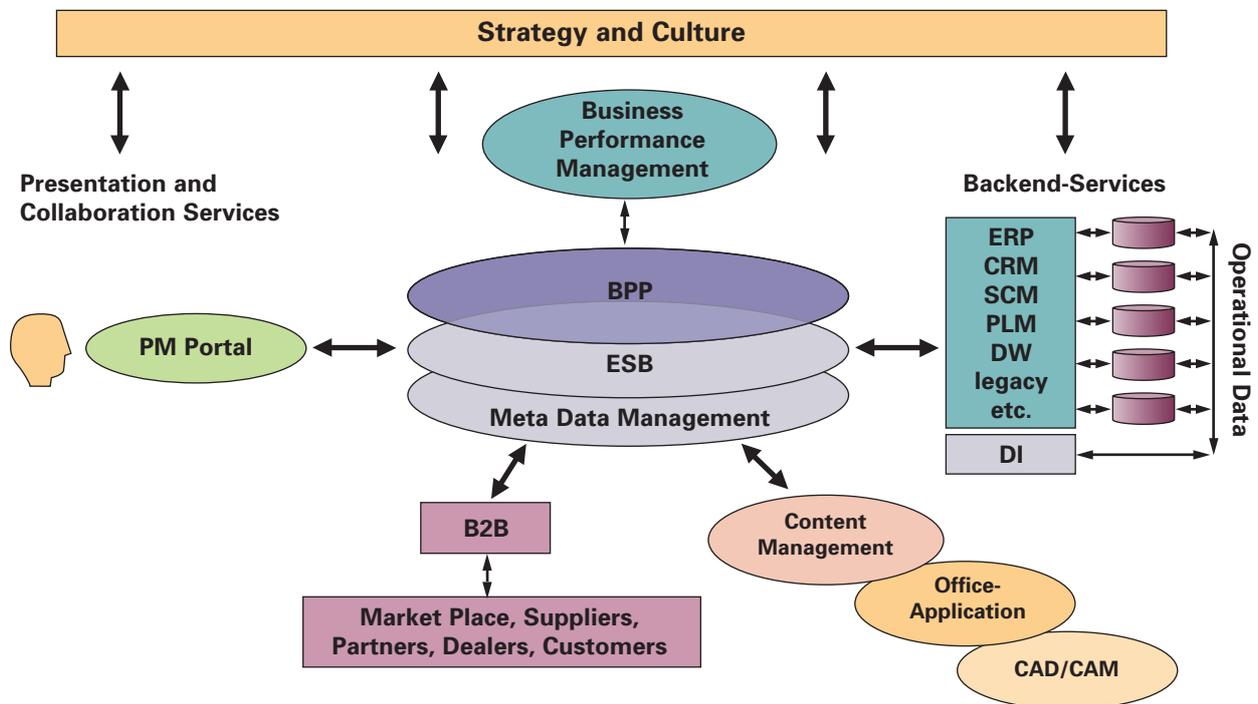
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Figure 1: In a process-oriented enterprise, management of business processes becomes the center point of all entrepreneurial actions and activities. It is based on a closed-loop model, and is implemented by a business process platform (BPP). Processes are modeled, executed, planned, monitored, and controlled independently of the existing application framework. Business Performance Management is a second closed-loop model for managing planning, monitoring and controlling of business processes and their performance within the BPP. Process-orientation is the foundation of an intelligent, agile real-time enterprise.

- **Processes run across the underlying application data models.** In order to automate event-driven processes across functions, departments, and enterprises, commonly-used application touch-points and data across the enterprise must not only be integrated and synchronized, but data models must be aggregated into a common information model to support collaboration processes. This common business vocabulary is the heart of master data management. Uniquely defined and centrally managed 'meta' data provides a common platform for all business terms and items across different applications and business constituents. This is essential when defining new products, gaining new customers, or adding suppliers to the business network. One simple update in the master database propagates changes safely and automatically to all related systems and services.
- **Processes consume and publish services.** The shift here is from application-oriented thinking to ESA-enabled processes. For a specific business process, operational, analytical, collaborative and data services are composed by a rules-based process engine. The result is that a business process either becomes a service or a group of services. Certain re-usability can be achieved by avoiding redundant implementation of functions and data. Redundancy was inherent in the old application-oriented model, service-orientation overcomes this problem.

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Role of a Enterprise Service Architecture



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Figure 2: ESA (enterprise service architecture) is the blueprint for a service-oriented architecture with an additional semantics layer, the business vocabulary. It is the infrastructure for a BPP (business process platform). The implementation is based on an integration hub supporting the life cycle management of processes and managing the back-end services including data services (DI = data integration) and meta/master data services. It also provides the B2B interface. Other business domains like content and knowledge management, office and CAD/CAM can also be incorporated via the integration hub. Business performance management acts as the brains of the process-oriented enterprise. It provides the "intelligence" for optimal monitoring and controlling all business processes and their performance. Intelligence is embedded into the processes for anticipating problems and risks. The PM Portal acts as the human interface. It supports human interactions through collaboration and presentation services. A PM Portal supports multi-channel communication via the web, PDAs, voice, etc.

(PM Portal – process management portal, ESB – enterprise service bus, ERP – enterprise resource planning, CRM – customer relationship management, SCM – supply chain management, PLM – product life cycle management, DW – data warehouse, B2B – business to business)

- **Processes drive the transformation to intelligent real-time enterprises.** Business intelligence is gleaned from metrics associated with each business process. Business metrics are defined by goals and objectives to manage a process in a measurable and proactive way with information, key performance indicators (KPI), rules, and predictive models.

Summary

Leading and winning enterprises move to process orientation. Process orientation means

- End-to-end, industrialized processes that are cross-departmental and cross-enterprise enabling seamless collaboration across all business constituents
- Intelligent processes by embedding analytics anticipating problems before they occur
- Business Process Management based on an enterprise service architecture as an infrastructure for modeling processes independently of applications, executing processes independently of applications (ESA enabled business processes) and planning, monitoring and controlling processes independently of applications (Business Performance Management)
- Driving IT strategy by business strategy by using business processes as the common communication platform

3 Embedded Analytics: Linking Business Intelligence to Processes

What is “Embedded Analytics”? Just another buzzword? Where is the value? You need to find out!

- Do you know which of your suppliers is mission critical to your production? Will their failure bring down your production for hours or even days?
- Do you know what percentage of the revenues of your suppliers is due to your spending? Do you get good terms and conditions from suppliers, using this information?
- Do you know which are your most profitable customers? Are you providing superior services in order to retain them and are you able to service them, upsell/cross-sell at appropriate points in your interaction with them?
- Do you know in Q1 that you will miss your sales target in Q4, because your actual volume of leads is insufficient?
- Do you know what revenue you are actually losing because customers cannot connect to your call center due to a peak demand?
- Do you know how much business you miss by not fully exploiting cross-sell opportunities in face-to-face, in boutiques, in web shops?

Do you know how much money this means for your enterprise? Do you know how to find it, get it and keep it?

The answer is linking business intelligence to business processes by embedding analytics into your processes. Planning, monitoring, and controlling of processes and of their performance is the issue. This is how analytics turns information into money.

Examples. Collaboration relies on discovering innovative ways to share critical information across the value chain, e.g., business-to-business, business-to-consumer, and business-to-employee. When collaborating, enterprises start sharing their production data with their customers, start sharing their warehouse, production and point of sales data with their suppliers for speeding up time-to-market and cutting costs. Leading retailers in Europe, for example, use shared real-time point of sales data for collaborative promotion management. Their goal is to optimize promotions by collaboratively managing product availability across all outlets in a region/country within promotional campaigns. In logistics, sharing of shipment data became a competitive edge hurting railway companies that do not have sufficient data about the location and routing of their wagons so that the arrival times of wagons cannot be predicted. In the airline industry, leaders are starting to manage arrival times of aircrafts by the value of customers booked on a flight. This means a lot of money when flights are delayed.

In process-oriented businesses, access to information is a must for everybody. Information must be “democratized”, e.g., made accessible to everybody involved in the management and execution of business processes. This is not restricted to your employees, indeed, all customers, suppliers, dealers and partners involved in the business’ processes also need information. Information reaches out to everybody

who is in business with the enterprise. But an information deluge is to be avoided. Access to information must be managed. When simultaneously modeling process logic and metrics, responsibilities must also be modeled: the process ownership model. It defines information profiles describing all the information necessary to manage a business process in an optimal manner. The issue is: deploy the right information to the right information consumer, at the right location, just in time, i.e. a real information supply chain is established.

Embedding analytics in processes requires a new approach to process modeling as well as a new approach to business intelligence. Modeling process logic and flow only as in the past is insufficient. We also have to model simultaneously metrics and responsibilities. We have to link strategy and goals to processes, metrics, and people and build the closed-loop.

Metrics represent management policies. The idea behind is obvious: You can only manage what you can measure. So, flexibility of changing and updating any metrics is one of the top requirements of the model. Furthermore, metrics must be consistent. Metrics specified to control the execution of a particular group of processes should not contradict other metrics. Indeed, metrics are cross-functional and cross-process: The performance of a business process may influence and interfere with the performance of other processes.

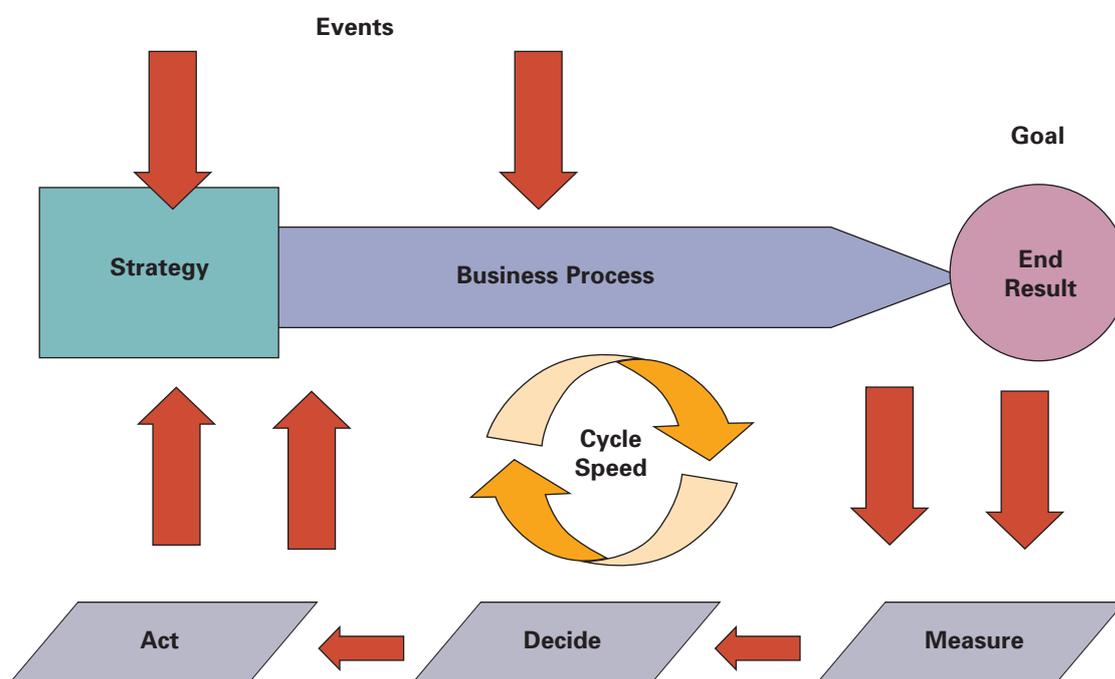
Example. Delivery time, a supply chain related metric, may influence customer satisfaction, a customer relationship management metric, which may in turn impact customer profitability which may be a corporate goal.

These issues are addressed by **business scorecards**. A business scorecard aligns all management policies presented by all metrics across the enterprise and presents the aggregated top management policy of the enterprise as well as all details for all employees. Examples of particular business scorecards are Norton/Kaplan's balanced score card or the six sigma model. The balanced scorecard, for instance, is a collection of metrics that is not only based on financial parameters, but uses also customer, employees and shareholders loyalties to provide a look to the business performance beyond the quarterly results. It presents indeed one particular style of management policies. Despite the wide variety of these metrics, the final goal remains the same: transform data into information and knowledge and maximize its value for the business.

There is an additional impact of linking BI to processes. **BI gets operationalized.** Operational processes are to be monitored and controlled in right time. This is sometimes called business activity monitoring (BAM) – real-time monitoring and alerting when metrics begin to deviate from their expected values. These ideas stem from control theory. Just as room temperature is monitored and controlled by a closed loop feedback model (embedded within the mundane thermostat), business processes are monitored and controlled in the same way, i.e. in right-time on the operational level. Right-time, by the way, is the better term than “real-time”. Right-time is a relative time, not clock-time as real-time. Right-time means synchronizing information delivery with the speed of the processes, another property of the information supply chain. Information is treated as the duty of the information provider. In the data warehouse model, information was treated as the duty of the information consumer. Now, the provider of information can be a system or a person. It is his / her / its responsibility to propagate information via publish and subscribe communication to all registered information consumers in right time.

Example Order Management: When customer calls the call center for information, customer is identified by his/her phone number. Customer value is exploited via a data service. If it is a high value customer, customer remarks are captured, and an online text mining makes a classification (merging structured and unstructured data for a holistic view). The process rules engine gets customer behavior via an additional data service, combines customer value, behavior and text mining classification and creates a up/cross sell recommendation. Based on the recommendation, the script for the call center agent is generated. Intelligent order management is implemented in many call centers and web shops, and it has proven that sales, customer satisfaction, and employee satisfaction go significantly up.

Business Performance Management



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Figure 3: Business Performance Management is a top down model for information-based business management. Measurable goals and objectives are derived from the strategy. Based on strategy, goals and objectives, business processes and business metrics for efficient process control and continuous optimization are modeled in parallel. Technical implementation of processes and metrics follows the principles of a BPP (business process platform) by operational and analytical services. Based on monitoring, decisions are taken either manually by man or automatically by decision engines. Decisions lead to actions for controlling the process and its performance (tactical and operational BPM) as well as updates strategy, goals and objectives (strategic BPM). Synchronizing monitoring, decision and action taking with the speed of the business process and business dynamics is key – indeed, this is a foundation of the real time enterprise.

Summary

Analytics still presents information and knowledge by reports, graphics, time and location presentation (e.g., time series and geographical information systems), and by models (e.g., customer behavior model, demand forecasting model, etc.). This looks very traditional at a first glance, but the two big differences are:

Business Intelligence must become process-driven, no more data-driven. It links business strategy to processes, metrics (Fig. 3) and the deployment of metrics to all employees, partners, customers and suppliers according to their role within the collaborative model: the use and value of information now goes beyond the power users and business analysts that in the past were the only people benefiting from information provided by business intelligence tools. Analytics now empowers all participants of the value network.

Business Intelligence must span from strategy to operations. Embedding analytics into operational processes means synchronizing information delivery with process speed so that decisions and actions can be taken in right-time. By embedded analytics, processes become intelligent and event-driven.

4 Analytics in a BPP

Faced with an ever-growing supply of data, and an explosive growth in the numbers of people who want to analyze business performance effectively and who need intelligence in their processes, how should analytics be designed, architected, and deployed? We have already introduced the concept of a business process platform (BPP). Cross departmental and cross enterprise processes can be implemented as composite applications supported by the business logic from existing back-end systems and missing components that have to be developed (Fig. 4). The BPP supports the composition of the services providing business logic and process templates.

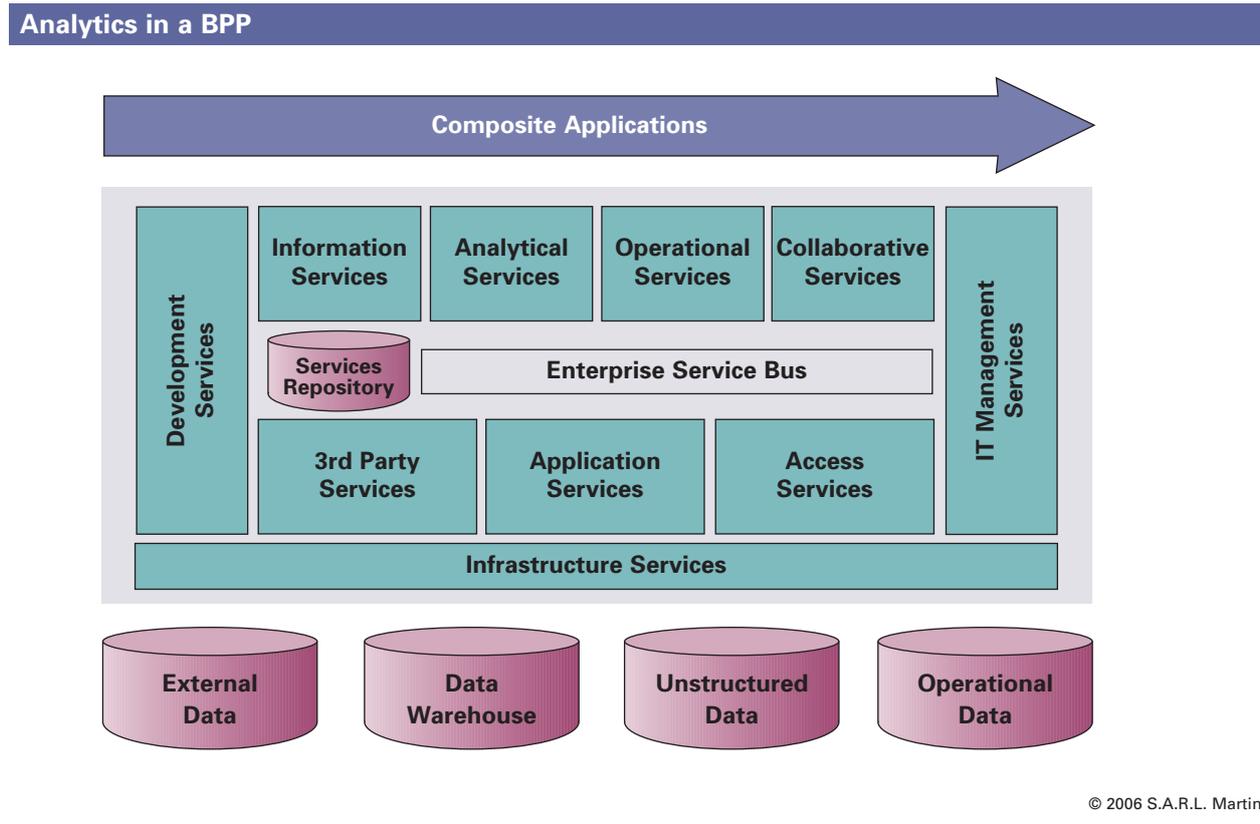


Figure 4: Composite Applications are the application independent implementation of end-to-end processes. They compose services provided by a Business Process Platform (BPP). In this service-oriented model, process logic and business logic are split. There are 4 categories of services providing business logic, information, analytical, operational, and collaborative services. These categories of services can be considered as "business services". They are composed out of "Technical Services" provided by 3rd parties, backend applications, and the various types of data sources. Furthermore, a BPP includes development services for both, process logic and business logic, and IT Management Services for administration, execution and security of services. The Enterprise Service Bus is a kind of intelligent middleware enabling service brokerage. It also includes the service directory listing and publishing all available services.

There are four categories of services providing business logic

- **Operational Services.** They provide transactional business logic like creating new customer, new account, placing an order etc.

- **Collaborative Services.** They provide services supporting human interactions and person to person communication like setting up a meeting, search services, communication services like embedded e-mail, chats, SMS, voice etc.
- **Analytical Services.** They provide analytical business logic like a threshold for product availability, a predictive model for customer behavior or customer risk, a forecasting service for sales, etc.
- **Information Services.** They provide composite information based on structured and unstructured, operational and analytical data sources like customer address, customer value, term of delivery etc. Information services also include meta data and master data services.

In this white paper, we now focus on analytical and information services.

4.1 Analytical Services

In a BPP, embedded analytics is implemented by analytical services. They are component based and consist of analytical business logic, i.e. content (customizable templates of all types of metrics for business performance management), and business intelligence components (spreadsheet, report generator, graphics, adhoc inquiry, OLAP, data mining, statistics etc). An analytical services life cycle management framework for implementing, customizing, and maintaining analytical services is part of the development services (Fig. 4). Analytical services extend the traditional data warehouse oriented business intelligence model. Indeed, as we have seen, embedded analytics puts business intelligence via metrics and predictive models into the context of strategy, goals, and processes.

- **Metrics and Key Performance Metrics** – Metrics are implemented as analytical services. They are used to manage the performance of a process and / or to control a process on strategic, tactical, and operational levels. They are top down derived from metricized goals out of strategy and process analysis. Metrics consist of indicators and scales. Scales define how to interpret instantiations of indicators and what decisions to take. A key performance metric (KPM) is a compound, cumulated metric. Term of delivery is an example for a KPM. It is cumulated of detailed metrics of time of delivery across all customers within a certain time period. Typically, an employee will have plenty of detailed metrics, but just some selected KPMs. KPMs should be related to the personal goals and match the model of management by objectives. In the end, KPMs could have an impact to components of the salary.

In the example about term of delivery as a KPM, a decision maker is responsible for interpretation of the KPM, making decisions, and taking actions. In case of such a human interaction, scales are typically visualized by traffic lights and / or speedometers. Green, yellow, and red lights ease and speed up the interpretation of instantiations of KPMs and metrics. In the example about managing the order process by product availability, interpretation is automated by a decision engine – visualization is not necessary.

- **Reporting, Query and Analysis Services** – In a BPP, traditional business intelligence tools functionality for reporting (interactive, production, and financial reporting), querying (ad hoc queries, OLAP) and analysis (data visualization, data mining, statistical tools) is implemented as components providing analytical services that can be embedded in any composite application. In the traditional world of BI, these tools have been sitting on a data warehouse architecture. In an ESA, these services can use any information service for data supply so that these services can now act on composite data stemming from analytical and operational data sources. Analytics goes real-time whenever relevant for the business.

- **Planning and Simulation** – Planning is a typical cross-departmental process that is best implemented as a composite application. So, planning functionality is implemented as planning and simulation services providing full flexibility and adaptability of this process to changing business scenarios. The advantage of implementing planning in an ESA is obvious, the planning process can be composed out of any analytical and other services avoiding the redundancy in analytical functionality by implementing a planning application in an traditional data warehouse / business intelligence architecture and by fostering a rigorous and audit-proof planning by a controlled process instead of spreadsheet based manually driven planning processes.
- **Alerting** – Event-orientation requires alerting services. When an alert is to be launched, the information describing the event causing the alert is automatically propagated to all recipients that have subscribed to receive this information. This is set up by publish and subscribe communication using message / queuing infrastructure. The principle of this communication method is defined by the information supply chain model. All information that is necessary to process the event / alert should be available to all recipients in right time for making the right decision and taking the right action. Again, right time means to synchronize the speed of the process with the delivery of information via the propagation. If speed is high, and the delta between event / alert and decision / action becomes small, then a human interaction may be too slow: The decision / action taking must be automated. Examples for automated decision / action taking can be found on various web sites where recommendation engines are working.
- **Broadcasting** – These are services for delivering personalized messages to millions of recipients via e-mail, fax, pager, mobile phone, PDA etc. Using exception conditions and recurring schedules as triggers, events can be automatically created and propagated to processes and people within the enterprise or to any external community. Content can be personalized to the individual subscriber, preventing information overload and ensuring that security requirements are strictly enforced.
- **Analytical Workflow** – It provides the analytical scenarios based on best practices for analyzing and understanding complex situations. Typically, such scenarios are jointly developed by information consumers and business analysts. In case of a new situation not yet supported by a business scenario, the analytical workflow is extended by a joint incremental development step. This joint development model for best practices is a key part of the information democracy model. Business analysts and power user's roles are updated. Instead of delivering first line support by creating reports and running adhoc inquiries on demand of information consumers, they now provide second line support for data exploration (see chapt. 4.3) and the development of analytical scenarios.
- **Dash-Board Services** – These are presentation services for publishing a scorecard model. A dashboard should be embedded as a portlet in a portal framework. The dashboard visualizes all metrics for each information consumer according to his / her information profile. The information profile describes which information, functions, knowledge and processes an information consumer (employee, customer, supplier, partner, dealer etc.) must have access to according to his / her role. Based on the information profile, the dashboard is personalized according to the paradigm of the information supply chain: Each information consumer gets exactly what he / she needs to do his / her job according to the process ownership model: All relevant metrics are arranged and presented to the information consumer.

Deployment is either passive, i.e. the information consumer uses search and navigation services to access its metrics and is guided by an analytical workflow, or active, i.e. only exceptions and alerts are passed by appropriate channels (e.g., SMS or e mails) to the information consumers triggering decisions and actions. This enables management by exception. Furthermore, in time critical situations, when human decision making takes too long time, alerts and alarms drive rules-based decision engines. Then, decision taking and launching of actions is automated.

When considering the huge volume of data to be analyzed and processed by analytical services, we must not forget performance issues. Analytical services will never find sufficient acceptance without a high performance infrastructure. Performance can be addressed by special database technologies like compression, indexing, vector processing, memory-based caching etc. This can dramatically improve the performance of adhoc queries and analytical services. But this can even be complemented by a business intelligence accelerator. This is one of the rather recent developments in in-memory processing. In-memory processing of analytical services especially benefits from a 64 bit address space and provides even more performance than the already classical specialized data base technologies that still process data according to relational schema.

4.2 Information Services

Traditional business intelligence tools worked on the data warehouse, whereas Analytical Services work on a data integration platform. Operational CPM in particular requires access to operational and analytical data simultaneously. So, in an ESA, the data warehouse becomes a backend data service, and the data integration platform is part of the enterprise service bus (Fig. 4). Data integration provides Information Services for analyzing data, master data and meta data, develop data models, prepare and profile any type of data, as well as ETL (extraction, transformation, load) services.

- **Information Latency** – Information Services can be either low latency or zero latency services. So, the key point is first to determine what latency can be tolerated for a given process. Note that latency is correlated with cost: the lower the tolerated latency, the higher the cost.

The low latency model is based on a data integration platform that collects all relevant transactional data and analytical data and stores it in a so-called low-latency data mart (LLDM). This requires integration of the data integration platform with the ESB where the processes across all backend applications are managed. The LLDM is refreshed either by message queuing or by batch, where the batch is executed in short periodicities according to the tolerated latency (e.g., hourly etc.). Innovative “real-time” enterprises use the LLDM for real-time data propagation. This is a feedback loop for triggering events in operational systems via cross-process metrics. This coupling with operational systems requires managing the data integration platform like the ESB platform: The data integration platform is an operational system.

This model is different from an operational data store (ODS) where data from operational data bases only is stored via ETL processes. So, all transaction logic that is not stored in the operational data bases cannot be mapped to operational data stores. Furthermore, The ETL process is not synchronized with the transactions, i.e. ODS data is not always in sink with the state of transactions. This stresses the need for low latency data marts, especially in the case of legacy systems.

The zero latency model is also called EII (enterprise information integration). It can be understood as a logical data base access layer spanning across all operational data bases and the data warehouse providing data as services. The access is done via XML and the EII resolves the data request into various SQL statements accessing the corresponding data bases and transforming the data so that the requested compound data is published as a service and available for the process. Indeed, such a data service could be also implemented as a web service.

- **Meta Data and Master Data** – An analytical services infrastructure should be meta data driven. Meta data is key to a consistent data model including life cycle management for a consistent comprehension and communication of the data model, for data quality and data protection and security. Meta data builds the business vocabulary of the enterprise and even across enterprises.

The business vocabulary plays a central role. Processes and metrics need a common and uniquely defined language for modeling and for communication to all business constituents in collaboration contexts. The services repository includes a container of all meta data. It plays the role of the integration hub for the meta data of all back end systems in the ESA. When services of back end systems are invoked by a composite application, then they must speak to each other in the same language that is based on the business vocabulary of the repository. A point-to-point communication would again lead into the chaos of isolated islands. The only solution is to transform the meta data model of each back end system into the central business vocabulary of the repository of the BPM integration hub. Then, all back end systems can speak to each other and adding additional back end systems becomes straight forward, easy, and fast.

A subset of meta data is used to describe master data, such as the structures of product, customer, supplier, dealer, employee data and other categories of reference data. Meta data and master data are not static. On the contrary, any merger and acquisition, market change, internal organizational restructuring, or update of a business definition and rule can result in a change or creation of new meta data and associated master data. But it is absolutely insufficient just to update meta data and master data and store the most recent and actual version in the repository. **For enterprise planning and for any comparisons between past, now, and future, the availability of the total life cycle of all meta data and master data is a must.** This is why meta data management and master data management should be tightly coupled with a holistic life cycle management approach. The repositories must include the life cycle of all meta and master data. Today, this is a weak point, sometimes even a gap in vendor offerings and enterprise architectures.

4.3 Data Exploration – An Analytical Composite Application

Data Exploration is an ad hoc, temporary, project-oriented process. In a BPP, it is best implemented as a composite application. The results of data exploration provide new analytics, e.g., profiles, rules, scores, and segmentation for a better insight into markets, customers, risks etc. Good example for data exploration is the development of predictive models by data mining. The final predictive model is then implemented in a rules engine enriching an operational process.

Example. Let us consider the process of credit approval in banking. Standard rules for checking a customer situation for solvency and credit approval can be rather easily modeled by a financial consultant. This top down model can be complimented by a bottom up model describing the risk of credit failure. This can be identified by data mining customer data and providing a risk based customer segmentation. A combination of the expert rules and the generated predictive model provides the final rules. The process of credit approval can now be automated, its workflow is controlled by a rules engine, and customers can now run credit approval as a self service on a web site, for instance. Other examples can be found in the context of cross/up-selling and customer retention.

Data exploration processes are modeled and executed by interdisciplinary teams. A specialist for analytical methods and a business user representing the future information consumers jointly drive the data exploration process. The necessary data services are provided by an IT specialist. The IT specialist ideally is a data architect who knows well the enterprise data and data sources and who can identify and evaluate external data sources and services for enriching the internal data. Data exploration processes are still a special task for especially trained experts with specialized tools.

But, data exploration provides “intelligence” that can be used to enrich other processes. This embedded analytics is then implemented as an analytical and/or information service. Within the intelligent process, it works as a black box. Special knowledge how this intelligence works is not necessary when working in the

context of intelligent processes. Analytics including even sophisticated approaches like data mining, text mining and web mining is made consumable for everybody, not only for some thousands of specialists, but for millions and more information consumers.

Summary

Business Intelligence and Business Process Management converge. Analytical Services in a Business Process Platform embed analytics into processes. Analytical Services and Information Services can be flexibly combined with Operational Services and Collaborative Services fostering innovative business processes. In the framework of analytics, data exploration and planning are good examples of how to address old, often incompletely resolved business challenges by composite applications creating world-class, audit-proof and seamlessly integrated processes.

5 Appendix

Related Reading:

Martin, W., Nußdorfer, R.: PM Portals – Collaboration and Presentation Services: Pulse Check – Processes and People, iBond White Paper Vol. 4, www.eaiforum.de, Munich, 2005, 33 pages

Martin, W., Nußdorfer, R.: Corporate (Business) Performance Management: Pulse Check – Operational, Tactical, and Strategic CPM, iBonD White Paper Vol. 2, www.eaiforum.de, Munich, 2005, 38 pages

Nußdorfer, R., Martin, W.: RTE – Real-Time Oriented IT Architecture: All Together Now, Strategic Planning of IT Architectures, iBonD White Paper Vol. 1, www.eaiforum.de; 2003, Munich, 35 pages

Nußdorfer, R., Martin, W.: iSO – Integrated Solutions: All Together Now, End-To-End Processes Across Integration Hubs, iBonD White Paper Vol. 3, www.eaiforum.de; Munich, 2004, 41 pages

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Designated in 2001 one of the top 10 most influential IT consultants in Europe (by Info Economist magazine), Wolfgang Martin is a leading authority on Business Integration, Service-Oriented Architectures (SOA), Business Intelligence (BI), Corporate Performance Management (CPM), and Customer Relationship Management (CRM). After 5½ years with META Group, latterly as Senior Vice President International Application Delivery Strategies, Mr. Martin established the Wolfgang Martin Team. Here he continues to focus on technological innovations that drive business, examining their impact on organization, enterprise culture, business architecture and business processes. Mr. Martin is a notable commentator on conference platforms and in TV appearances across Europe. His analytic skills are sought by many of Europe's leading companies in consulting engagements. A frequent contributor of articles for IT journals and trade papers, he is also an editor of technical literature, such as "Data Warehousing – Data Mining – OLAP" (Bonn, 1998), "Strategic Bulletin on EAI" (Munich, 2002, 2003 & 2004), „Strategic Bulletin on CRM“ (Munich, 2002, 2003 & 2004), "Strategic Bulletin on BI" (Munich, 2003, 2004 & 2005), „Jahresgutachten CRM“, (Würzburg, 2002, 2003, 2004 & 2005). Prior to META Group, Wolfgang Martin held various management positions with Sybase and Software AG, responsible for business development, marketing and product marketing. Prior to this, he became an expert on decision support while with Comshare. His academic work included Computational Statistics at the Universities of Bonn (Germany) and Paris-Sud (France). Dr. Martin has a doctoral rer.nat. degree in Applied Mathematics from the University of Bonn (Germany).