

Methods and Technologies for Business Process Monitoring

Josef Schiefer

Vienna, June 2005



Agenda

- » Motivation/Introduction
- » Real-World Examples
- » Technology Perspective
- » Web-Service Based Business Process Monitoring
- » Adaptive Business Process Monitoring with Sense & Respond
- » Modeling Sense & Respond
- » Business Process Monitoring with Senactive
- » “Diplomarbeitsthemen” in the area of business process management & monitoring
- » Q&A



Motivation



Motivation

"What one can measure, shall be measured; what cannot be measured, shall be made measurable."

Schmalenbach (1963)

"If you cannot measure it, you cannot control it. And if you cannot control it, you cannot manage it."

Harrington (1991)

"Large scale production workflow systems with thousands of interactive tasks per day will generate megabytes of audit trail data for analysis."

What do you do with this information?

McLellan (1996)



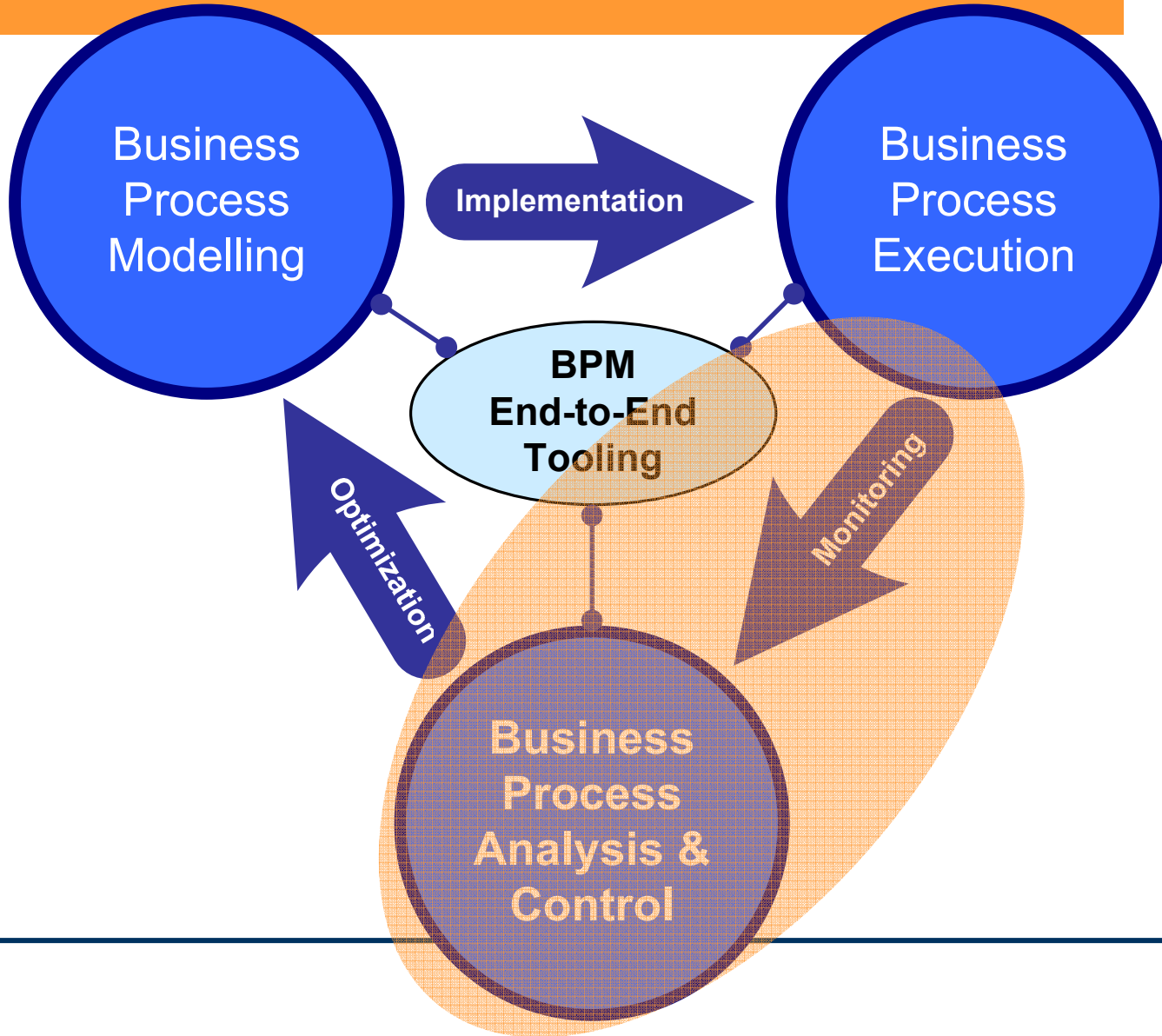
Why Business Process Monitoring?

- » Automatically **extracts and generates performance data** from enterprise processes
- » Uncovers **weaknesses in process handling**
- » Optimize throughput times, resource assignments
- » **Warning system** by monitoring business processes
- » **Benchmarking** based on measurable process indicators -> identification of best practices
- » **Process-driven analysis** of business data (e.g. break down metrics by business activities)
- » **Past activities** can be used to drive prospective interactions with the customer
- » Continuous process improvement, closed loop analysis

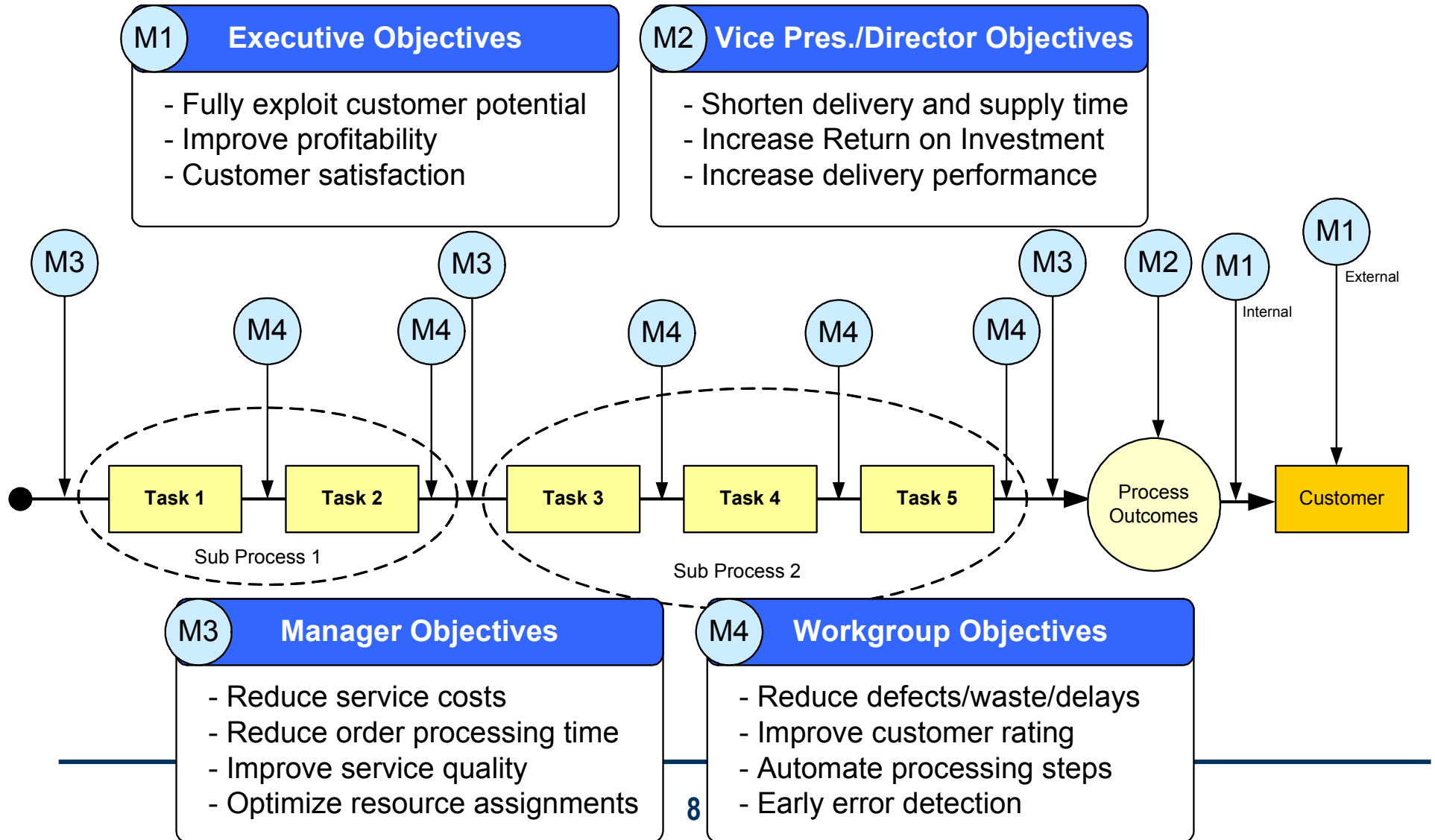


Introduction

Business Process Management Lifecycle



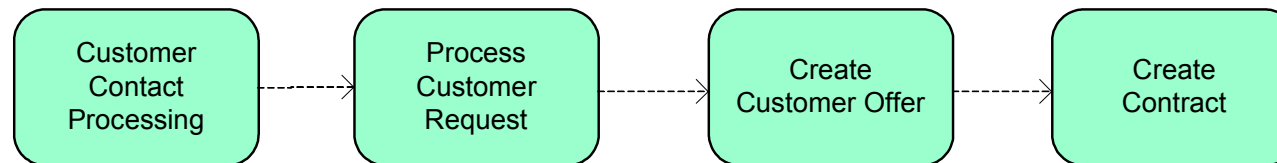
How well is Performing a Business Process?



Process Related Business Questions

Customer Request Processing 1/3

Sample Process



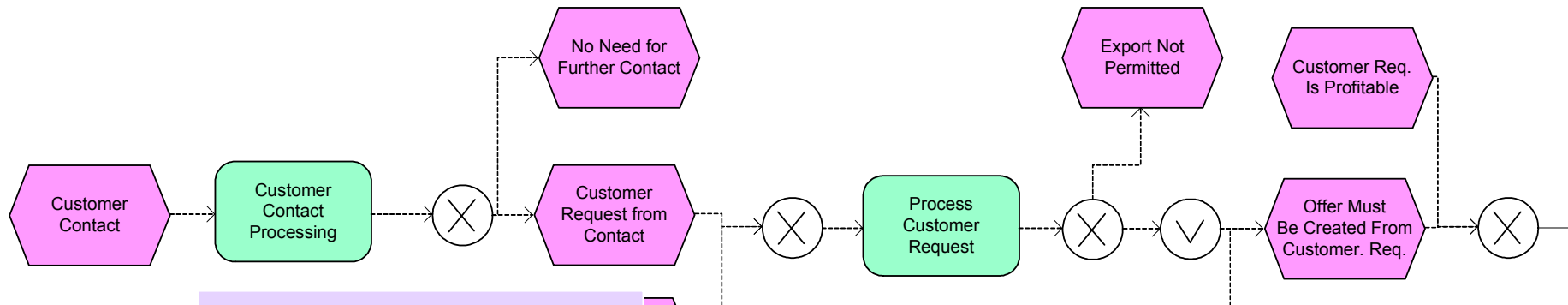
Business Questions

Analysis of the process (time, quality, costs...) and its activities:

- How many customer requests result in a contract?
- Which activities are the bottlenecks in the customer request processing?
- How satisfied are customers with the current process?
- Show the customer requests with the longest processing time?
- Show the average processing time of customer requests for the company XY?
- How did the processing time and process cycle time change compared to the last quarter / last year?
- How did an introduction of an CRM software package impact the processing of the customer requests?

Process Related Business Questions

Customer Request Processing 2/3



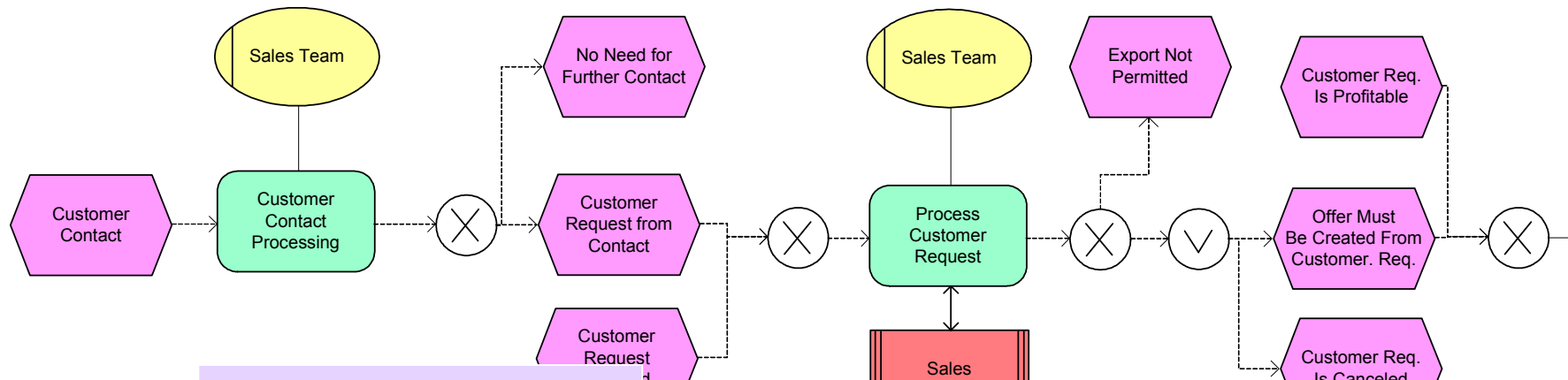
Business Questions

Analysis of the control flow and the events:

- How many customer contracts originate from customer contacts and how many are direct customer queries?
- Which customer requests couldn't be processed because of export restrictions?
- Which customer requests were turned back because of less profitability?
- Which customer requests were canceled? Why were they canceled?
- Which customer requests were not processed because the items or services could not be delivered?
- Which customer requests were canceled during the contract processing?

Process Related Business Questions

Customer Request Processing 3/3



Business Questions

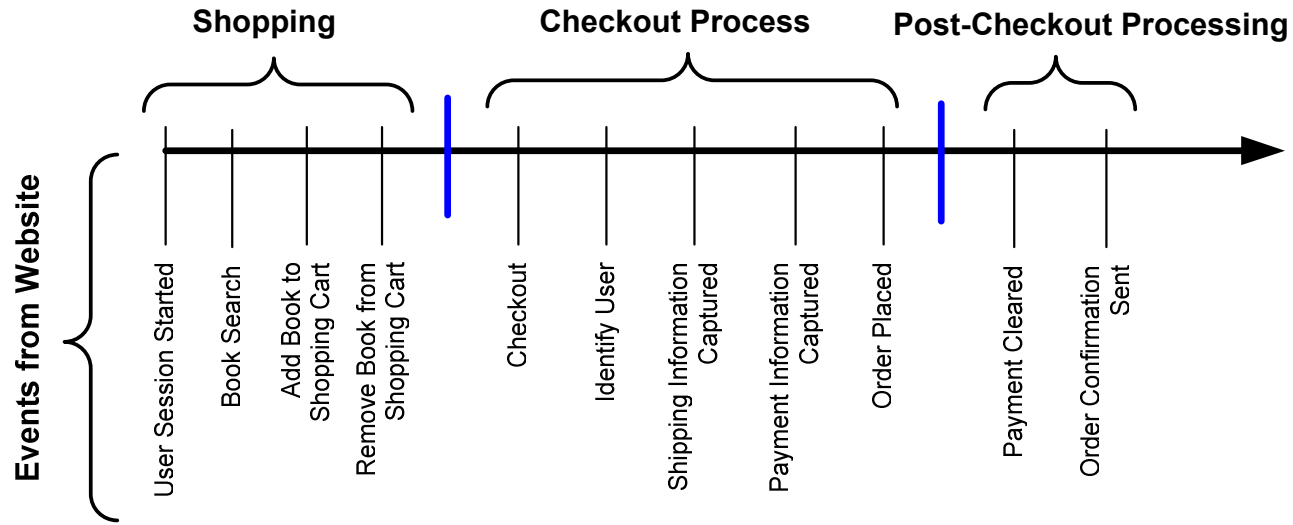
Analysis of the process context (organization, customer, channel...)

- Which sales teams initiated and processed the most customer requests? Which sales teams are initiating customer contract with a contract volume of more than 100.000\$?
- What are the Top/Bottom 10 contract volumes by channels which were used for the customer contacts.
- Which sales teams do the most profitable customer request processing?
- Which customer requests result in long-term contracts?
- Which customer requests cannot be fulfilled and why?
- How long is the average customer request processing per sales team?
- How much time does the contract processing take with a contract volume of more than 100.000\$ compared with last quarter / year?

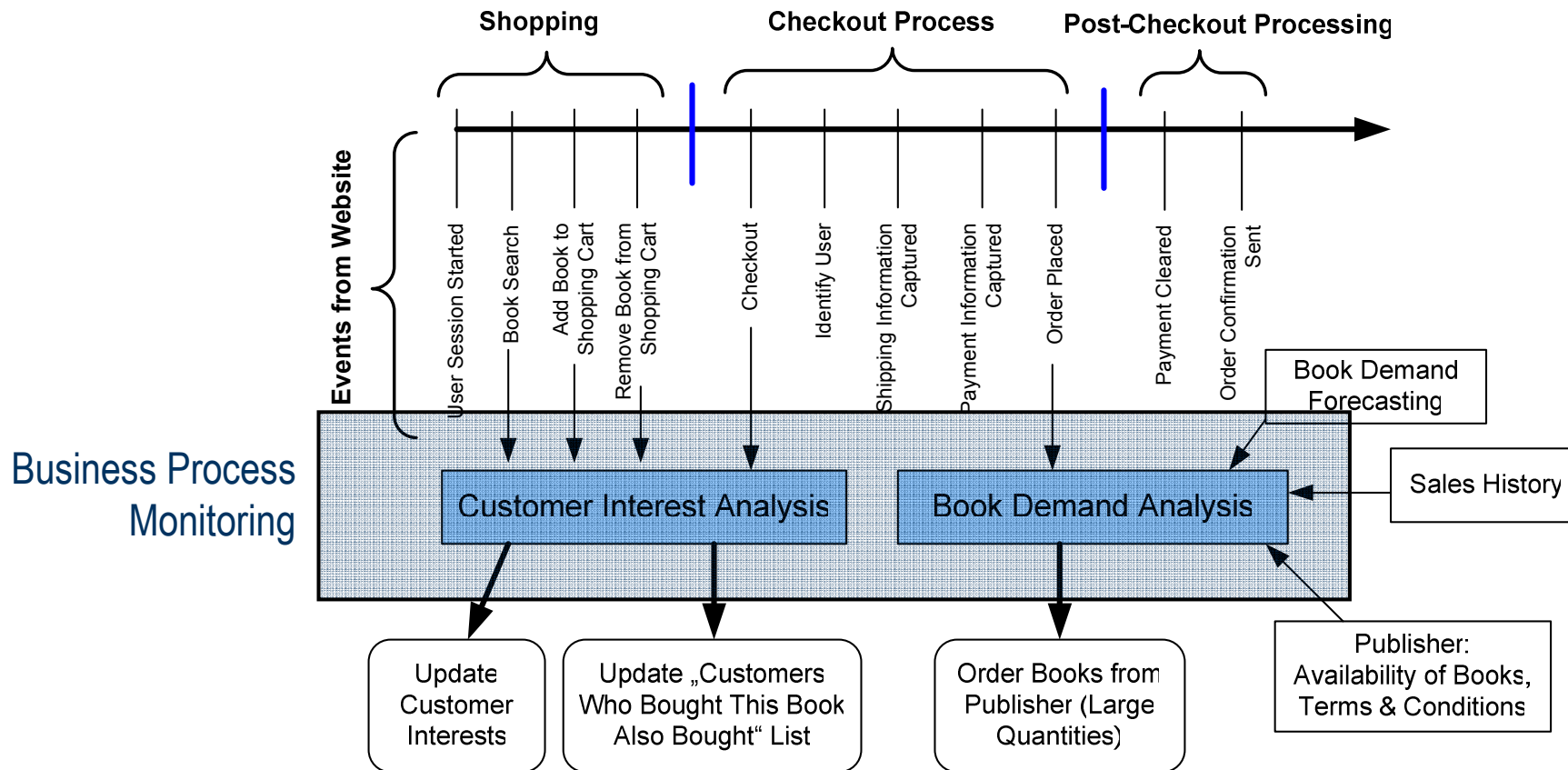


Real-World Examples

Example: Ordering a Book from Amazon



Example: Ordering a Book from Amazon



Management Portal for Supply Chains

IBM WebSphere Portal - Microsoft Internet Explorer

Address: <http://maverick.watson.ibm.com/wps/myportal/.pcmd/changePageGroupJSPCommand>

Welcome MD! January 15, 2003

Home Work with Pages Solution Manager

MicroElectronics Division

Real Time Exception Monitor

Event	Exception Type	Time	Alert Type
15541	Demand	2002-07-29	→
15531	OTD	2002-07-29	→
15521	Demand	2002-07-29	→
15511	OTD	2002-07-29	→
15504	Revenue	2002-07-29	→
15503	Revenue	2002-07-29	→
15502	Revenue	2002-07-29	→
15501	Demand	2002-07-28	→
15491	OTD	2002-07-28	→

Inventory Monitoring Portlet

Quoted at: 2002-07-30
Current Period: Quarter = 3, Year = 2002

Family	In Process Inventory(\$)	Finished Goods Inventory(\$)
00006K2152	16786.400	2515.000
00012P9314	143777.300	135321.850

[Refresh](#)

OTD Monitoring Portlet

Quoted at: 2002-07-30
Current Period: Quarter = 3, Year = 2002

Family	Service Level Agreement	Actual OTD Performance	Status
00006K2152	98.00%	98.30%	
00012P9314	98.00%	100.00%	

[Refresh](#)

Above target
 On target
 Below target

Demand Monitor

Quoted at: 2002-07-30
Current Period: Quarter = 3, Year = 2002

Family	QTD Forecasted Shipments	QTD Actual Shipments	Status
00006K2152	3411.870	2709	
00012P9314	3305.337	2691	

[Refresh](#)

Above target
 On target
 Below target

(c) IBM Watson Research

Management Portal for Supply Chains – Detailed Exception View

IBM WebSphere Portal - Microsoft Internet Explorer

Address: http://maverick.watson.ibm.com/wps/myportal/_cmd/ActionDispatcher/_pagr/104/_pa.104/111/.aref/1001850676/.pid/143/.cid/167/.reqid/-1#167

MicroElectronics Division **Real Time Exception Monitor**

All Events > View Event >

ID 15502

Status: NEW Type: Revenue Timestamp: 2002-07-29

Family ID: 00012P9314 Exception Week: 2002, week 31

Week	Cumulative Revenue Track	Cumulative Revenue Outlook	Actual Revenue	Revenue Outlook	Status
27	46248.520	46291.000	46291.000		On target
28	277587.120	251605.200	205314.200		Below target
29	503409.265	462365.400	210760.200		Below target
30	725049.503	668496.500	206131.100		Below target
31	948529.262	886695.936	34309.800	218199.436	Below target
32	1187426.489	1120632.406		233936.470	Below target
33	1426070.260	1371859.654		251227.248	Below target
34	1654156.397	1622266.189		250406.535	On target
35	1875487.699	1892670.981		270404.792	On target
36	2098759.471	2184863.040		292192.060	Above target
37	2327556.610	2494533.765		309670.724	Above target
38	2548750.724	2821982.411		327448.647	Above target
39	2780836.000	3165996.701		344014.290	Above target

Legend: Lower, Upper, Actual, Prediction

Legend: Above target, On target, Below target

Recommended Solution(s)

Cancel Approve

Work Flow

Step #	What	View Details
1	Adjust current quarter revenue target from \$2780836.000 to \$3165996.701	
2	Update 13-week rolling demand statement	⇒⇒
3	Update 13-week rolling build plan and DOS policy	⇒⇒ build plan & DOS policy

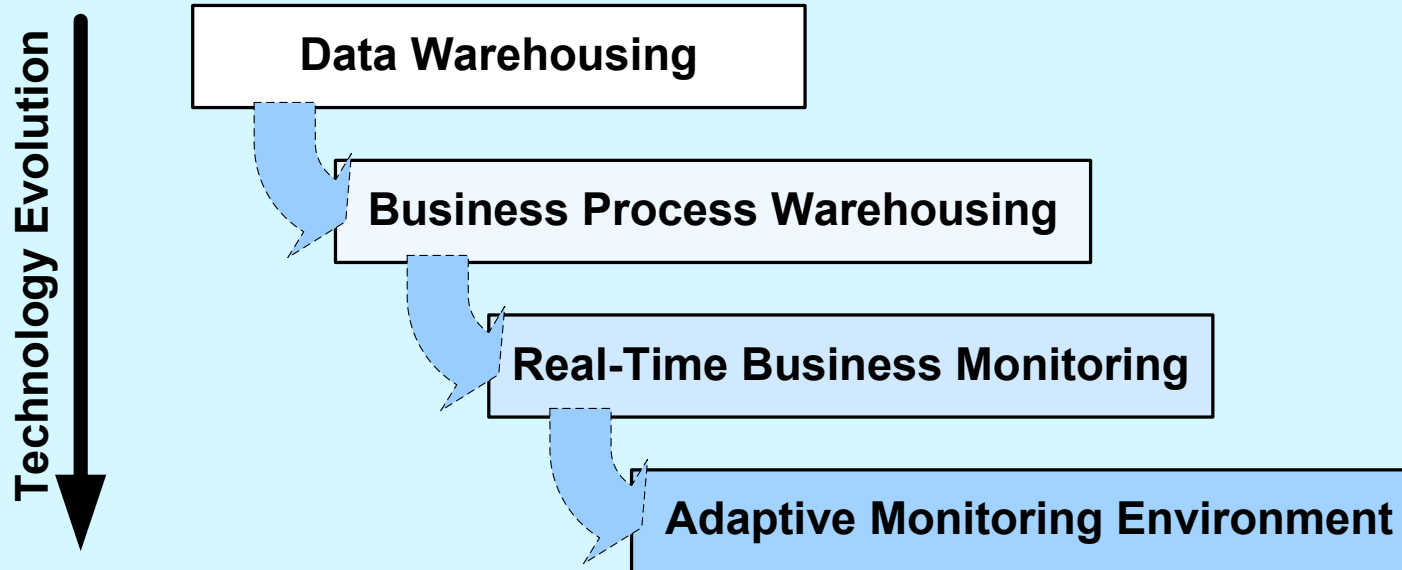
(c) IBM Watson Research



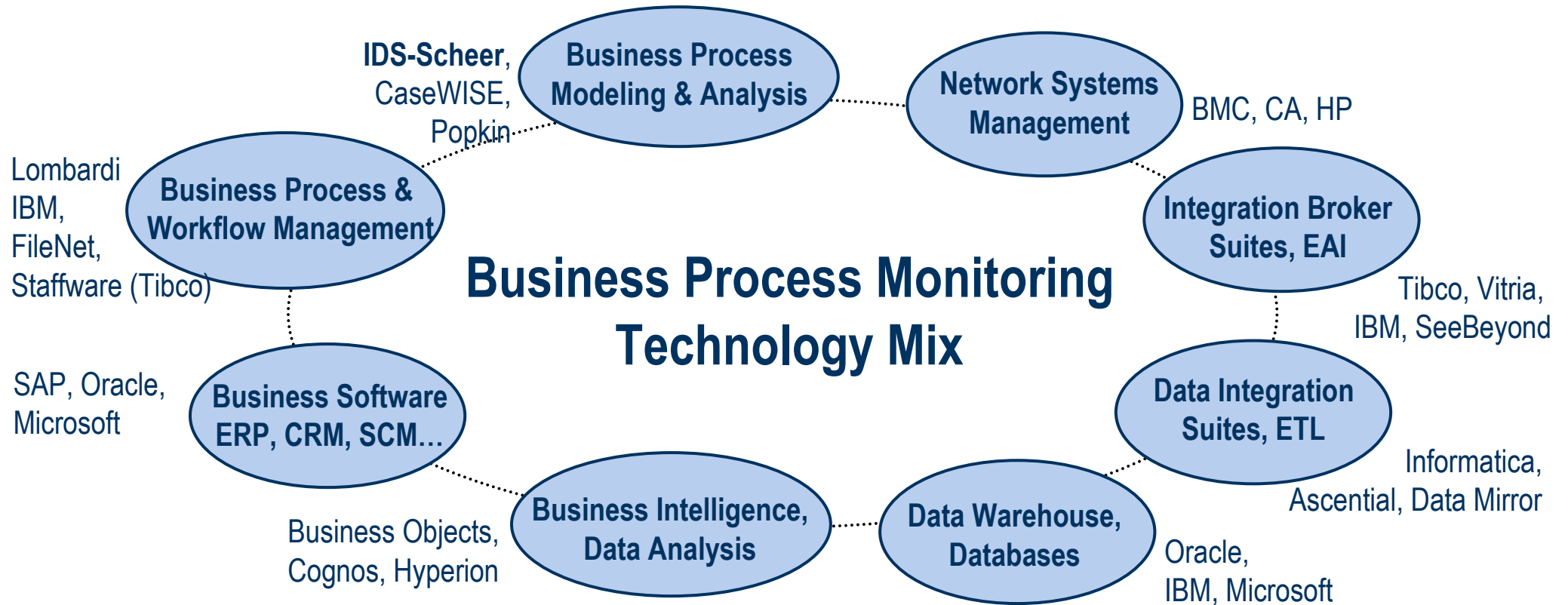
Technology Perspective of Business Process Monitoring

Technology Evolution for Gaining Insight into the Business

Approaches for Insight into Business Data



Business Process Monitoring – Technology Landscape

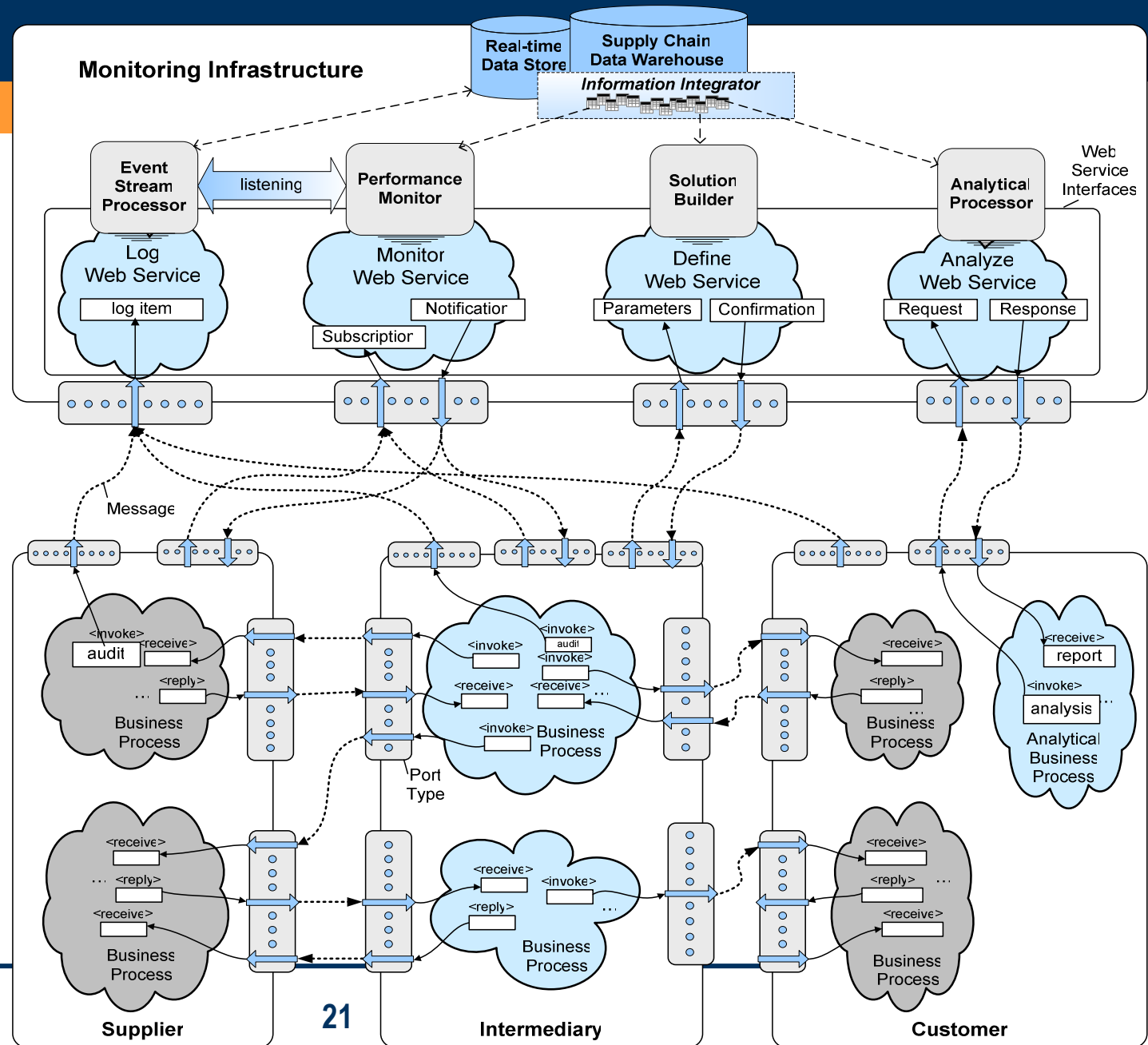




Web-Service Based Business Process Monitoring

Monitoring of a Distributed Supply Chain Process

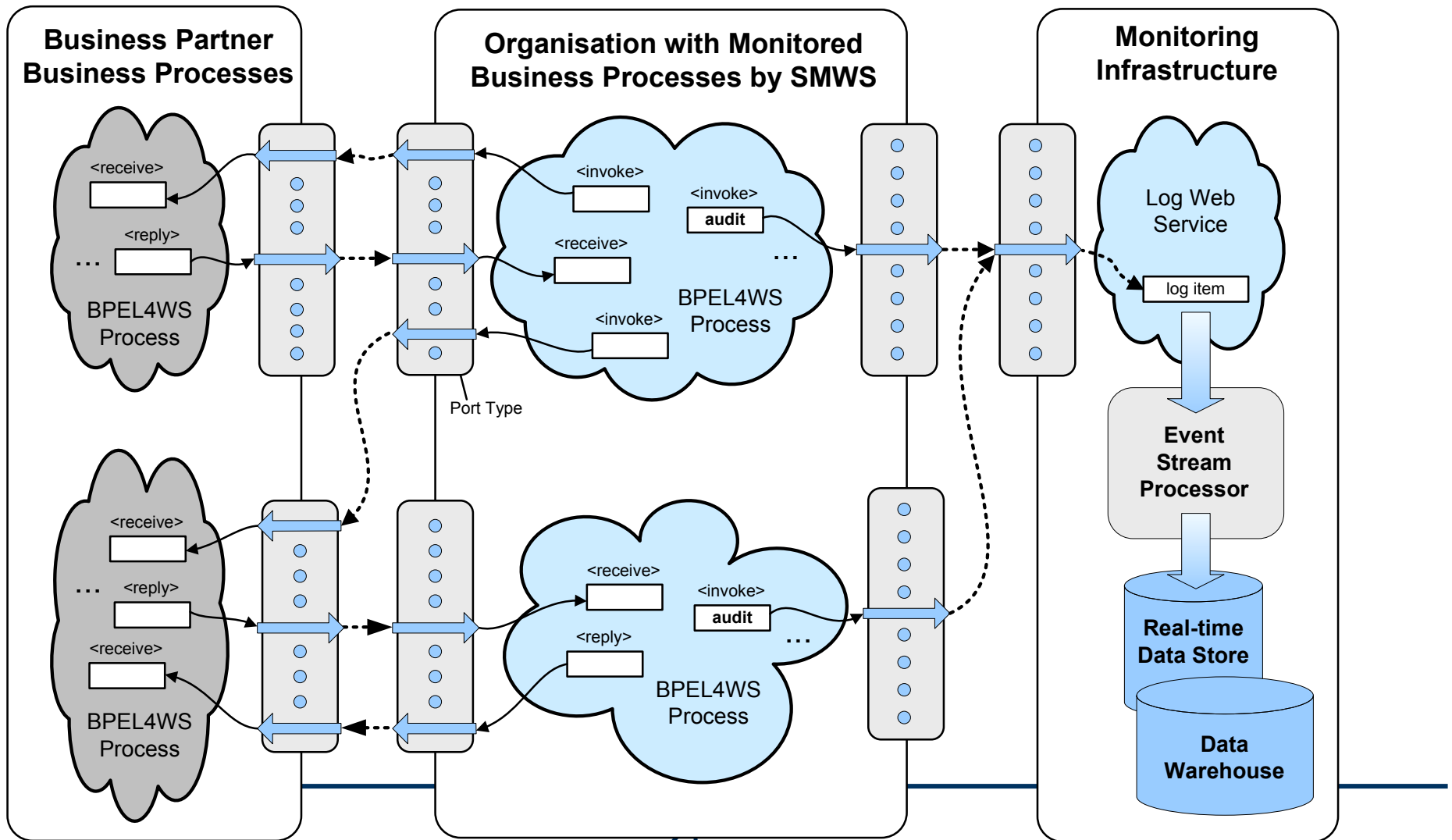
- Monitoring of intra-organizational business processes
- Shared monitoring infrastructure for business partners
- Monitoring of business processes as on demand service



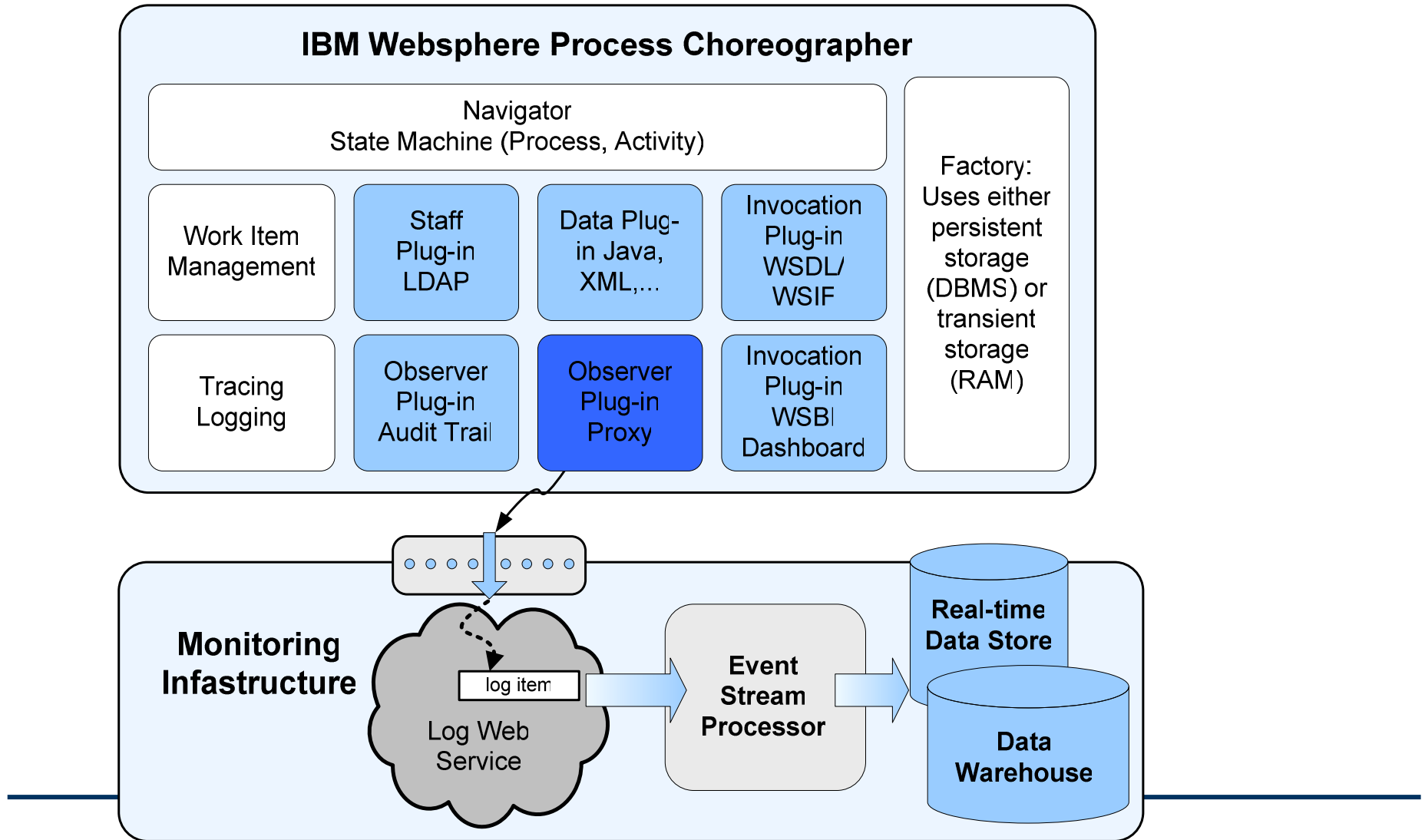
Business Process Monitoring: Four Web Service Types

Define Web Service	Log Web Service	Analyze Web Service	Monitor Web Service
<ul style="list-style-type: none">• Setup of monitoring infrastructure• Identifies web services for monitoring and their owners• Defines the web services states and state transition rules• Defines performance objectives• Defines security policies	<ul style="list-style-type: none">• Captures audit trail data from various source systems• Logs state changes of a business process• Calculates business process metrics and stores them in a database• Correlation of process events	<ul style="list-style-type: none">• Query interfaces for retrieving performance data• The performance data includes<ul style="list-style-type: none">• web service enactments• process metrics• service level violations• Access to analytical agents• Dependent on policies defined by the web service owner	<ul style="list-style-type: none">• Senses performance data for exceptional business situations• Responds to exceptional business situations (e.g. by calling another web-service)• Manages service level agreements

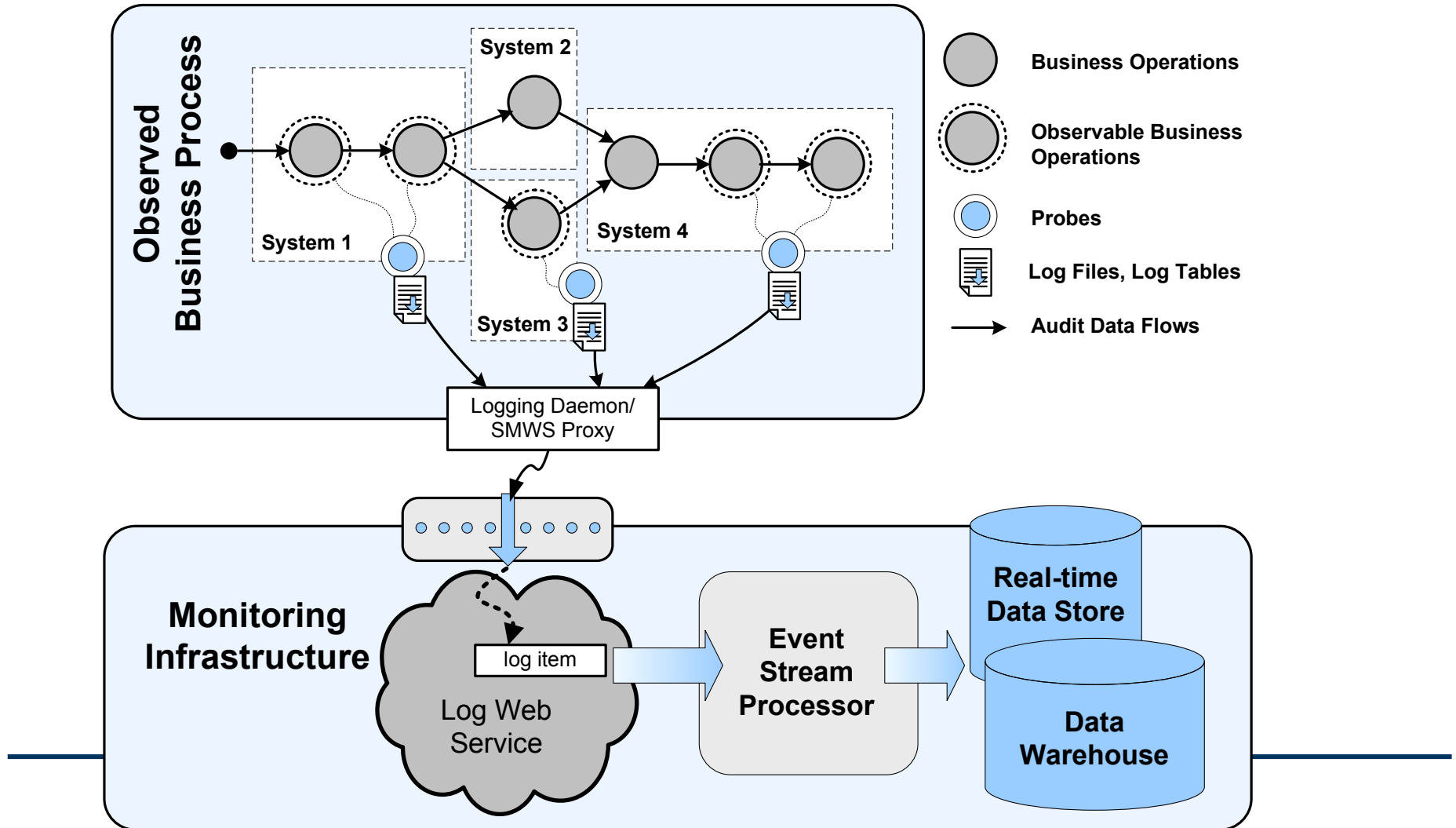
Monitoring BPEL4WS Processes



Monitoring Process Managed By Workflow Management Systems

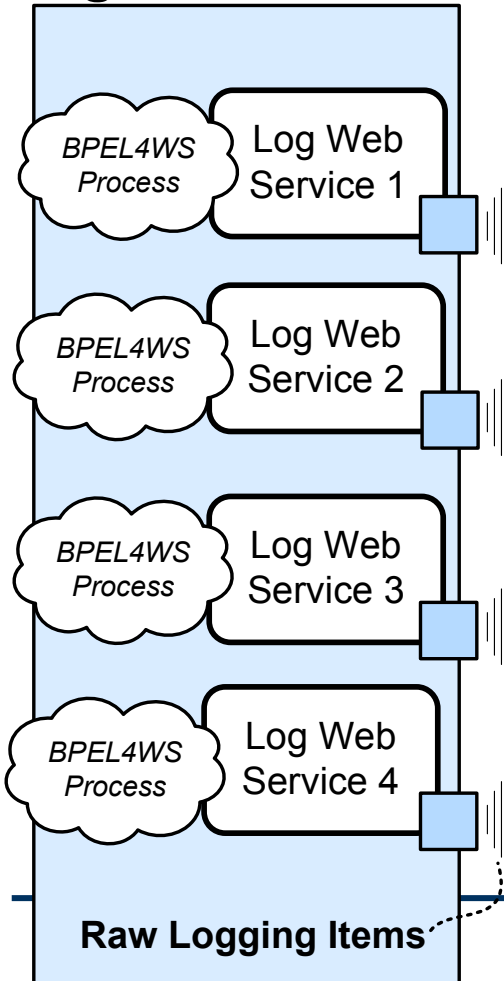


Monitoring with Probes in Operational Systems

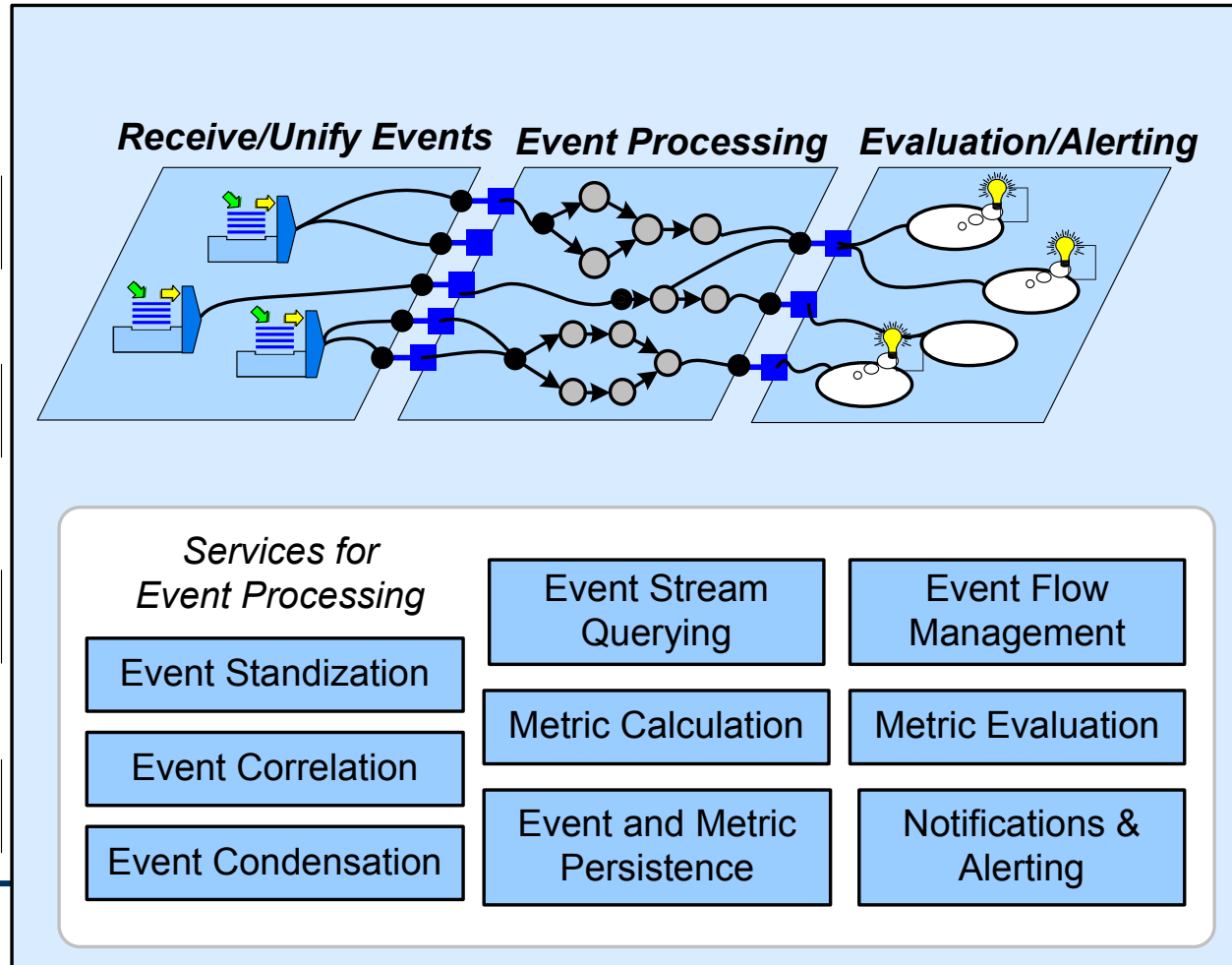


Event Stream Processor

Log Web Services



Event Stream Processor

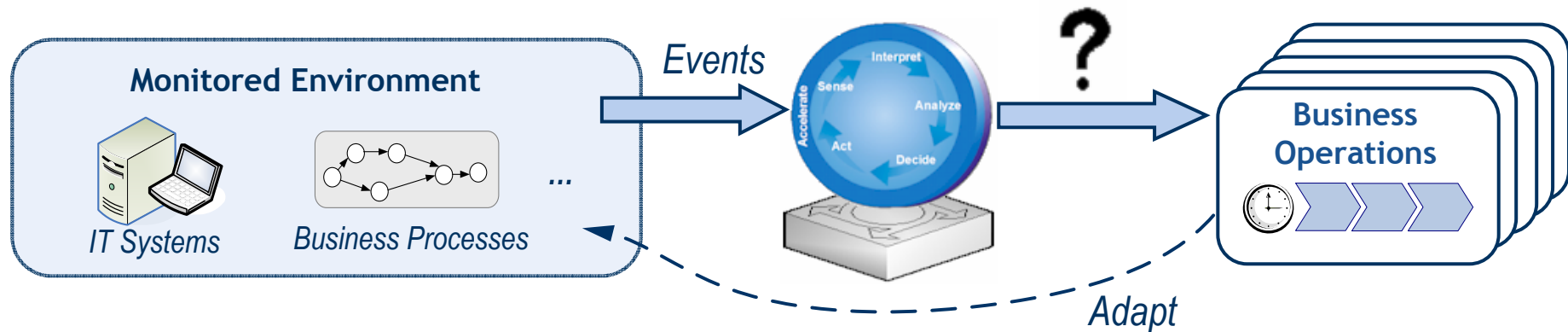




**Adaptive
Business Process Monitoring
with Sense & Respond**

Business Process Management and Sense & Respond

Sense & Respond adds intelligence to when and how a business operation is executed



Sense & Respond adds intelligence when the execution of a business operation depends on

- » State of a business process (e.g. delays of process activities)
- » Complex event pattern (e.g. a fraud event patterns)
- » Assessment of opportunities, risks, capacity utilization, quality of service
- » Real-time key performance indicators, which can be highly aggregated business metrics (e.g. cycle times, processing costs, response time to customer)
- » Predictable indicators (e.g. demand forecasts, production plans)

Sense & Respond Loops

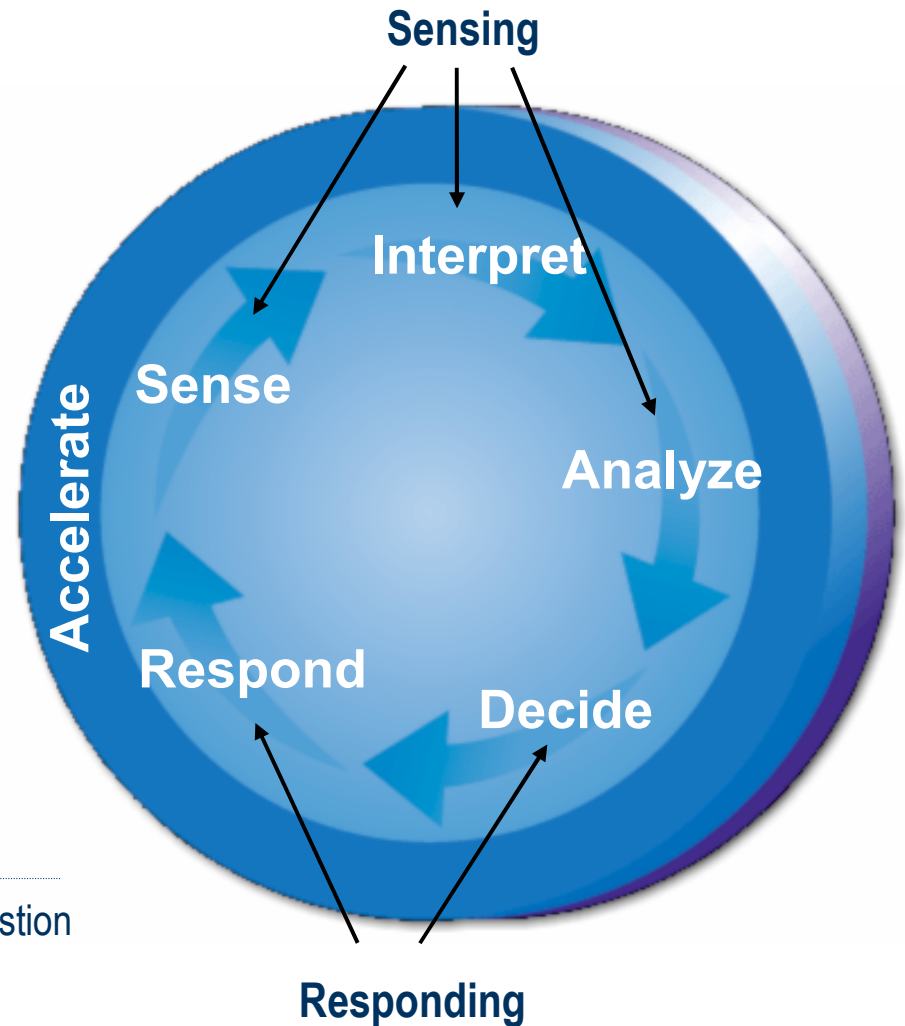
- Sense**
 - » Extracts and collects relevant event data from the business environment

- Interpret**
 - » Giving the event data a meaning
 - » Transforms event data into information (e.g. KPIs, business situations and exceptions)

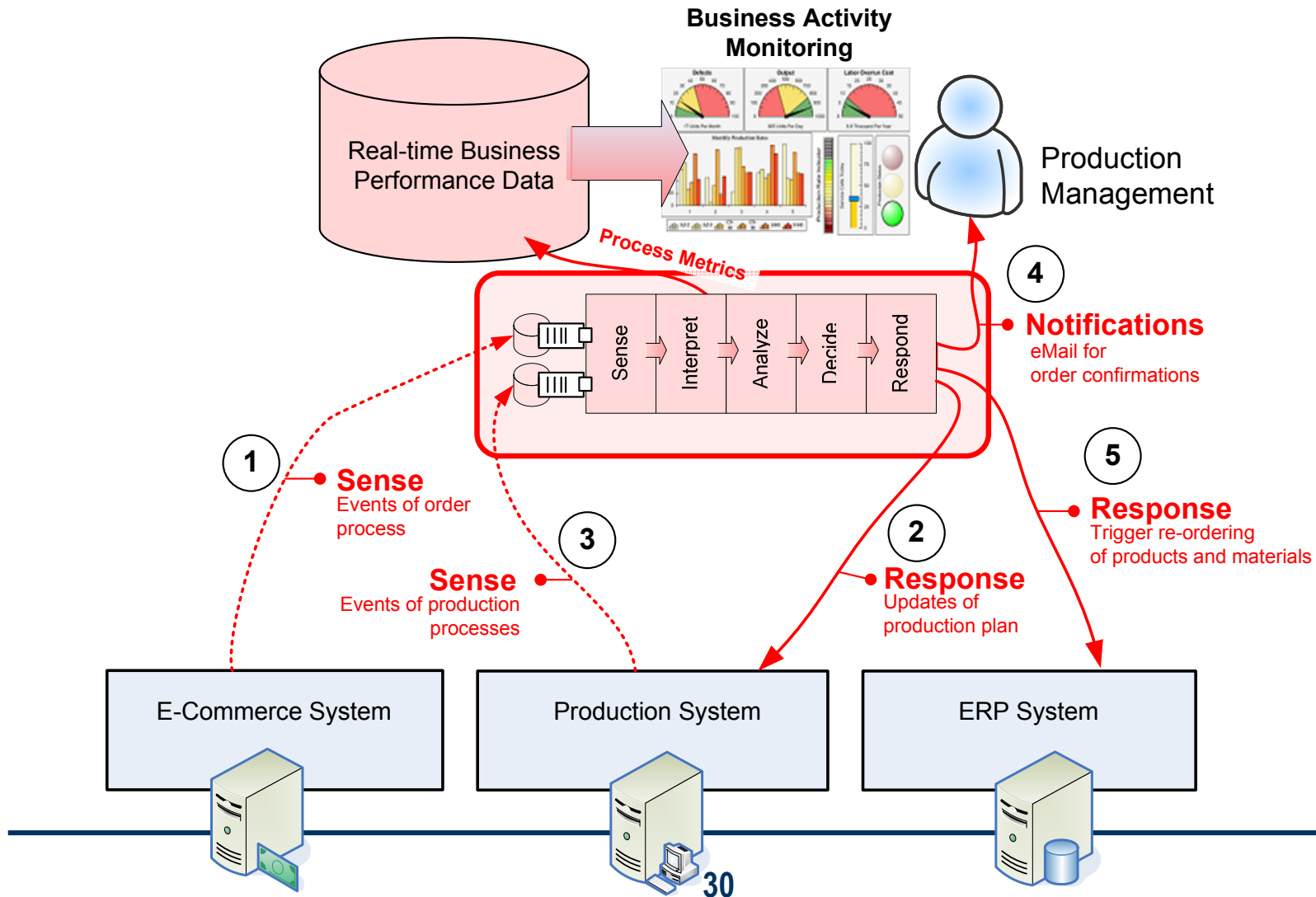
- Analyze**
 - » Determines root causes of identified business situations
 - » Predicts the performance and assess the risks for changing the business environment

- Decide**
 - » Selects the best option for improving the business situations
 - » Determines most appropriate action for a response to the business environment

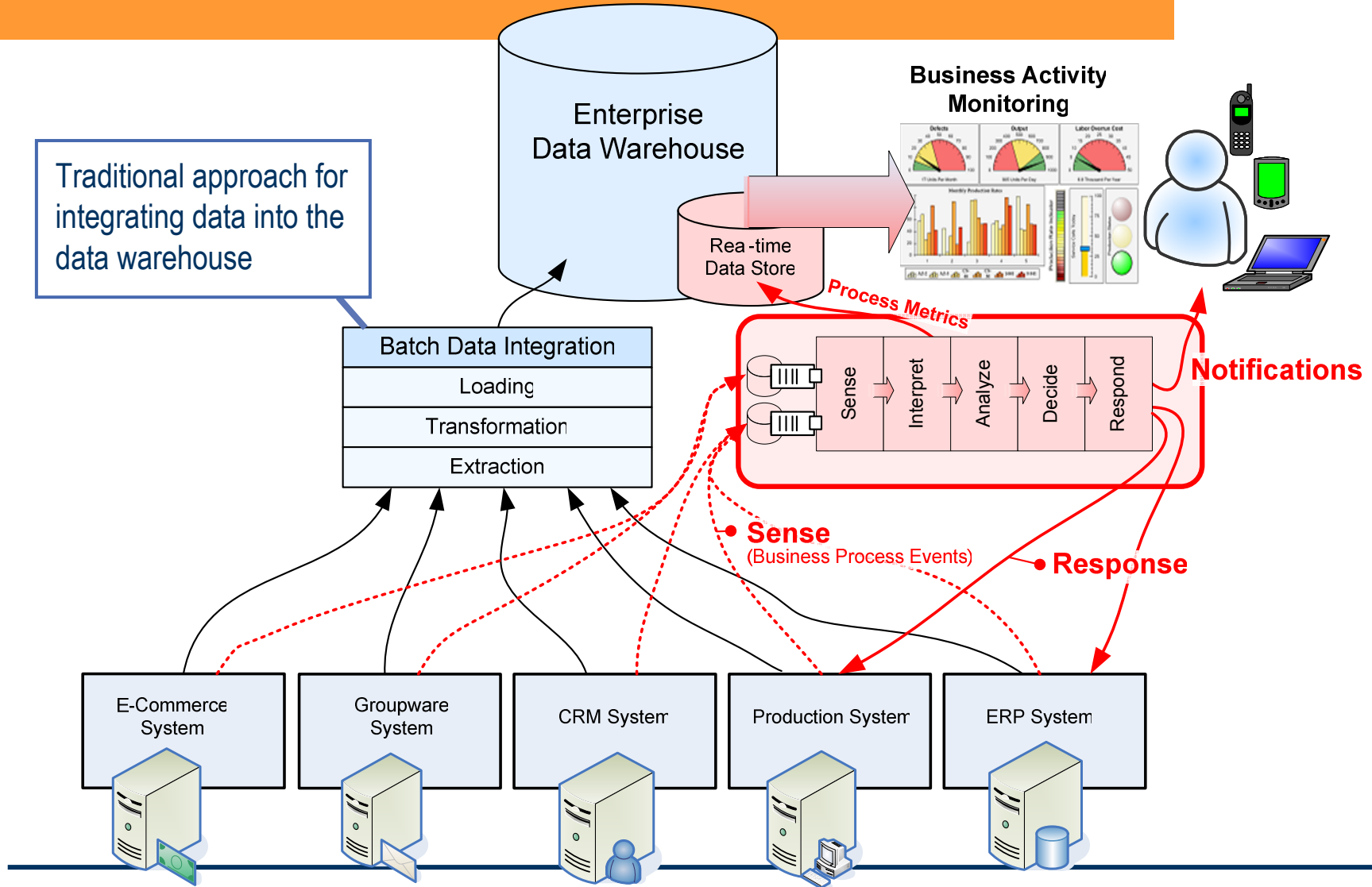
- Respond**
 - » Communicating the decision as a command or suggestion
 - » Executing the business actions in target systems



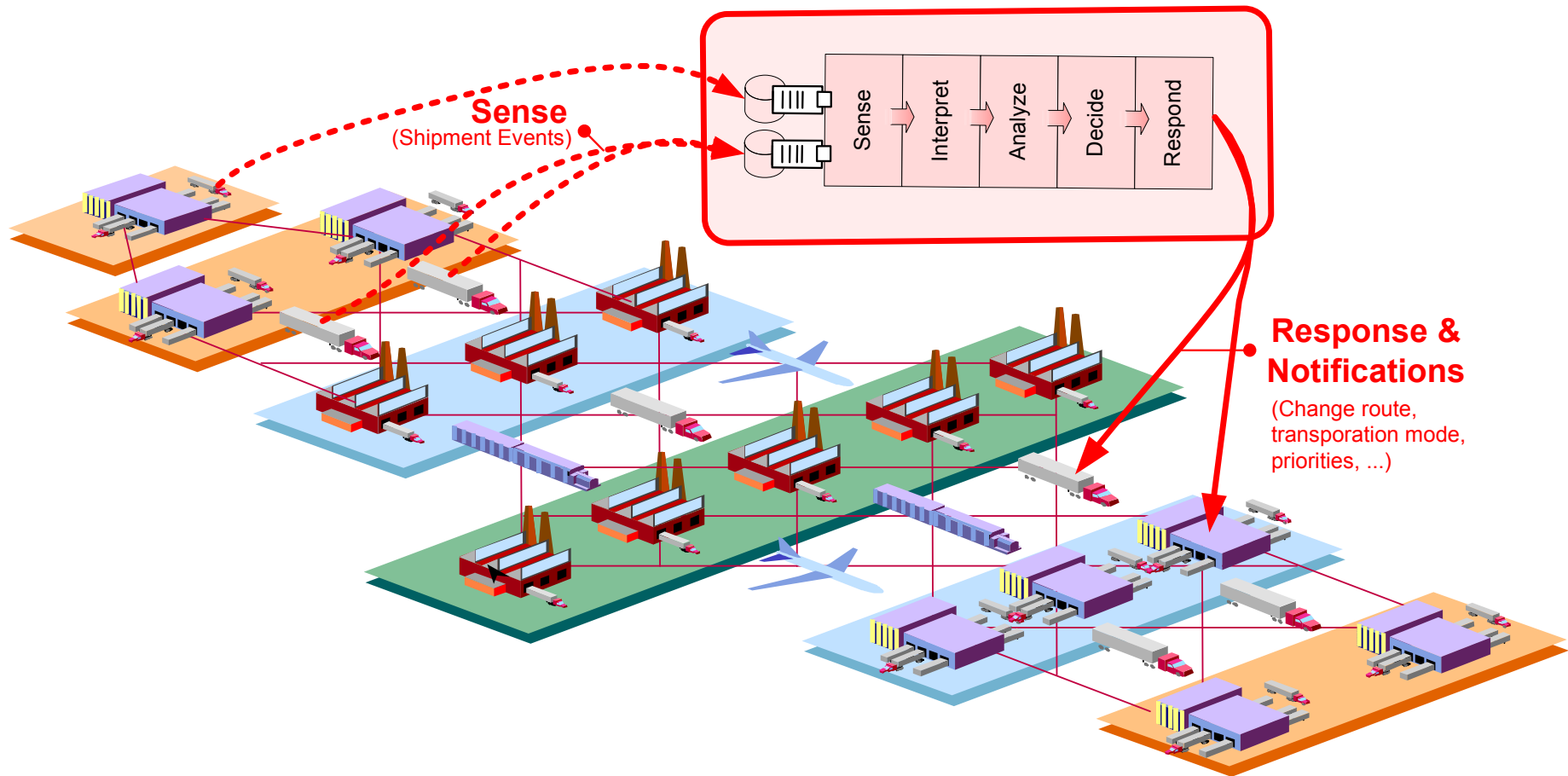
Business Activity Monitoring with Senactive InTime



Sense & Respond and Data Warehousing



Sense & Respond – Logistics & Transportation Management

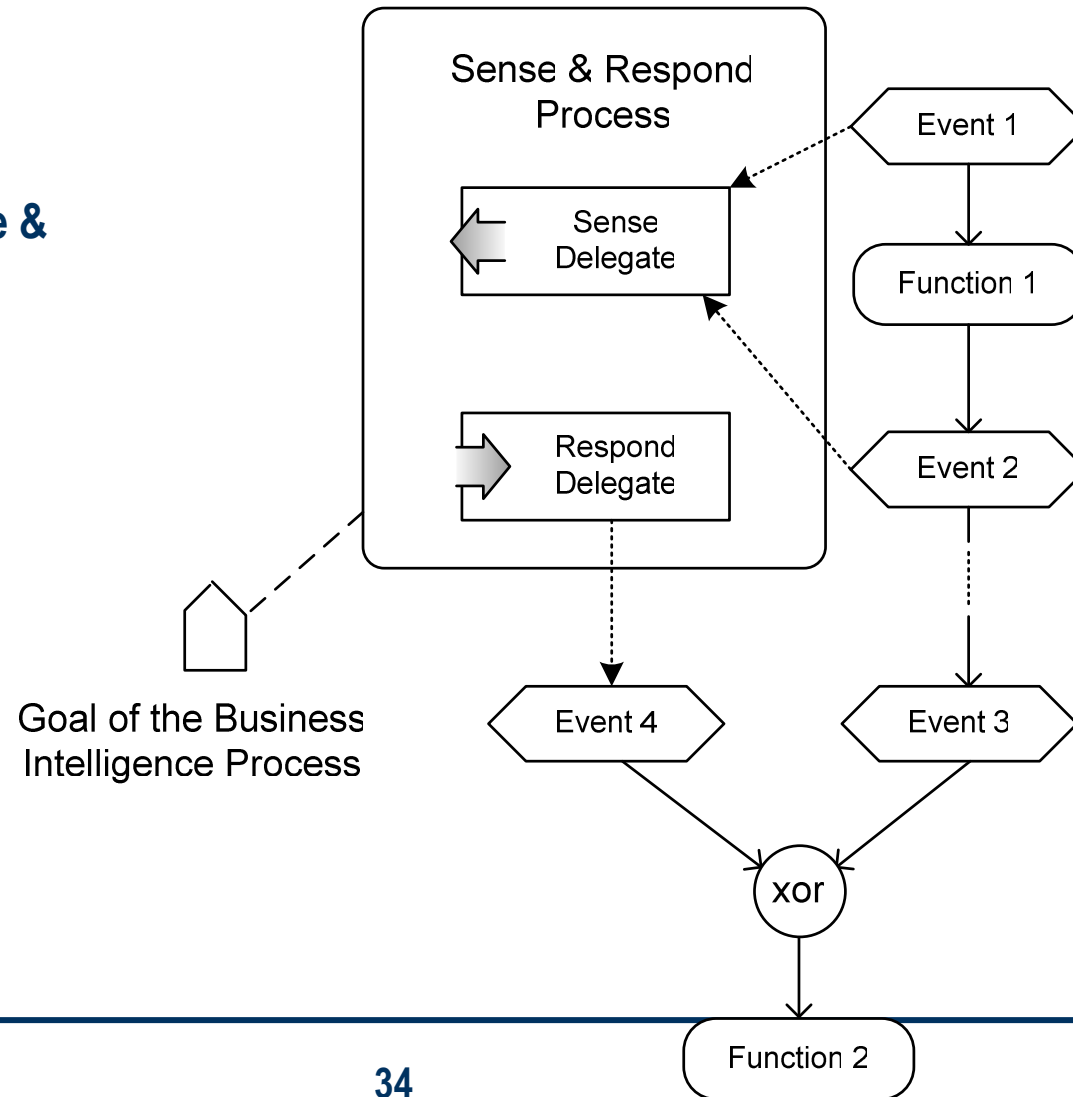




Modeling Sense & Respond

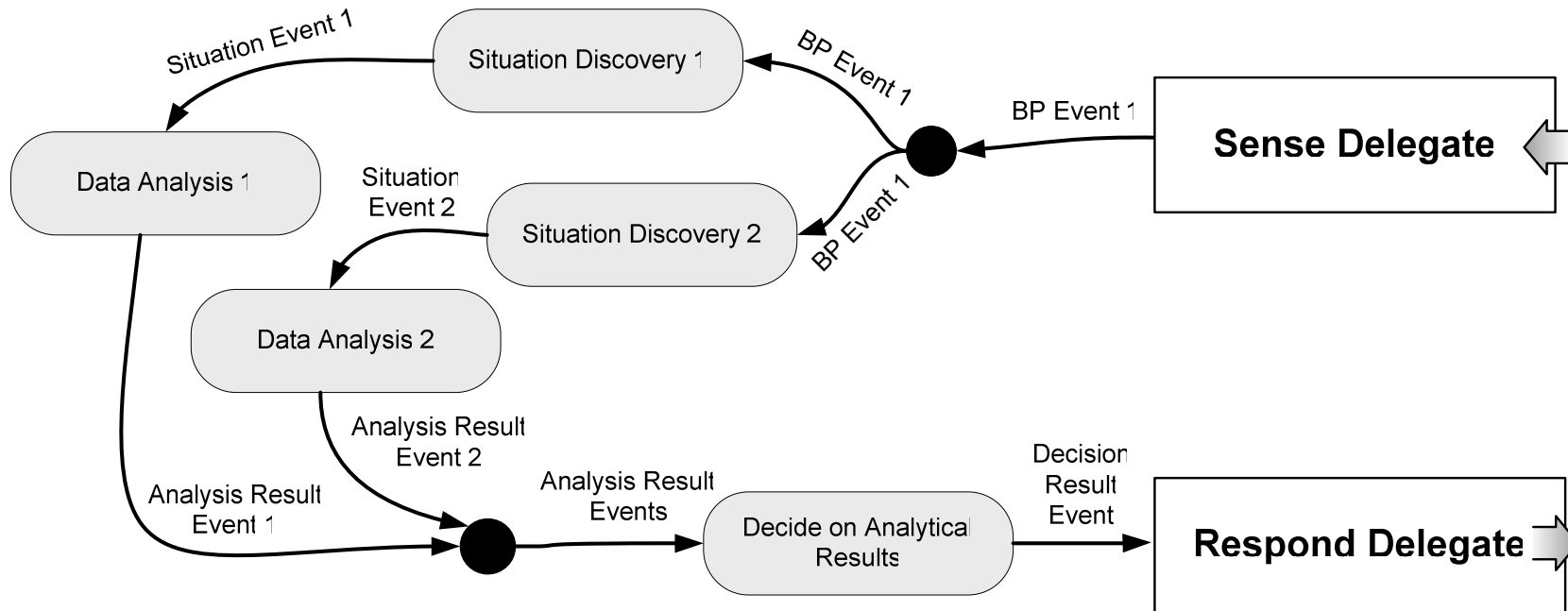
Event Driven Process Chains and Sense & Respond Processes

Outside View of a Sense & Respond Process



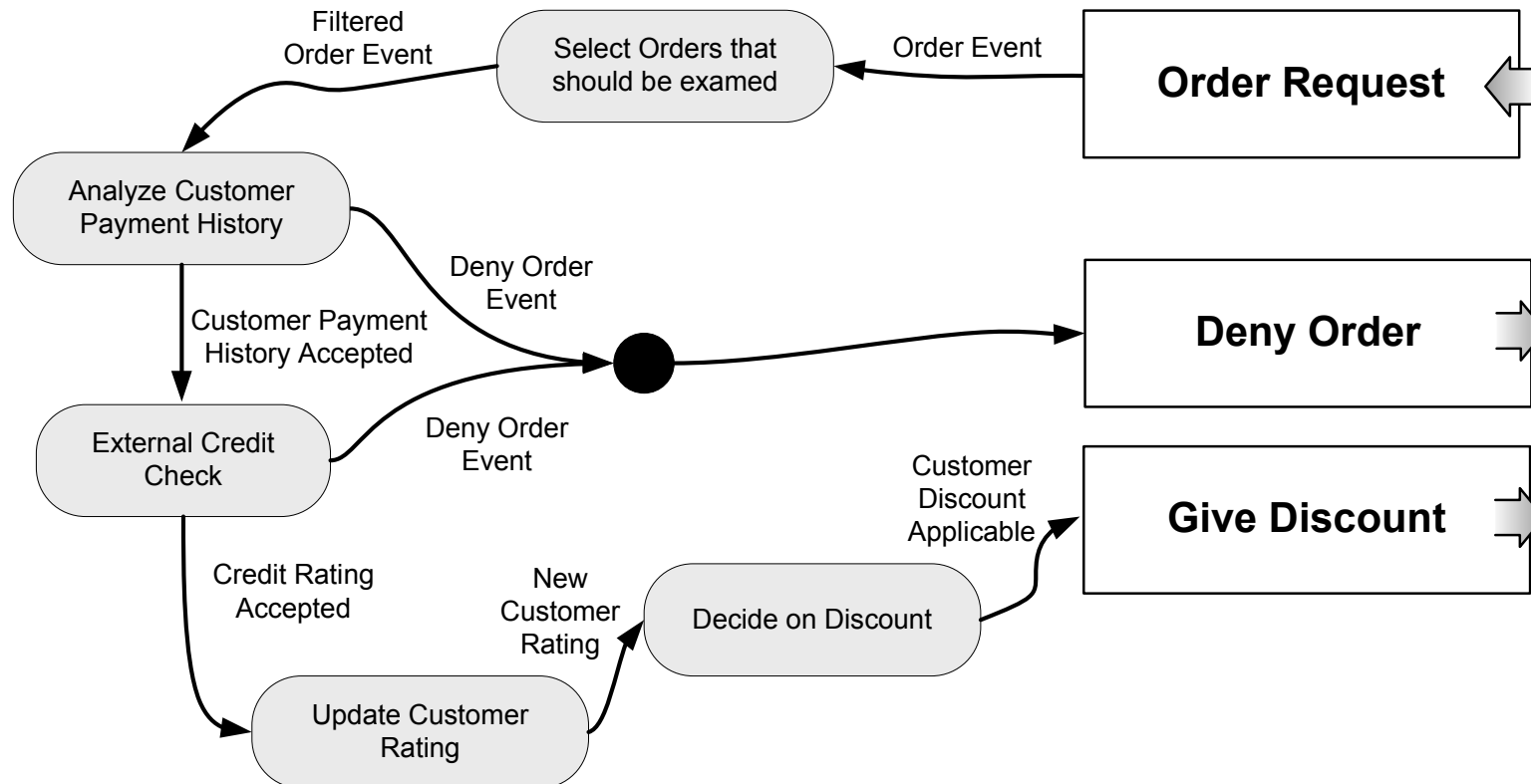
Event Driven Process Chains and Sense & Respond Processes

Inside View of a Sense & Respond Process



Event Driven Process Chains and Sense & Respond Processes

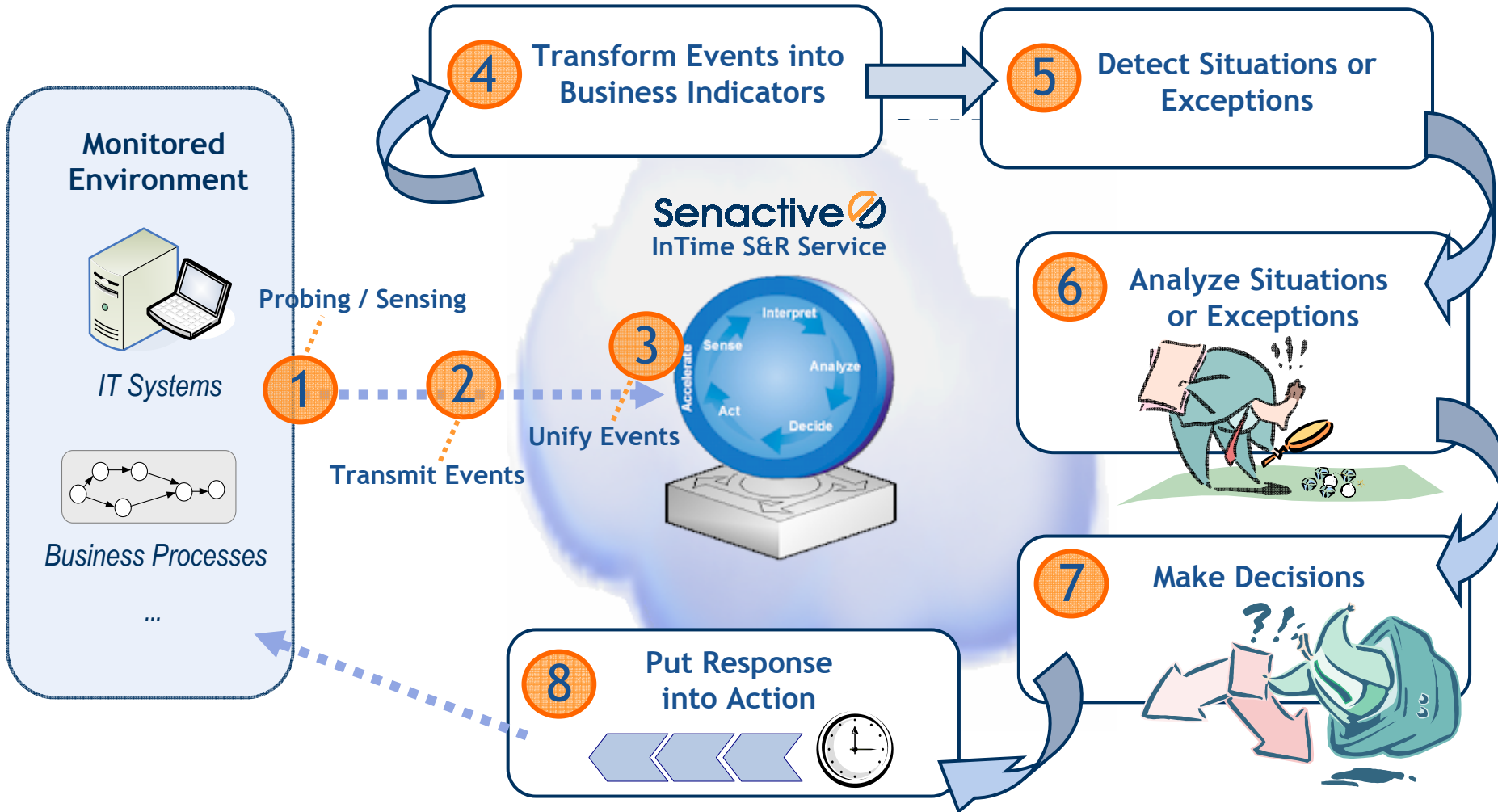
Example for Inside View of a Sense & Respond Process



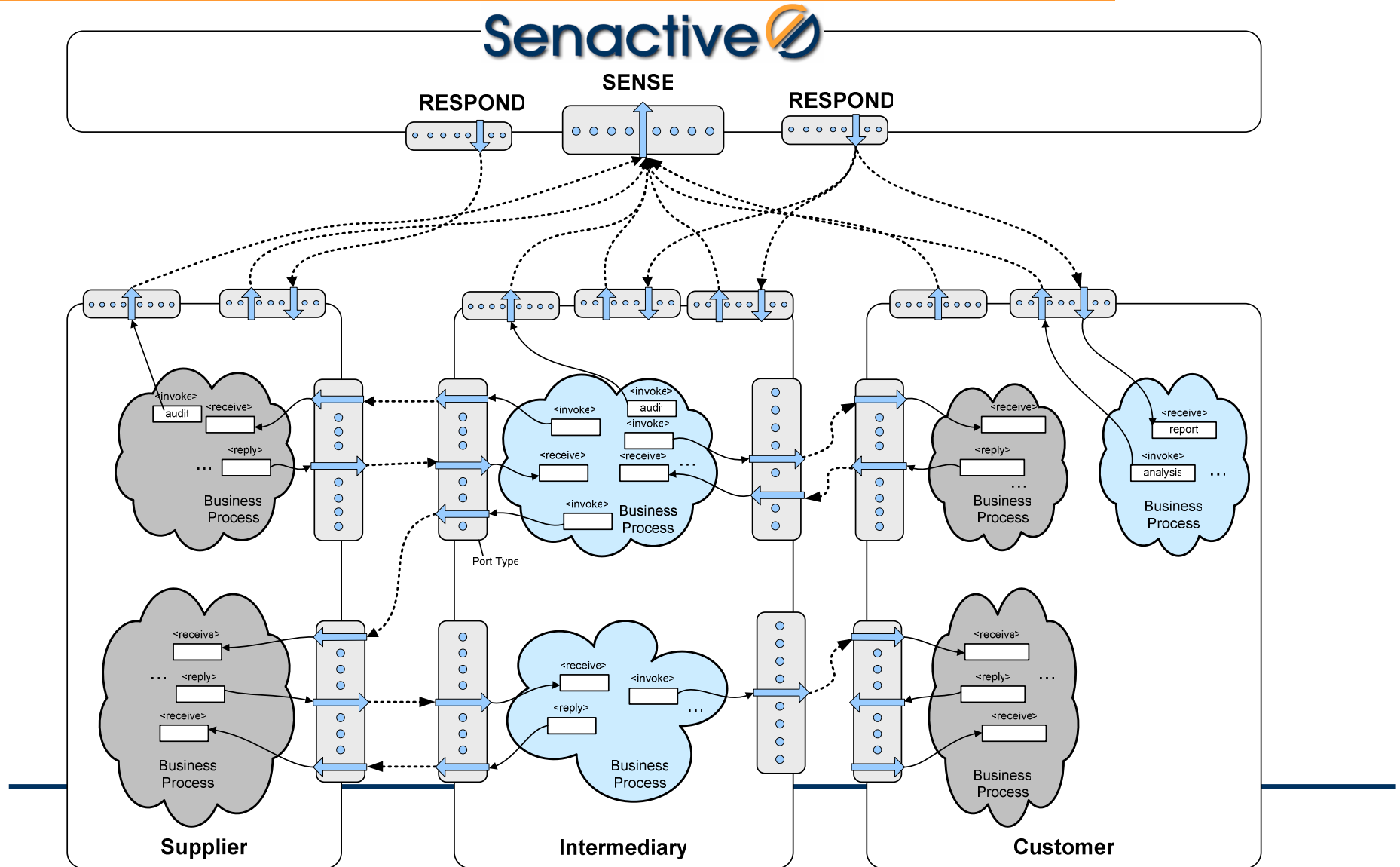
Web-Service Based & Adaptive Business Process Monitoring

Senactive 

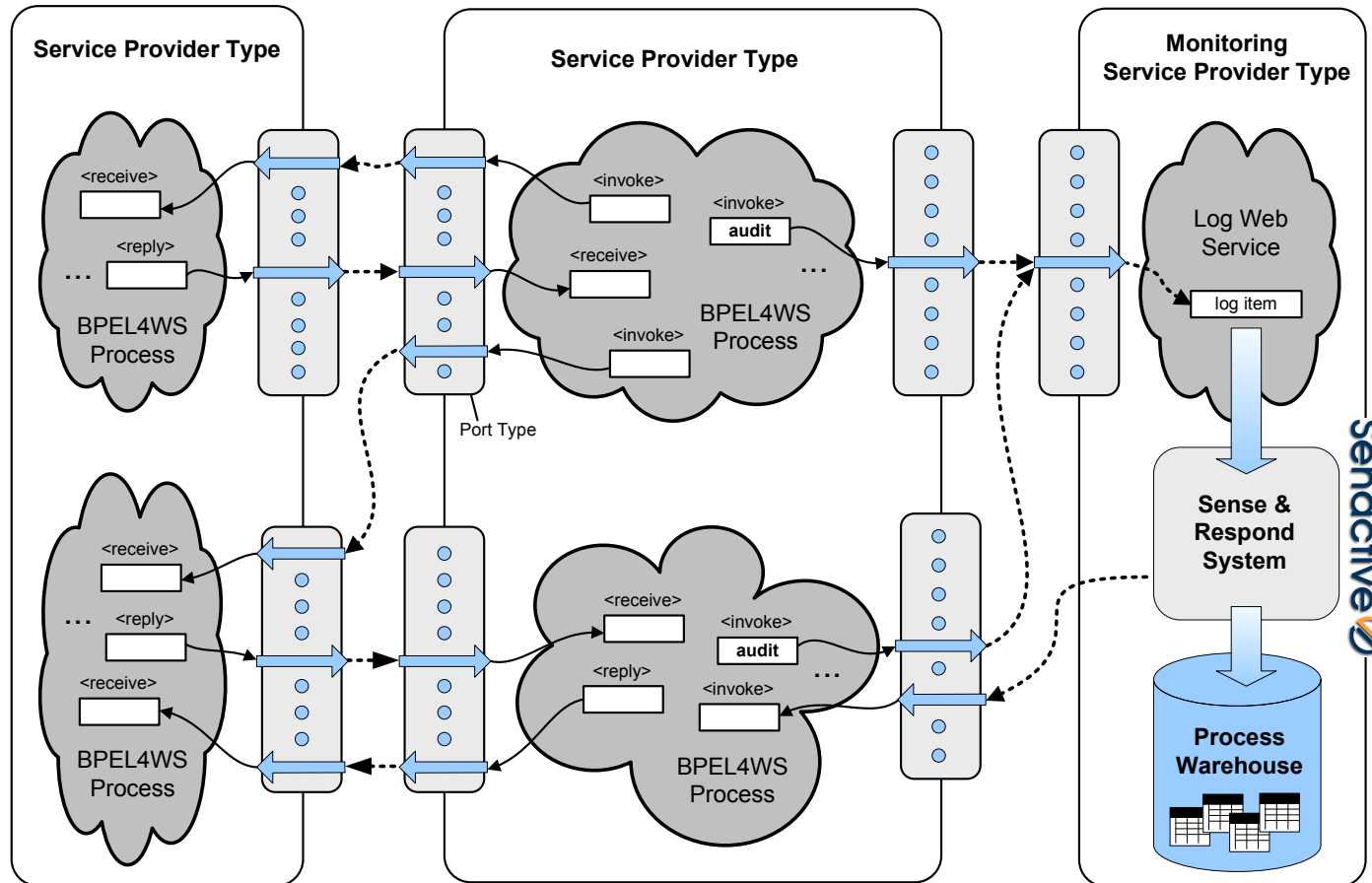
Senactive InTime Sense & Respond Loops



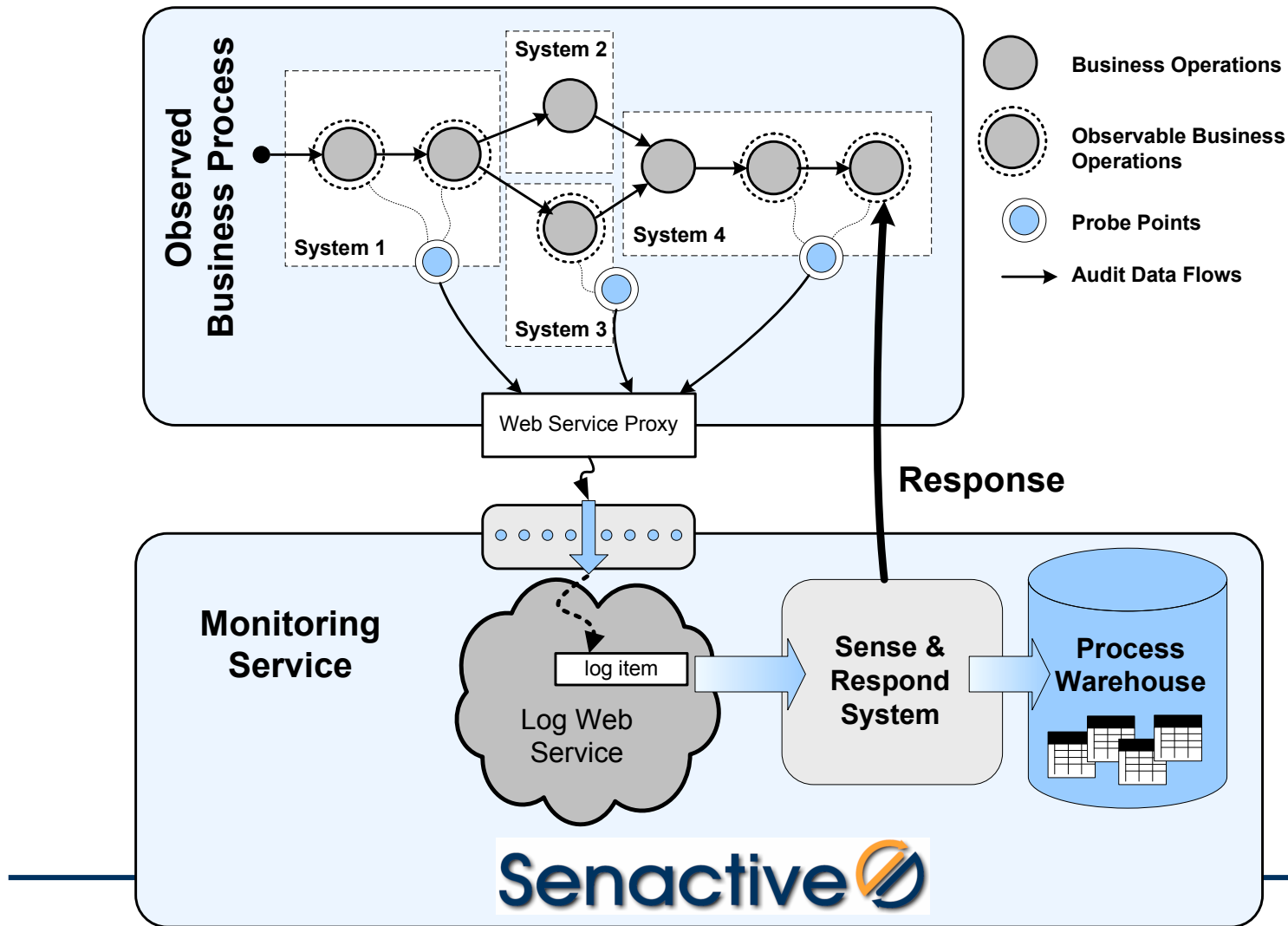
Supply Chain Monitoring of BPEL4WS Processes



Monitoring of BPEL4WS Processes with Senactive

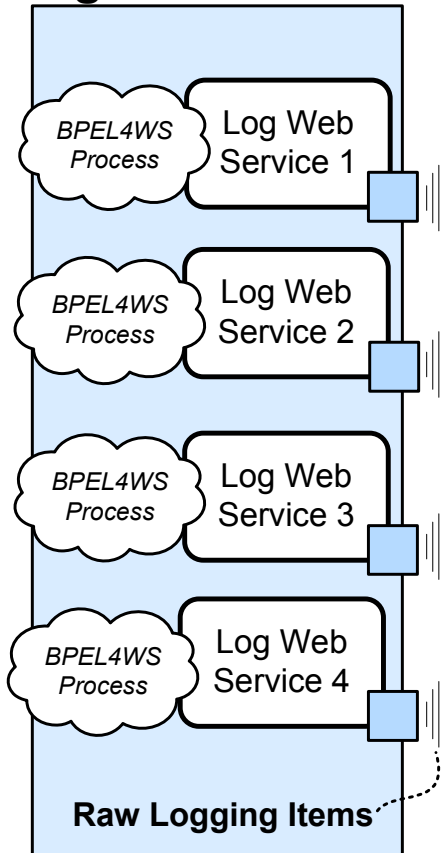


Monitoring of Non-BPEL4WS Processes with Senactive

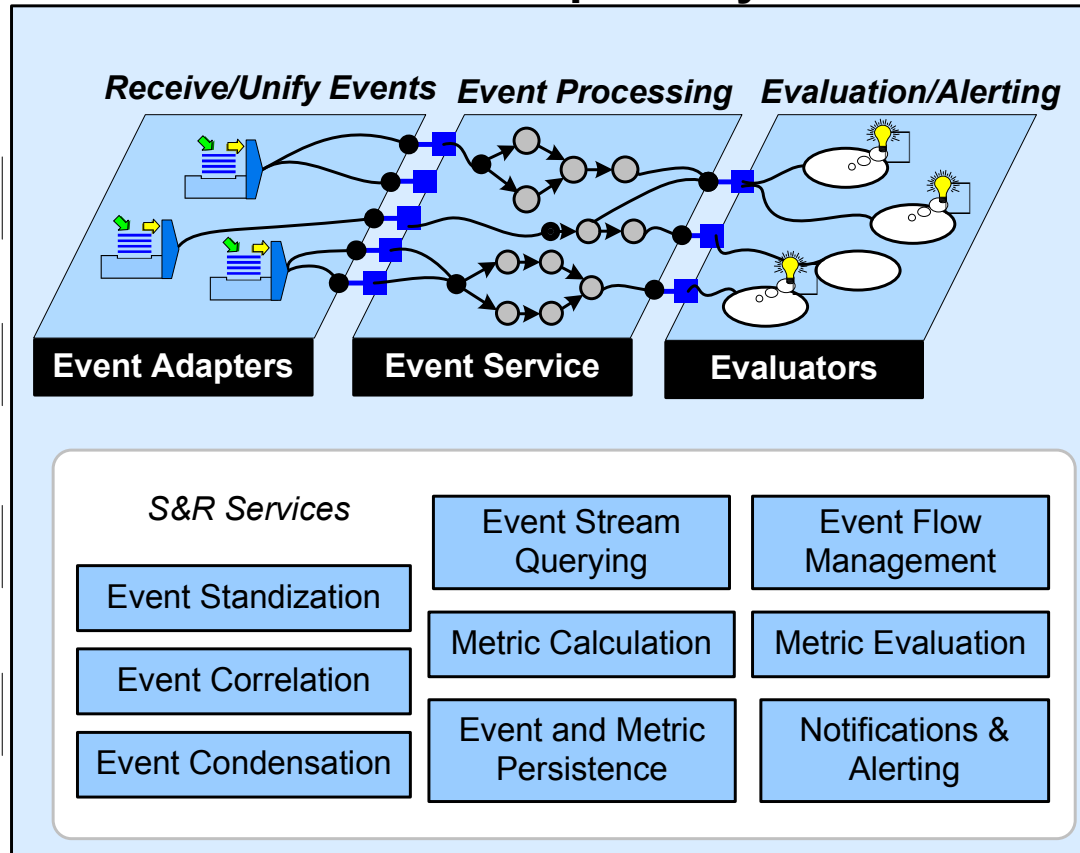


Sense & Respond System

Log Web Services

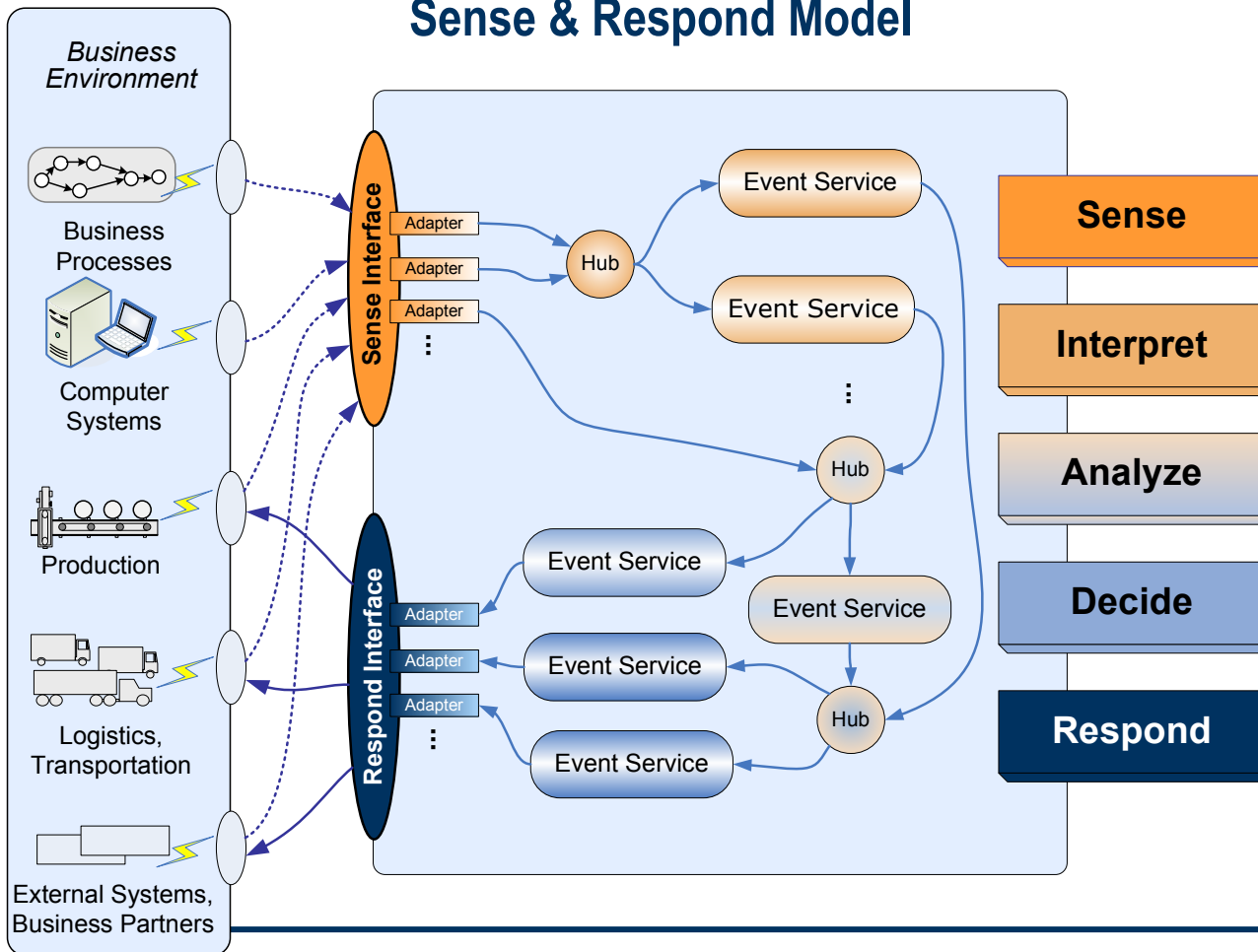


Sense & Respond System



Sense & Respond Monitoring with *Senactive InTime*

Sense & Respond Model



Senactive InTime Key Features

- » Visualization of Sense & Respond Processing
- » Modular and Service-Oriented Architecture
- » Generation of Real-Time Key Performance Indicators
- » Real-Time Data Analysis for Controlling Business Processes
- » Instant Response on Business Situations and Exceptions



**Research Topics for “Bakk.-
Arbeiten”, “Diplomarbeiten” etc.**

Research Topics (see also <http://www.ifs.tuwien.ac.at/~js>)

Business Process Management

- » Web Service Based Auditing of BPEL4WS Processes (→ Web Services, BPEL4WS, Messaging)
- » Scalable Messaging Infrastructure for Monitoring Business Processes (→ Messaging, MSMQ, MQSeries, JMS,...)
- » Analysis Services with XMLA for Business Process Monitoring (→ OLAP, Data Mining, SQL Server 2005)

Event Management

- » Event Models for Monitoring Business Processes (→ XML Schema for events)
- » Event Simulation Model for Business Processes (→ Generating consistent XML events)
- » Discovering Patterns in Event Streams, Event-Driven ECA Rules (→ Rule Engines, XML Rules)
- » Correlation and Synchronization of Event Streams (→ XPath, Concurrency, Distributed Computing)

Data Management

- » Data Management for Event Streams (→ Star Schemas, Data Warehousing, SQL Server 2005)
- » Real-time Analytics & Data Stream Analysis with OLAP, Neuronal Network, Decision Trees, Clustering Techniques, Association Rules (→ Data Warehousing, Business Intelligence, SQL Server 2005)

User Interfaces

- » Visualization/Modeling of Sense & Respond Processes (data flows, control flows, dependencies)
(→ Visualization and manipulation of Graphs, GUI design, Visual Studio 2005, C#)



Q&A

Methods and Technologies for Business Process Monitoring

Josef Schiefer

Vienna, June 2005

