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# Business Intelligence Technical Reference Architecture

**November 12, 2003**



## Session Objectives

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- Provide an architectural framework for understanding end-to-end Business Intelligence solutions based on the Business Intelligence Reference Architecture
- Answer the following questions
  - What is a BI reference architecture
  - Why a reference architecture is important
  - What are the components of the Business Intelligence reference architecture
  - How we can apply the reference architecture in practice



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# Introduction



## What is a Reference Architecture?

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- Provides architectural guidance
- Incorporates best practices
- Can be used as a blueprint for designing and deploying solutions
- Defines hardware, software, and environmental components that are needed to build end-to-end solutions to help meet specific business needs

## Why is a reference architecture important?

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- It describes the major foundational components or candidate building blocks of an end-to-end architecture solution
- It spans all industries and all solution areas
- It provides a common language
- It provides a framework for
  - Identifying the scope of a project
  - Defining a roadmap for building a total solution
  - Identifying building blocks which if not considered may increase project risk
  - Assessing current infrastructure, tools and technologies to identify gaps
- It provides an environment to “prove things out” so we know they work
- It’s key benefit – allows us to reduce the complexity, cost, and risk of solution deployment

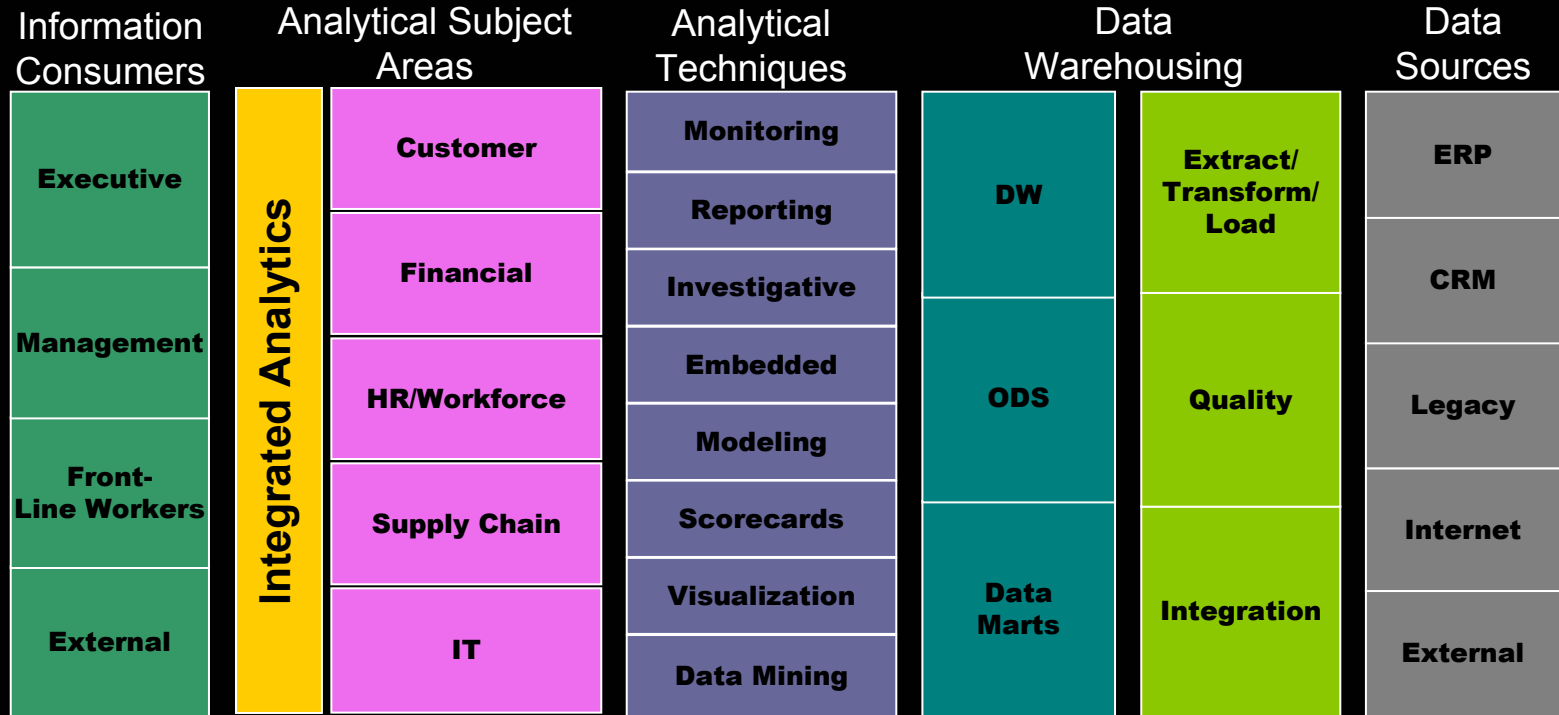


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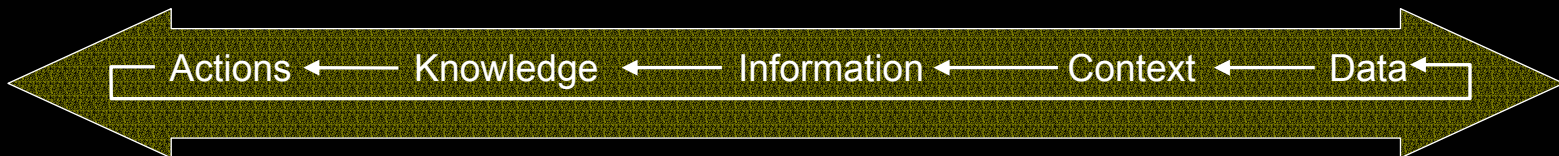
# Business Intelligence Reference Architecture – Business View



# Business Intelligence – Analytical Framework



Security and Data Privacy



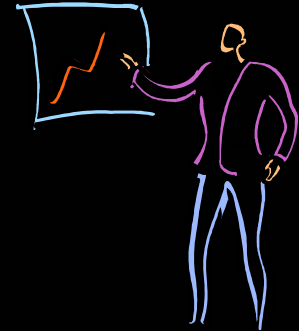


# Information Consumers – Role Based Business Intelligence



- Lead Enterprise
- Steer / Adapt
- Achieve Plan

Executives



- Manage Resources
- Improve Cost, Quality, Capacity
- Control Service, Productivity
- Optimize

Management – Business & Operational



- Deliver with Quality

Front Line Workers



- Monitor
- Assess
- Ensure Compliance

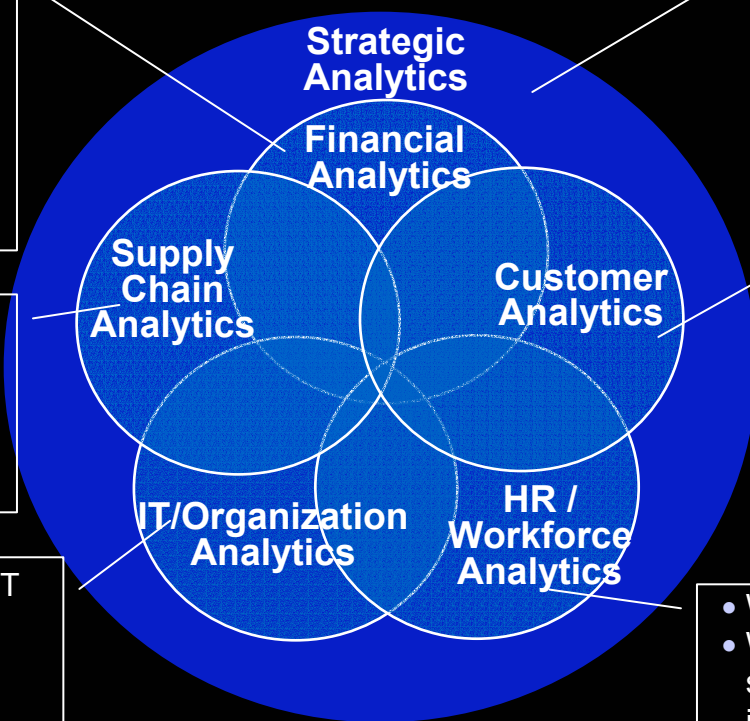
External





# Business Intelligence – Analytic Subject Areas

## Integrated Performance Analytics



- Are we maximizing shareholder value?
- Do we understand our revenue and cost drivers and their impact on the bottom line?
- Do we understand and proactively manage our risk?

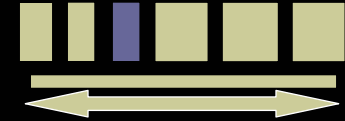
- What markets?
- What products and services?
- What key value drivers?
- What Key Performance Indicators (KPIs) and measures?

- Do we understand our production and procurement cost drivers?
- Do we actively manage our vendors?
- Are we optimizing inventory levels?

- What do our customers want?
- What type of customer should we be acquiring?
- Which customers do we want to retain?
- How do we value the revenues and costs of each customer?

- Are we spending too much on IT or too little?
- Is our IT service provisioning efficient?
- How do we increase speed to market? Call resolution?
- How do we reduce process errors and write-offs?

- What are our staffing needs?
- What elements of our business strategy drives HR and workforce issues?
- Do our HR processes address employee needs?
- What is the cost or recruiting?

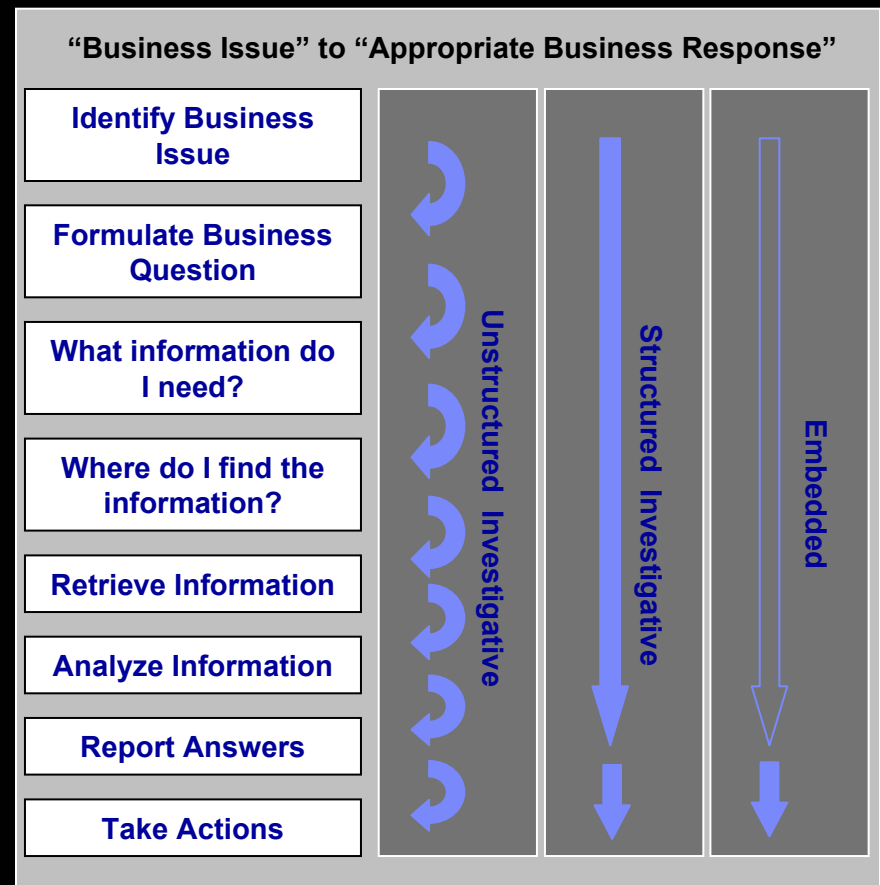


# Business Intelligence – Analytic Techniques

The value of Business Intelligence increases as the delivery of information is embedded in the processes and systems of the enterprise.

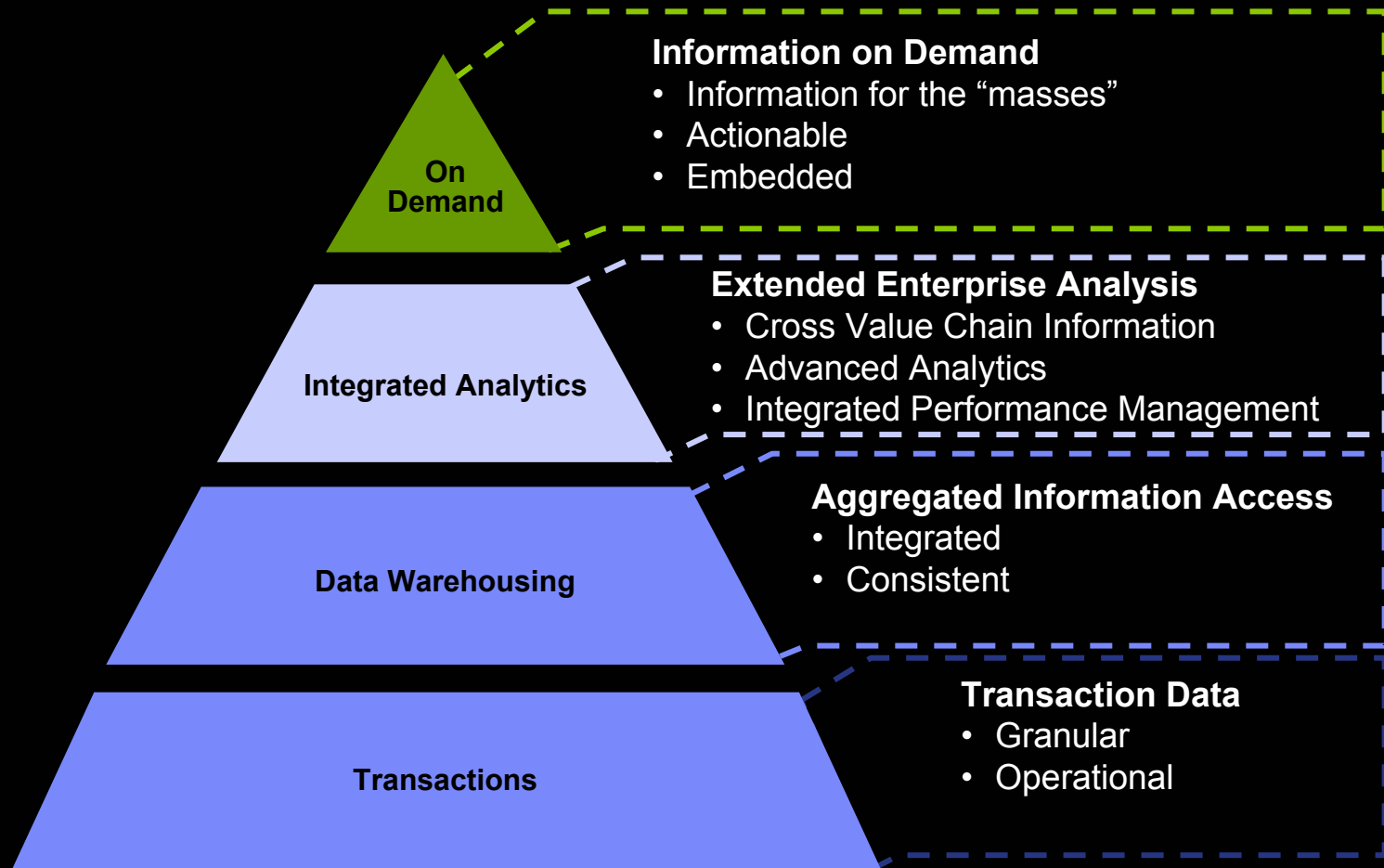
## Business Intelligence Delivery – 3 types:

1. **Unstructured Investigative** – Provide a robust database of business information to analysts seeking information to support infrequent and non-recurring business questions (modeling, mining, visualization)
2. **Structured Investigative** – Deliver structured sets of information on-demand to end-consumers to provide answers to recurring business questions (reporting, monitoring, scorecards)
3. **Embedded** – Intelligently “push” information directly to end-consumers by continuously monitoring ongoing business performance against business objectives





# Business Intelligence – From Data to Information on Demand



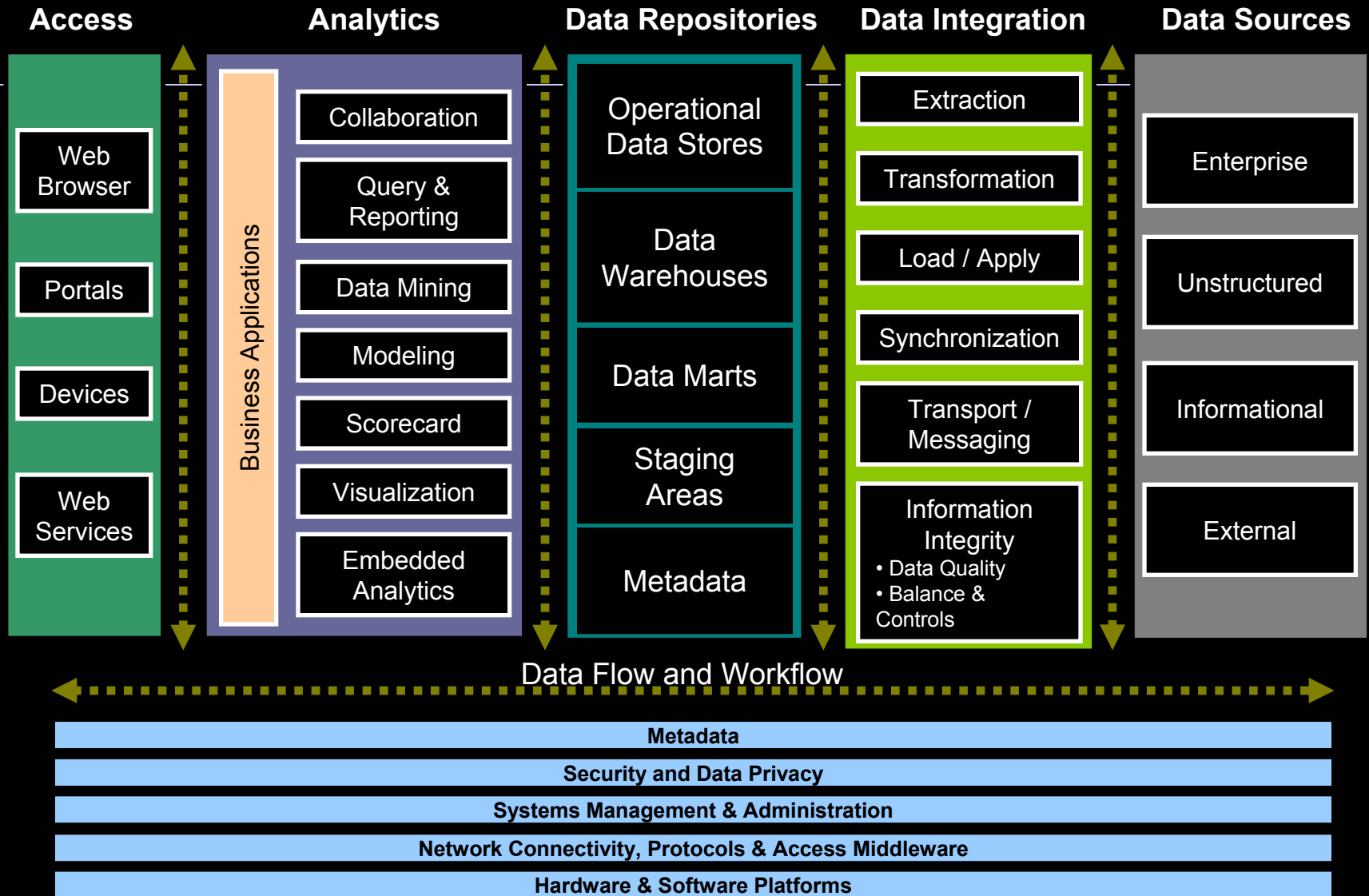


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# Business Intelligence Reference Architecture – Technical Views



# Business Intelligence – Reference Architecture

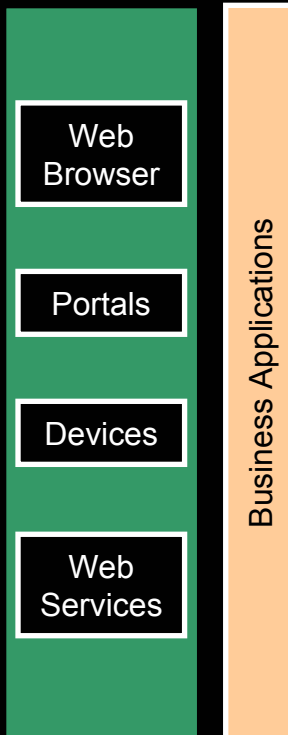


## The Access Layer provides the Information Consumers' presentation view and interaction with the business analytic applications

### Consumer



### Access



### ▪ Web Browser

- Intranet, extranet, internet

### ▪ Portals

- Consolidated view based on role, function, preference and typically coordinates authentication and authorization

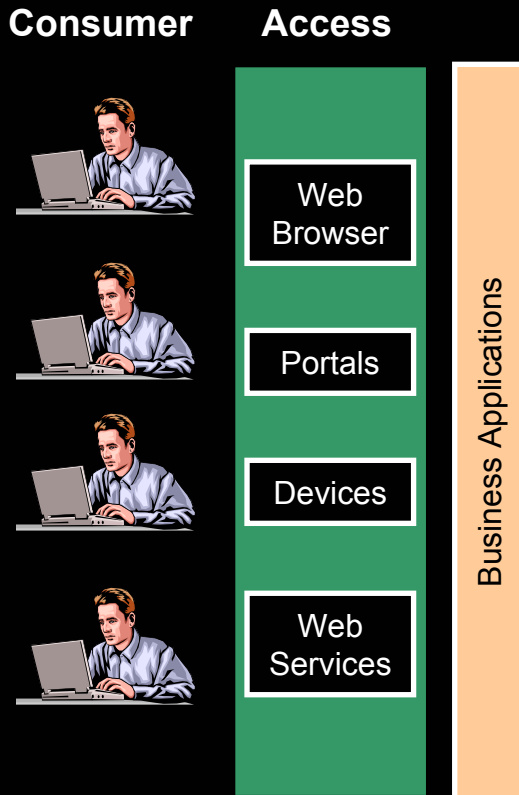
### ▪ Devices

- Technology used to receive and interact with analytic environment

### ▪ Web Services

- Facilitating exchange of information between applications to publish analytical information internally and externally

## Examples of Access Layer tools (not inclusive)



- **Web Browser**

- Brio, Business Objects, Cognos, MicroStrategy, SAS web-based front ends

- **Portals**

- WebSphere Portal, WebSphere Commerce with portlets from IBI, Crystal, Actuate

- **Devices**

- PC, PDA, mobile phone, KIOSKs, ATM

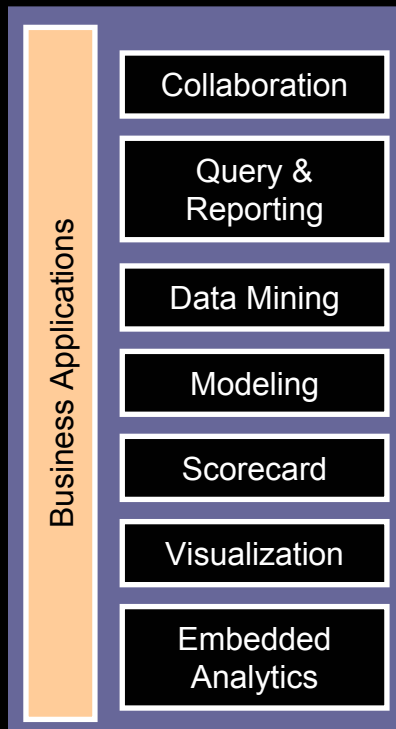
- **Web Services**

- WebSphere Business Integration

*On Demand: Responsive, Predictable, Personalized, Integrated, Low Cost*

## The Analytics Layer provides the business analytic applications and their underlying capabilities and services.

### Analytics

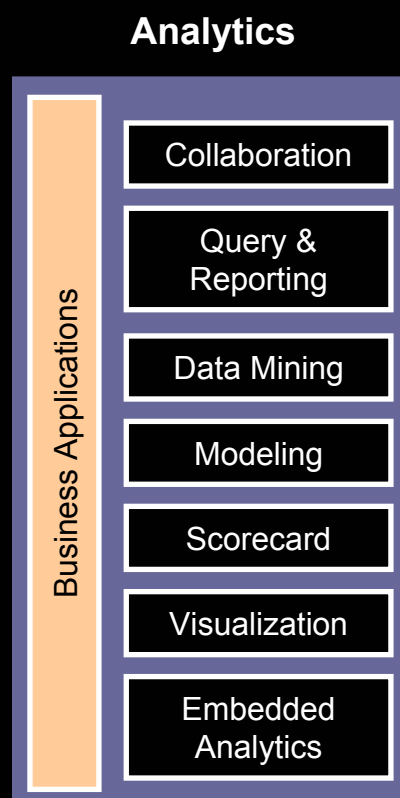


### Business Application Examples

- Campaign Management
- Personalization and Adaptive Marketing
- Corporate Dashboard
- Customer / Market Segmentation and Scoring
- Channel Effectiveness
- Warranty Analysis
- Risk Management
- Operations / Product Analysis
- Cost Analysis
- Compliance Reporting
- Fraud Detection



## The Analytics Layer provides the analytic techniques used against the data in the Data Warehouse/ Data Marts



### ▪ Collaboration

- Technology and process to share results and work jointly on investigations
- E.g. Email, co-browsing, annotating a report, Lotus Suites

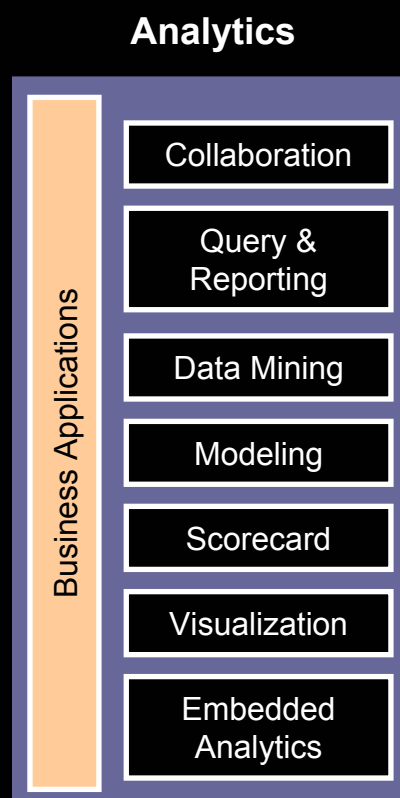
### ▪ Query and Reporting

- Structured investigation or sophisticated analysis of information often with sophisticated graphical capabilities
- May be pushed through email, alerts, agents in multiple formats such as PDF, XML, document
- E.g. QMF, Office Connect, Crystal Decisions, Microstrategy

### ▪ Data and Text Mining

- Unstructured investigation or exploration and discovery of data and text
- May include sophisticated searching algorithms to deliver outputs
- Mining of unstructured text is becoming increasing important form of analysis
- E.g. Intelligent Miner, SAS

## The Analytics Layer provides the analytic techniques used against the data in the Data Warehouse/ Data Marts



### ▪ **Modeling**

- Unstructured investigation
- Predictive modeling and simulation
- E.g. SAS

### ▪ **Scorecard**

- Structured answers to recurring business questions
- Dashboards that display key performance indicators (KPI's)
- E.g. Websphere BI Monitor

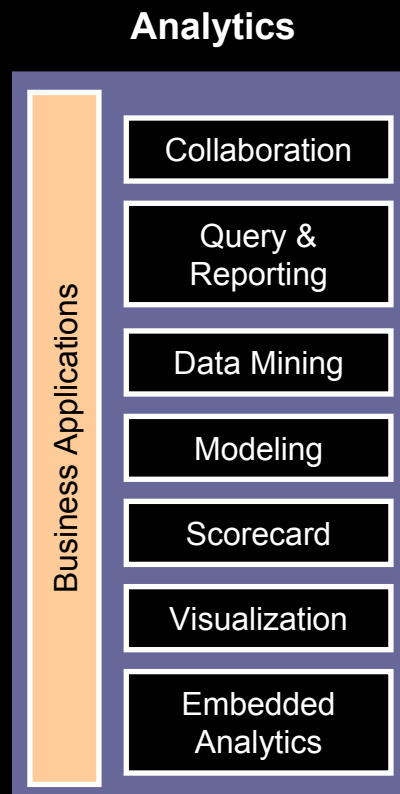
### ▪ **Visualization**

- Unstructured investigation through use of sophisticated graphic techniques for viewing results
- E.g. Intelligent Miner Visualization

### ▪ **Embedded Analytics**

- Analytics that are embedded into applications or business processes based on pre-defined advanced models or detection patterns and executed in real time (sense and respond)
- Provides closed loop feedback, real time offer, and personalization capabilities

## Examples of Analytics Layer tools (not inclusive)



- **Business Applications** – Siebel Analytics, PeopleSoft Analytics, e-piphany, KANA, SAS, SearchSpace
- **Collaboration** - Lotus Suites, email tools, co-browsing tools, report annotation
- **Query & Reporting** – QMF, Office Connect, Business Objects, Cognos, MicroStrategy, Hyperion Brio, SAS, Crystal Reports
- **Data Mining** – Intelligent Miner, SAS Enterprise Miner and Text Miner
- **Modeling** – SAS, Intelligent Miner Modeling,
- **Scorecard** – Cognos Metrics Manager, Websphere Business Integration Monitor
- **Visualization** - Intelligent Miner Visualization, ESRI ArcGIS
- **Embedded Analytics** – SAS, DB2 Cube Views

*On Demand: Actionable, Anticipatory, Insightful Information That Improves Decisions, Creates Business Value, and Tracks Performance Across Organizational Boundaries*

**The Data Layer contains the Business Intelligence data stores. These data stores should be viewed as single repositories even though they may exist as a set of federated data stores.**

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### Data Repositories



- **Operational Data Store**
  - Integration point for operational data from one or more disparate source systems
  - Typically specific to a given subject areas (e.g. Customer ODS)
  - Current normalized, transactional data, updated on a defined frequency, available for operational reporting
- **Data Warehouse**
  - Integrated subject areas of data that have been reshaped, derived or cleansed for analysis
  - Contains transformed historical transactional data some of which may exist in archive data stores
  - Content management repositories may be used to store unstructured information within the data warehouse
- **Data Marts**
  - A subset of data warehouse data built to support a single business function, application or process
  - Contains historical snapshots stored in dimensional models with summarization and aggregation
  - May include individual data stores downloaded to client desktops (spreadsheets)

## The Data Layer contains the data stores needed to support the Business Intelligence data environment.

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### Data Repositories



### ▪ Staging Areas/Work Areas

- Database or files used as part of the integration layer
- Data is transient in nature
- May be used for cleansing
- May be used for short term exploration of subsets of data and are sometimes referred to as exploratory data warehouse data stores

### ▪ Metadata

- Metadata repository for Information Consumers and Technical Users regarding data meaning and relationships, calculation rules, reference tables, reports available, transformation rules, documentation and traceability mapping back to source systems

## Examples of Data Layer Tools (not inclusive)

### Data Repositories



### ▪ Databases

- DB2 ESE, DB2 OLAP, DB2 Cube Views, Hyperion Essbase, Content Manager, Oracle, SQL Server

### ▪ Metadata

- Data Warehouse Manager, CA Repository, MetaStage

Industry semantic reference models such as Insurance Industry models (IIA/IIW) and Banking Industry models (IFW/BDW) can be leveraged to provide consistency and integration capabilities across data repositories.

CIIS, DWL and Siebel often provide the ODS layer for customer data.

*On Demand: Consistent, Integrated, Quality Information That is Reliable, Scalable, Available, That Meets Performance Expectations, That is Based on a Common Understanding of Data*

# The Integration Layer owns the technology and processes for moving and enhancing the data from the data sources to Business Intelligence repositories.

## Data Integration

Extraction

Transformation

Load / Apply

Synchronization

Transport /  
Messaging

Information  
Integrity

- Data Quality
- Balance & Controls

### ■ Extraction

- Processes and tools for selecting data from the data sources in full or in increments
- Includes extraction engines, change data capture tools

### ■ Transformation

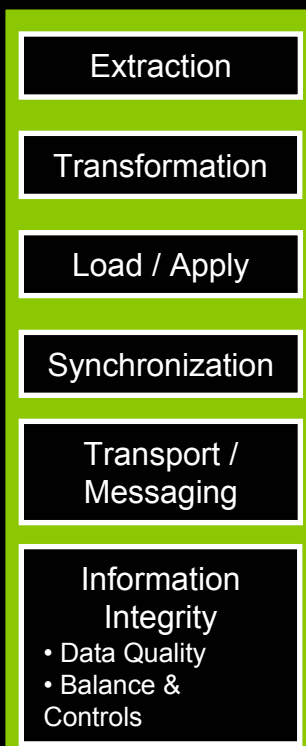
- Processes and tools for integrating data structures, processing defined business information rules used to derive, transform, calculate, aggregate or enrich data

### ■ Load/Apply

- Processes and tools for populating the Business Intelligence data repositories
- Includes high performance batch loading or near real time updates through the use of asynchronous message queues

# The Integration Layer owns the technology and processes for moving and preparing the data for the Data Layer from data sources to Business Intelligence repositories.

## Data Integration



### ▪ Synchronization

- Processes and tools for propagation and replication of data with light transformation
- May be used to populate data from one data repository to another

### ▪ Transport/Messaging/Integration

- Processes and tools for exchanging information, connecting, workflow and federation
- EAI plays the role of a data hub using message queues, XML and enables near real time updates
- Definition of message structure such as XML provides message schemas

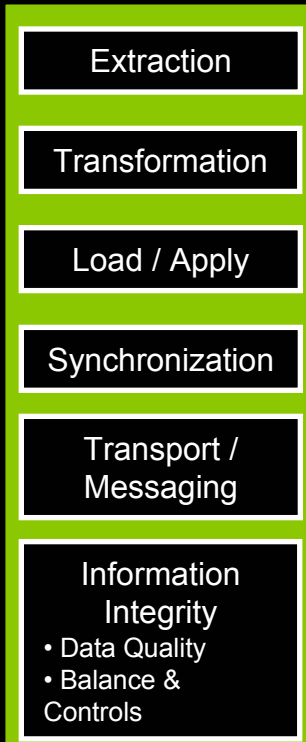
### ▪ Information Integrity

- Processes and tools for assessing missing values, completeness, reliability, and accuracy of data throughout the integration
- Actions may be performed through transformations, statistical methods, and merging data
- Provides the balance and control audits and audit trail of where the information came from



## Examples of Integration Layer tools (not inclusive)

### Data Integration



### ▪ Extraction, Transformation, Load

- Data Warehouse Manager, Informatica, ab initio, ProfileStage, ETI, Database Utilities

### ▪ Synchronization

- Data Propagator, Information Integrator

### ▪ Transport/Messaging/Integration

- Information Integration, MQSeries, Cross Worlds, WebSphere Business Integrator

### ▪ Information Integrity

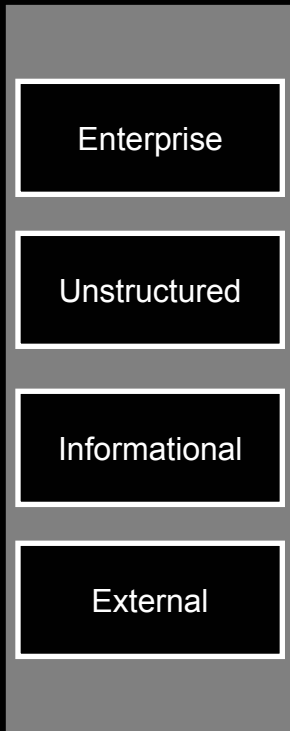
- Quality Manager, Evoke's Axio, Integrity, MetaRecon, Trillium, Harte Hanks

*On Demand: Reduced Cycle Time, Scalable, Near Real Time Delivery, Flexible, Reliable, Quality Driven, Auditable*

**The Data Source Layer provides the data or raw materials (both internal and external to the organization) that will be the foundation for analysis and knowledge.**

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### Data Sources



- **Enterprise**

- Used to operate the business such as ERP, CRM, SCM, Legacy Applications, spreadsheets
- Stored in many different technologies and formats

- **Unstructured**

- Not captured in structured data bases such as text documents, email, audio, video, groupware
- Usually requires parsing, interpretation, and classification

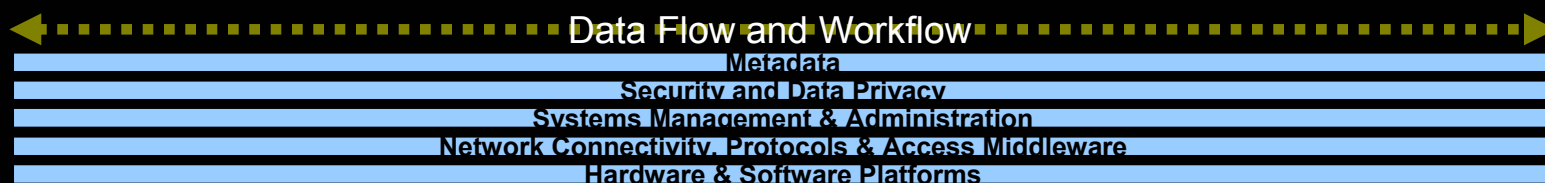
- **Informational**

- Data in the Business Intelligence repositories
- E.g budgeting and forecasting, scoring

- **External**

- Data sources available from external organizations such as suppliers, business partners, syndicated sources, web crawlers/internet, public information

## The Cross Layers provides the infrastructure necessary to support the Business Intelligence environment.



### ■ Metadata

- Business, technical and operational information needed to use, access, develop and operate the environment
- E.g. Data Warehouse Manager, MetaStage

### ■ Systems Management & Administration

- Policies, procedures, processes, standards, guidelines for managing data , technology, processes
- Includes performance monitoring, backup/recovery, version management, change control, problem management, software distribution, data archival

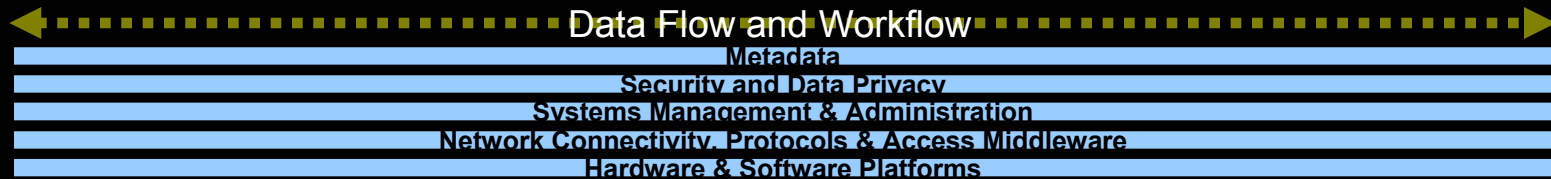
### ■ Security and Privacy

- Needed at every layer to protect the organization's information
- Define and manage the proper use of highly sensitive data including do not call lists, Gramm/Leach/Bliley, Sarbanes/Oxley

### ■ Network, Middleware, Hardware and Management Software

- Also includes standards and protocols for connection, transportation & delivery of multi-platform solutions
- Must be scalable, reliable, efficient

## Examples of Cross Layer tools (not inclusive)



- **Metadata**
  - Data Warehouse Manager, MetaStage, CA Repository
- **Systems Management & Administration**
  - Database Utilities, Tivoli, Query Patroller, SourceSafe
- **Security and Privacy**
  - TivoliSecure Way
- **Network, Middleware, Hardware and Management Software**
  - p-Series, x-Series, z-Series, i-Series
  - AIX, Linus
  - Enterprise Storage Solutions, FastT

*On Demand: Low Cost to Maintain/Use, Available, Reliable, Scalable, Performs, Can Be Recreated, Is Protected*

# Business Intelligence – Technical Reference Architecture

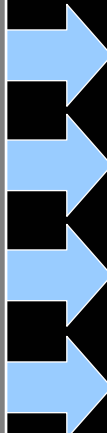
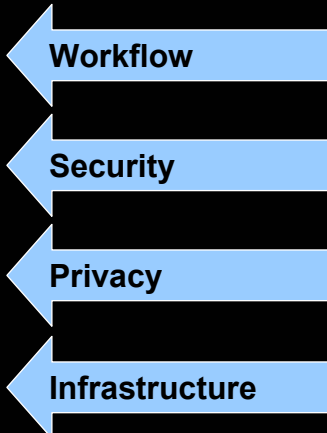
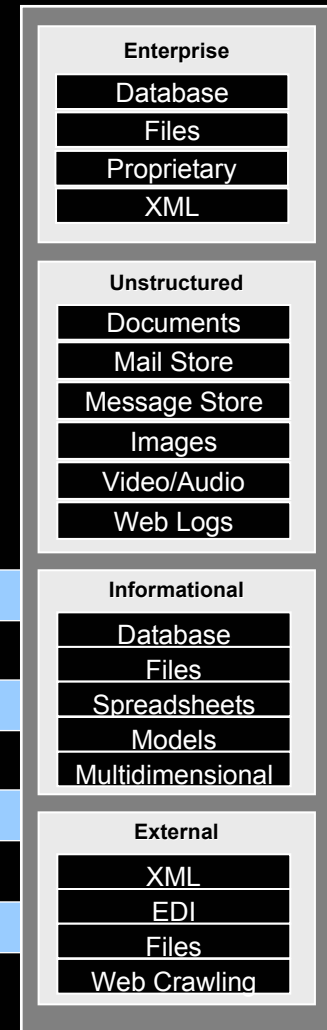
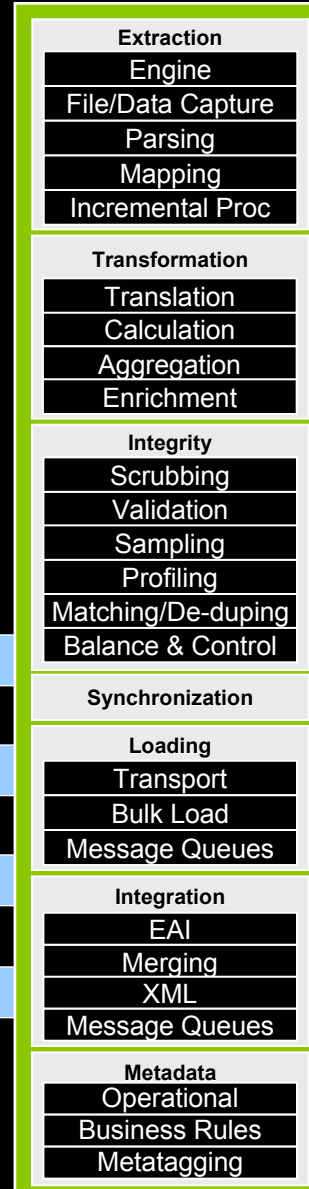
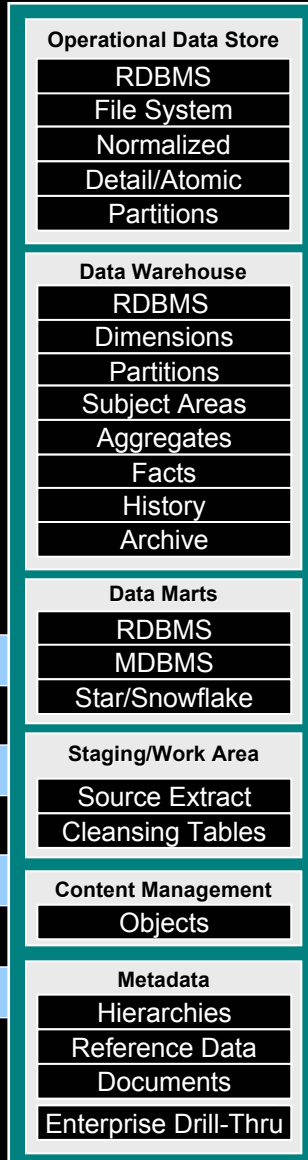
## Access Layer

## Analytics Layer

## Data Layer

## Integration Layer

## Data Source Layer



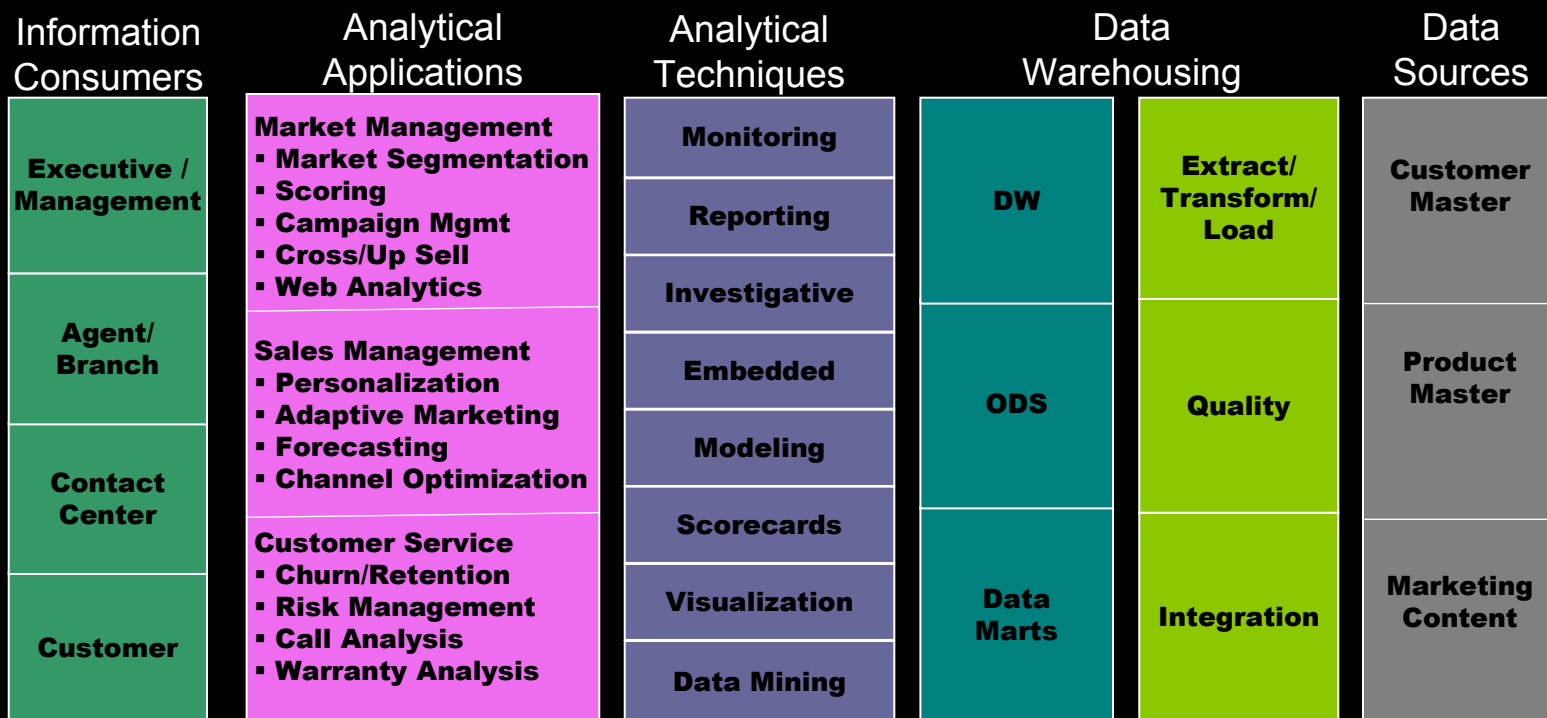


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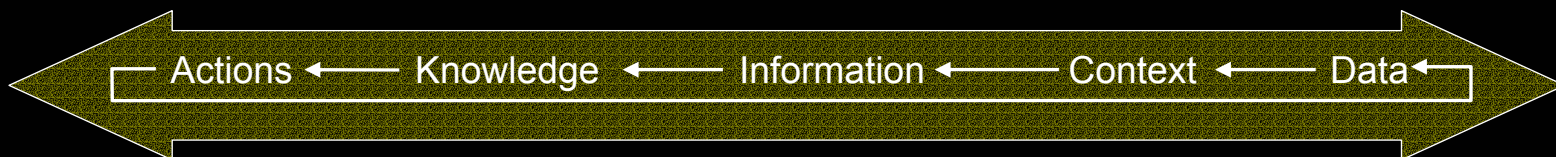
# Applying the Reference Architecture



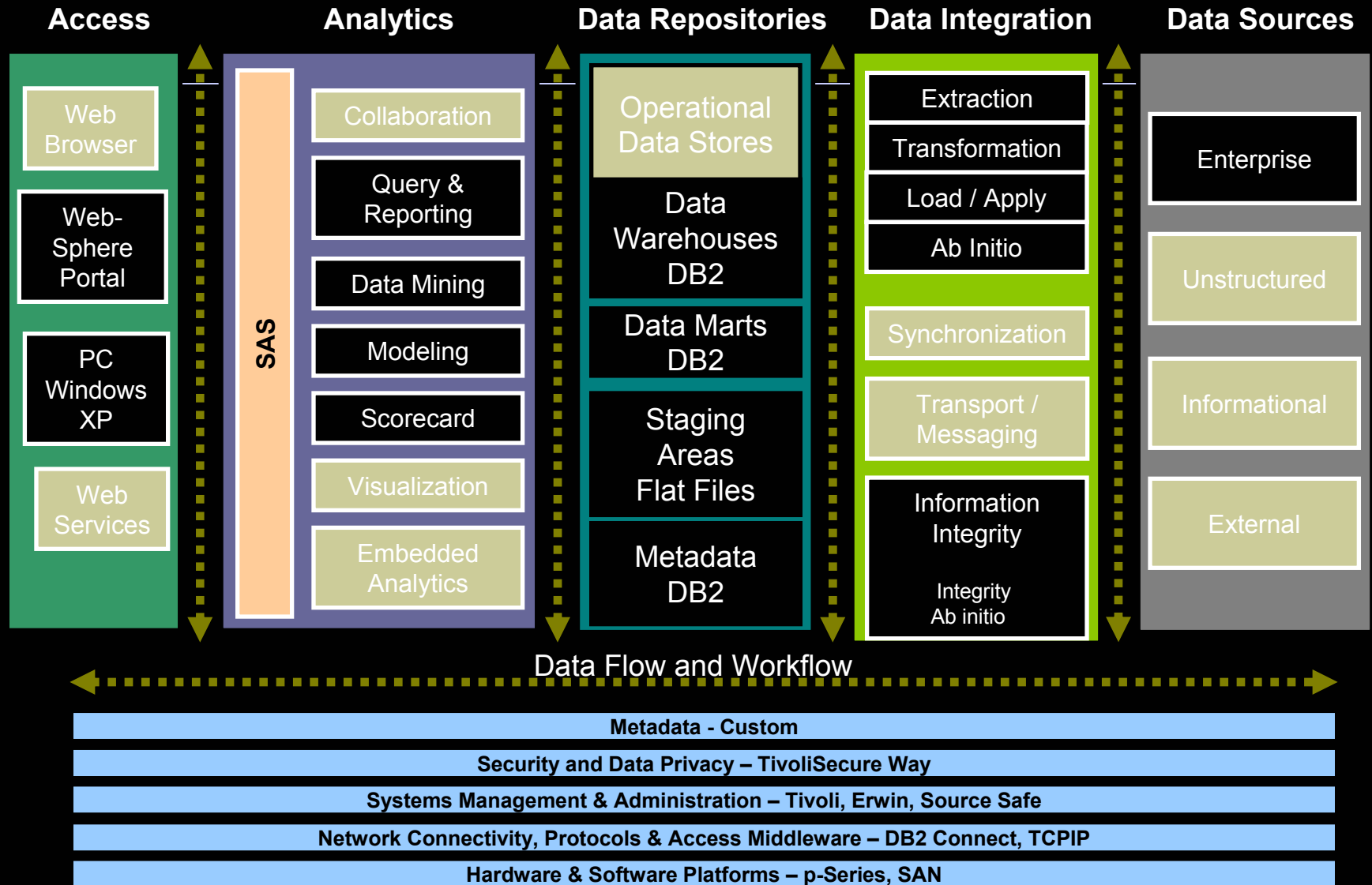
# Marketing & Customer Intelligence – Analytical Framework Example



Security and Data Privacy

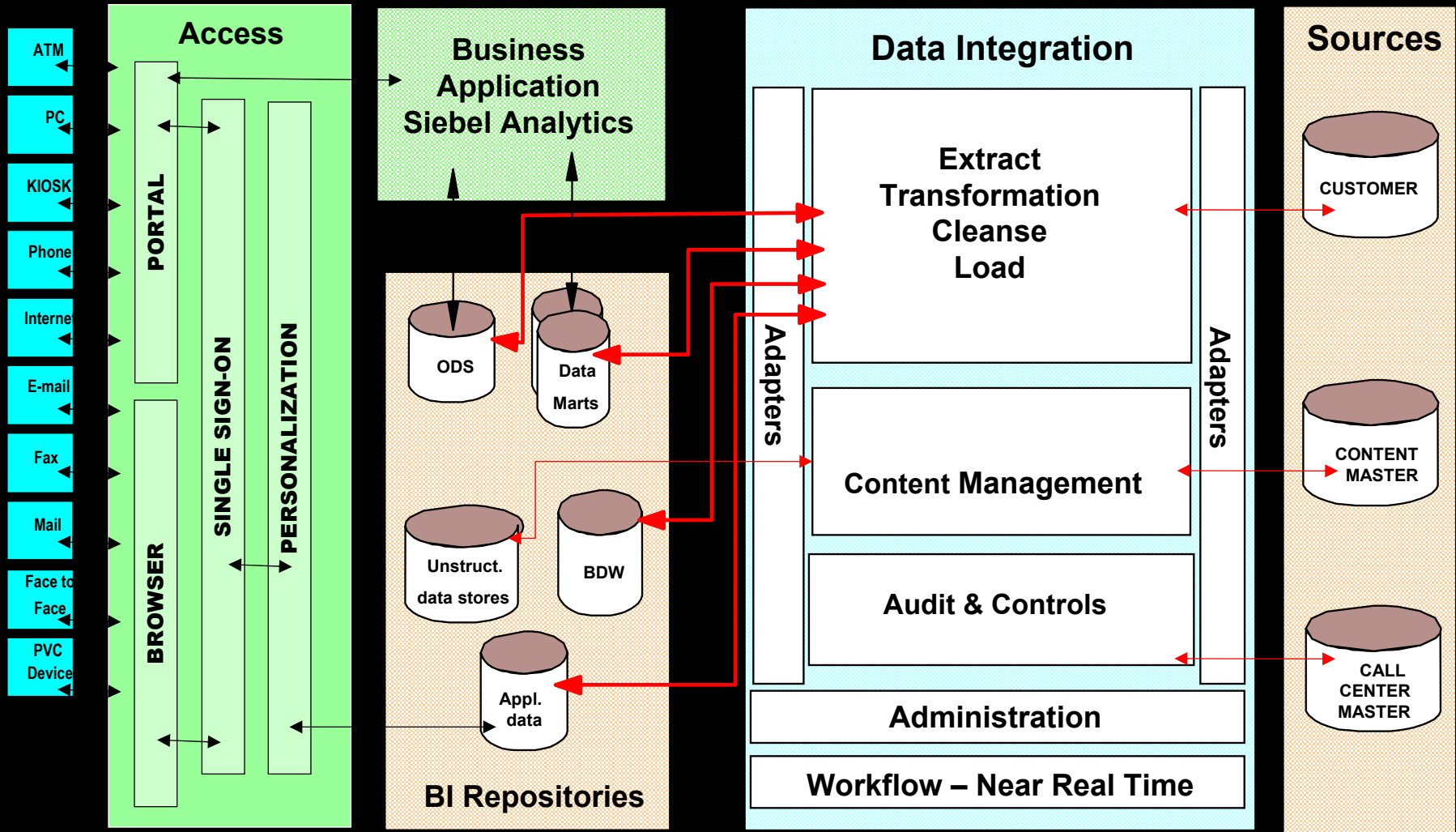


# Reference Architecture Fit-Gap

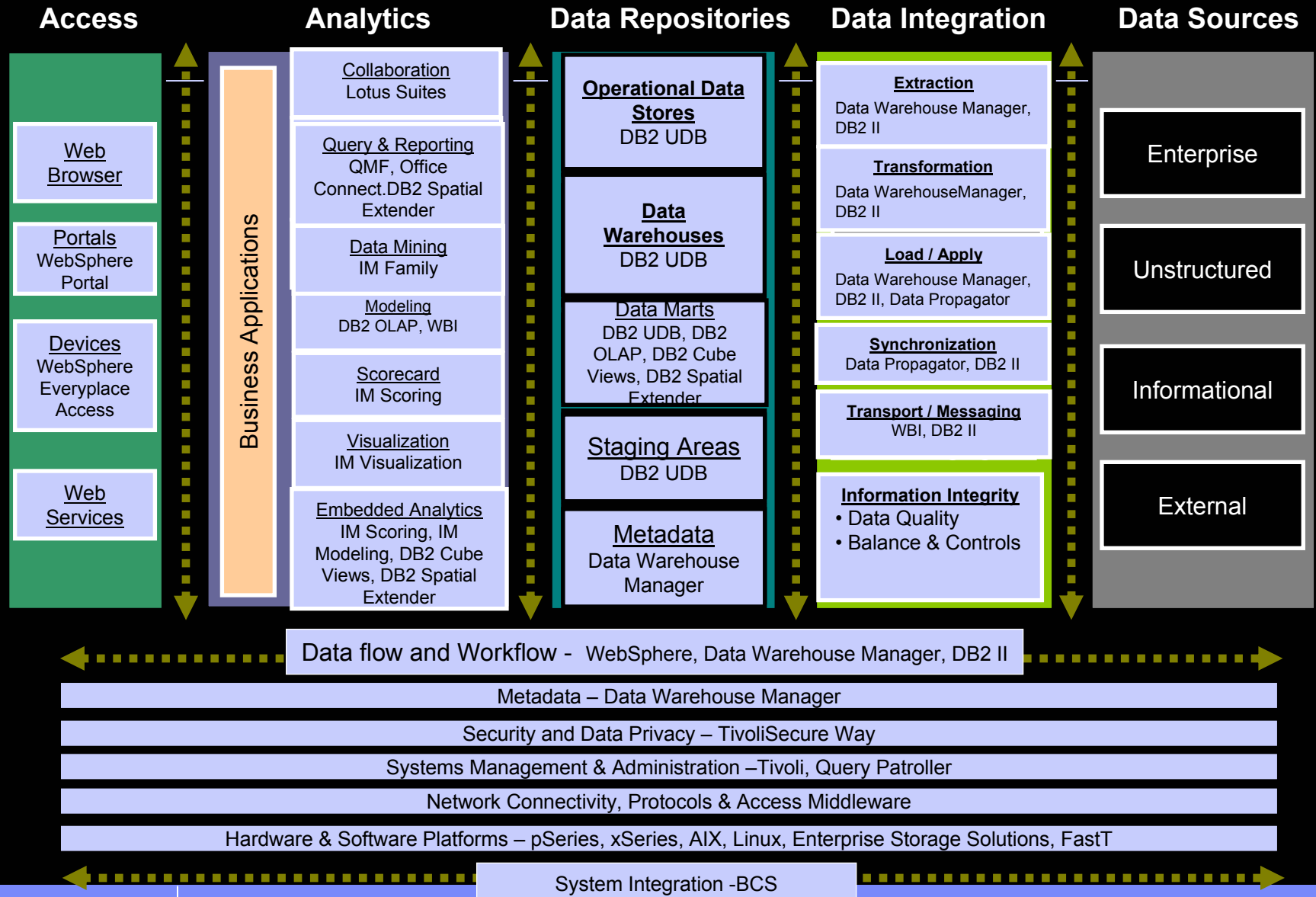




# A Sample Client Marketing and Customer Analytics Component Diagram



# IBM Product Mapping



# BI Solution Products

