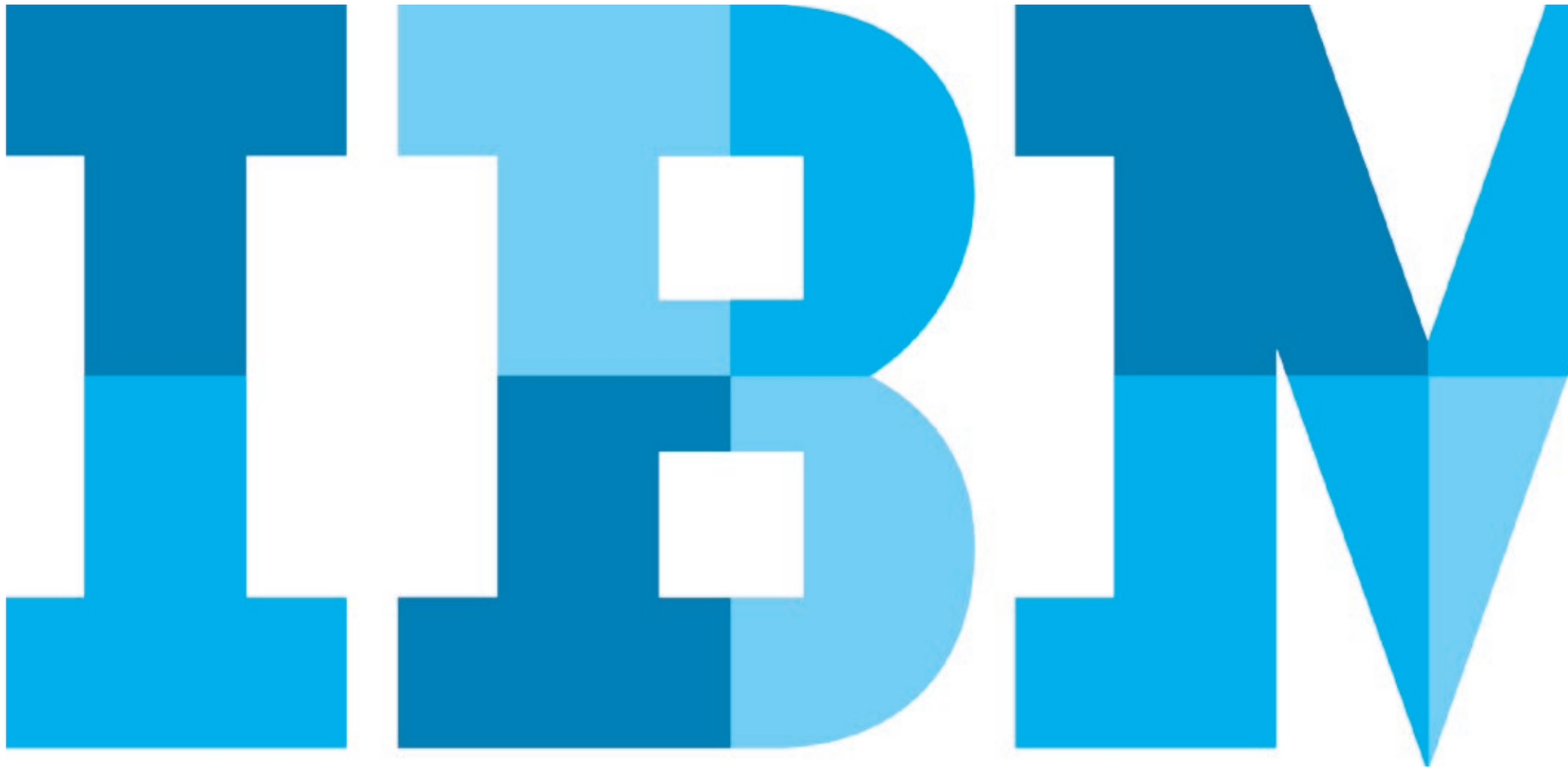
IBM Analytics

IBM Data Model for Energy and Utilities

General Information Manual



IBM

Executive Summary

The challenges have become clear: the need for clean water and air; affordable and reliable delivery of energy; the dwindling supply of fossil fuels; the reality of climate change and its implications for future generations. Smarter energy capabilities must be developed in order to improve reliability, efficiency and return on assets, better engage customers, reduce costs, manage distributed energy resources, and transform operations for the 21st century.

The structure of today's electric grids reflects a time when energy was cheap, environmental impact wasn't a priority, and consumers weren't even part of the equation. Many utilities are now adding a layer of digital intelligence to their grids – creating intelligent utility systems that actually look a lot more like the Internet than a traditional grid. These smart grids use sensors, meters, digital controls and analytic tools to automate, monitor and control the two-way flow of energy across operations – from power plant to plug.

A power company can optimize grid performance, prevent outages, restore outages faster and allow consumers to manage energy usage right down to the individual networked appliance. Based upon consumer usage patterns, peaks and valleys can be smoothed by offering consumers alternative pricing schemes – hence altering consumer behavior. "Smart" grids can also incorporate new sustainable energies such as wind and solar generation, and interact locally with distributed power sources or plug-in electric vehicles. All of this instrumentation generates new data that advanced analytics can turn into insight so that better decisions can be made in realtime.

The emerging utility trends can be broken into three categories. The first category is a completely changed customer environment that consists of smart appliances, new loads and more sophisticated control technologies. The second is an ever smarter grid that can integrate distributed sources of sustainable energy.

And the third is the enabling regulatory and market constructs that are creating the environment for a fundamentally different set of business models than the industry has enjoyed over the last century.

New customer environments
Smart appliances will increasingly become ubiquitous in consumer homes. Connected to the Internet, these appliances can be observed and controlled by consumers and by third parties — such as a utility — and can optimize programs such as demand response and energy efficiency. Sophisticated systems such as affordable energy management systems, automated demand response appliances and mobile smart phone applications will offer control. In many cases, the consumer will simply set their preferences, and these systems will respond and learn their patterns and additional preferences.

New grid
The grid itself will fundamentally change. With the increasing percentage of renewable energy sourced from wind and solar, a new pattern of infrastructure deployment and operations will support the unique characteristics of renewable energy. Battery technology, at the grid and consumer level, will become broadly available and affordable. In areas of the world where existing infrastructure is insufficient or the economics for investing large centralized generation and transmission is not feasible, micro-grids will emerge as a reasonable alternative.

New business models
The regulatory environment will increasingly permit new businessopportunities and business models, for existing utilities and new entrants, to emerge and thrive. This development will be tempered by a recognition and acceptance that significantly more investment is required to ensure the reliability and resiliency of the grid. This trend and the others mentioned previously will shape the rapidly evolving utility industry landscape, aided by advances in technology.

Data Privacy and Protection - GDPR
DMEU supports the General Data Protection Regulation[1] (GDPR) and provides an industry-specific vocabulary, that can help you discover and govern privacy data, and KPI templates for regulatory reporting.

It can help organizations ensure that their enterprise data architecture is able to provide the necessary data artifacts to report on data protection issues and can help to determine and define which personal data types your business uses.

Data Privacy and Protection – CCPA
DMEU has been updated to support the California Consumer Privacy Act (CCPA) and provides an industry specific vocabulary, that can help you understand requirements for privacy data. Building on the foundations put in place with GDPR, CCPA identifies the key terms within the regulation which are then mapped to the Business Terms. The coverage can help you understand what components to be considered including consumer rights, personal data types, processing activities, processing purposes, and roles.

Standards in the industry
DMEU provides alignment and lineage to CIM 61968 and 61970 industry standards through its glossary of terms, accelerating auto classification of your organization various data sources.

IBM has developed a point of view centered on three critical challenges that drive a set of strategic imperatives for the industry.

Viable substitutes rise
The rise of viable energy substitutes introduces a set of business and technical challenges such as supply intermittency, demand response dispatchability and business disintermediation. Photovoltaic solar at grid parity, the mainstreaming of renewable and storage technologies, and the increasing ability for demand response to replace supply in the power dispatch balancing process are formidable alternatives in the value chain of the traditional utility model.

In almost every case, these technologies and methods have been used experimentally for decades but were not viable for mass deployment until recently. Better technology, more liberal public policy, lower costs and new industry entrants now challenge the future of the traditional utility business model.

This challenge drives the first strategic imperative: Successful energy companies will assume the role of energy integrators. Energy integrators, commonly known as trusted energy providers, assume the business and technical responsibility of providing all sources of energy supply safely and reliably to a customer. It encompasses both demand-side and supply-side technology and associated business models. And, it requires infrastructure that is substantially more sophisticated and complex than today's typical utility environment.

Customer engagement deepens
As the future utility framework evolves, rich and instant customer interactions delivered primarily from social and mobile apps are required. Why? For one, per capita demand of energy is rising. However, energy intensity, which is the measure of energy input required for a fixed economic output typically measured in BTUs per dollar of gross domestic product, is falling.

Given the intent of energy efficiency programs, the result is not surprising and now the same functional outcome, for example lighting or heating, is increasingly less expensive on a unit basis to provide.

As a result, it will be difficult for utilities to generate the same revenue per customer as they have in the past. The implications are onerous as growth opportunities not only dwindle, but in some situations, actually reverse. Along with this loss of revenue, utilities face customers who are evolving. As the ability to generate electricity on-site becomes more accessible, some customers are turning into "prosumers".

Revenue losses and prosumers mean that the traditional method of interacting with customers once a month in a bill by mail or during a telephone call to inquire about service interruption is no longer sufficient or cost-effective. A much more instantaneous and fulfilling method of interaction is required.

This new customer engagement interaction drives the second strategic imperative: Utilities must deliver a 360-degree "customer-of-one" experience. This is fundamentally a retail customer engagement model and one that the vast majority of utilities globally are not yet delivering. Just as with the challenge of viable substitutes, this new way of engaging with customers will require investment in technologies that are fundamentally new to the utility industry.

Core expectations persist
Despite the changes in the industry, the core expectations to deliver safe, reliable, affordable and sustainable energy remain. No one is expecting less safe or less reliable or less sustainable energy at higher cost nor will global regulatory processes allow it. However, the new entrants in the industry are much more agile and not bound by the limitations of traditional utility regulated economics. These entrants challenge the very necessity of the grid in the first place and argue that customers can deploy technologies that enable them to disconnect from the grid and their utility. And in many places, that is exactly what they are doing.

For utilities to compete in this new environment successfully and ensure safe, reliable, affordable and sustainable energy, they will have to fundamentally transform their current business processes. This leads to the third strategic imperative of this point of view: utilities need to disruptively innovate business processes through analytics driven operational excellence.

If the 1980s and early 1990s were all about labor arbitrage, and the late 1990s and early 2000s were all about business re-engineering, the future of the industry is all about using advanced analytics to eliminate unnecessary processes.

Substantively more sophisticated analytics technologies are just the beginning of what can be accomplished in terms of disruptive innovative business processes. For example, in the area of storm restoration, advanced forecasting techniques can be used to forecast not only the weather but also a damage profile. This profile would enable the optimum positioning of restoration resources and material before the event and is a good example of where a current manual (albeit refined) process can be replaced in its entirety with advanced analytics.

Another example is the use of advanced forecasting to predict the actual power output of a wind farm or solar installation, which could significantly reduce the level of additional services that must be provided. Other examples in the areas of customer, finance, and even IT operations also abound.

IBM Data Model for Energy and Utilities

IBM Data Model for Energy and Utilities (DMEU) provides a blueprint for comprehensive data warehouse business intelligence applications, as well as the foundation for an operational model based on data architecture best-practice principles.

It is aligned to the Common Information Model (CIM 61968 and CIM 61970) and provides a robust set of business and technical data models, which are extensible and scalable so that they can fit an organization's unique environment and offer significant competitive advantage.

Strategic and operational leaders need reliable and accessible information to prioritize and allocate funding, resources, and technology to remain competitive. They are challenged to aggregate the data they need to make key business and operational decisions to improve performance across complex environments.

But for many organizations this information is not easily accessible. While there is no shortage of data, it is often spread across numerous information silos and in multiple formats, making it nearly impossible to turn this information into the type of actionable insight that can drive competitive differentiation.

Most organizations do not have a detailed roadmap showing how to bridge the gap between operational and financial data. They lack the cross-functional expertise, resources and processes to design a comprehensive foundation for business intelligence. Attempting to develop this themselves is expensive and is unlikely to yield results within the necessary timelines for regulatory compliance and business goals.

Packaged business intelligence solutions may not support technology investments already made, and may require an application specific and rigid data model.

Many organizations have outgrown the functionality and effectiveness of their current systems, and cannot achieve the level of data analytics capabilities necessary to understand fully the broad range of activities conducted by its consumers and operations.

What is needed to meet these demands are innovative solutions that can provide the foundation for a broad range of query-based and near real-time business intelligence activities that can effectively integrate and analyze information from a wide range of data sources. The foundation needs to be robust enough to support current needs and extensible and scalable enough to support future requirements that may still be unknown.

DMEU offers the ability to create an analytical data store that connects to critical data, across disparate systems and formats, across diverse departments and other organizations. It helps build a dynamic analytics environment and forms the foundation of a true information management infrastructure where trusted, relevant information is available to the people who need it, when they need it, so that they can make better and timelier decisions.

Recent updates include improved integration with The Weather Company®, IBM Maximo®, as well as a broadening of the model content to support the gas industry.

IBM Data Model for Energy and Utilities provides a glossary of requirements, terms and concepts that can be clearly understood and communicated by both business and IT professionals, thereby helping to accelerate project scoping, appropriate reporting, data quality and data requirements and identifying sources of data.

Ultimately, it acts as a blueprint by defining the structures necessary to build an effective data warehouse and provides managers with critical prebuilt reporting templates that offer a wide and deep view of their business through key performance indicators (KPIs) and other measures.

DMEU supports the General Data Protection Regulation (GDPR[1]) and the California Consumer Privacy Act (CCPA). It can help organizations ensure their enterprise data architecture is able to provide the necessary data artefacts to report on data protection issues. It isolates and represents the distinct data terms from GDPR and CCPA in an easily navigable structure which clearly relates each term to the enterprise terminology, translating the regulatory context into how it would be more commonly known across the organization.

Business benefits

- Comprehensive view of asset, customer, meter, and measurements
- Aligned with IBM Maximo APM for Energy and Utilities analytics platform to address key components of the new overall analytics landscape
- Aligned to CCPA
- Aligned to GDPR[1]
- Aligned to the Common Information Model (CIM 61968 and CIM 61970).

Technical benefits

- Can help the organization build a repository of reliable, accurate and up to date information capable of supporting all of the organization's business and asset management requirements
- Can be customized to reflect the exact needs of each organization, including areas that are specific to their business, because it has a strong orientation on both business and IT.
- Can be flexible enough to evolve over time with the ever changing requirements of the industry. Open standards make it easy to build out additional features and accommodate extensions
- Can help IT staff implement an enterprise data warehouse on time because it contains thousands of hours' worth of development effort and expertise to help business users
- Can help with the classification and identification of the types of data stored in sources using the 290 CIM related data classes.

Comprehensive: An integrated model across asset, meter, customer, and measurements to enable cross-functional analytics and insights that will drive more informed decisions.

Inclusive: Incorporate existing in-house data models and evolve and innovate as needs expand.

Validated: Validated industry data model establishes a working vocabulary to accelerate business intelligence design across business and technical resources.

Portable: A logical data model decoupled from specific technology, portable across data warehouse systems ensuring enterprise-wide adoption.

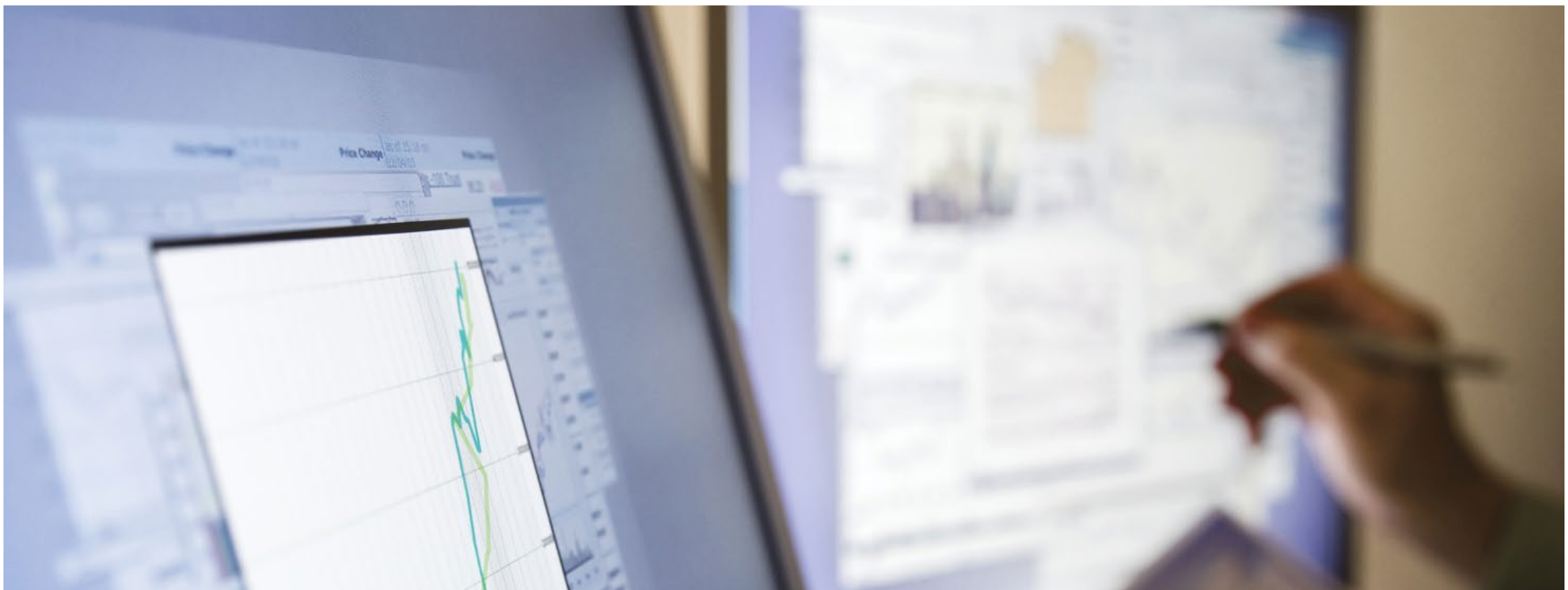
Intelligent: Analytical Requirements address common analytical and reporting requirements such as asset and work management, CCPA and GDPR[1].

Collaborative: Provides a gateway between the business language and technical data elements used to deliver your data warehouse, including integration with IBM InfoSphere Information Governance Catalog.

Tailored: Customizable and fully extensible using data modeling tools to tailor the model to your businesses specific requirements.

Trusted: 20+ years of IBM data model design experience supporting more than 500 clients representing large and complex data warehouse and analytics programs.

Reduced Risk: Lower total cost of ownership of platform will minimize risk, project duration and rework.



value requires the proper balance of a comprehensive data schema design across asset, customer, meter, paired with the ability to support existing models and technologies. Only a flexible model structure developed specifically for the energy industry can support this.

As platform independent models, the offering is the result of tens of thousands of hours of development effort and deep subject matter expertise to help business users and IT staff implement an enterprise data warehouse on time and on budget.

IBM Data Model for Energy and Utilities reaches far beyond simple data gathering. It offers a significant competitive advantage through the ability to continuously process data and transform it into information led business initiatives.

By unlocking information contained in individual applications and repositories from a variety of vendors and making it readily available to the people and processes that need it, IBM Data Model for Energy and Utilities can help get you closer to a true information management infrastructure.

Solve complex problems requiring complex data

- Turn operational data into strategic insight with end to end integration of your most valuable data
- Build a comprehensive analytics platform and leverage the investment for years to come
- Track improvements and trends in cost and quality over time with historical views and traceability
- Provide data in a way that enables detailed analysis by business analytics applications
- Leverage existing investments by incorporating existing complex data models into the cross-functional view

Turn insights into action

- Analyze asset inspections, asset health scores and recommended treatments that are recorded as inspection result in order to reduce instances of asset failures.
- Analyze the variety of costs that are associated with asset maintenance work, based on the type of resource that is consumed or used in the assessed period.
- Analyze the costs that are associated with asset maintenance work. Focuses on the split and comparison of the cost that results from preventive maintenance and corrective maintenance, and expresses the cost as a percentage of the total maintenance cost.
- Analyze the performance related to the dispatching and resolution of unplanned work.

Be responsive to your businesses changing needs

- Align business and technical resources with a common target and vocabulary to accelerate progress on your initiatives
- Increase agility and decrease time to deliver new reports to your decision makers with a design optimized for analytics
- Enable department heads with the tools they need to be innovative and collaborative
- Adapt to evolving regulatory requirements
- Expand management dashboards and reports to include emerging analytical areas without re-implementing an entire platform

Components

Business Terms

Business terms define industry concepts in plain business language, with no modeling or abstraction involved. Business terms have a set of properties and are organized by business category. Clearly defined business terms help standardization and communication within an organization. Mappings to the data models make it possible to create a common, enterprise-wide picture of the data requirements and to transform these requirements into IT data structures.

Business terms define key business information used for business operations and analysis, enabling users to understand information used by IT assets by allowing traceability between business terms and IT assets. As a consequence, developed IT solutions are driven by business requirements.

Business terms should exclude terms that are not meaningful to a business user, such as terms that are too abstract. Business terms do not model data requirements but capture the data requirements in a simple and flat structure.

The modeling activity happens in the subsequent use of the data models when the business terms are modeled using modeling artifacts such as inheritance, relationships and attributes.

Business terms are defined by properties that describe in business language, the meaning of the business term and its status, organized in business categories within a structured hierarchy.

Business Data Model

The Business Data Model is a logical entity relationship model that represents the essential entities and relationships of the industry. It includes common design constructs that can be transformed into separate models for dedicated purposes such as an operational data store, data warehouses and data marts.

The Business Data Model is the first point at which the various business requirements are brought together and modeled in an entity relationship fo rmat.

It enables organizations to perform the initial modeling of their business requirements and helps the organization understand the various constraints, relationships and structures that can be implied in their business requirements. This is the essential model of the business that provides the overall business context and a common basis for the downstream models that can be used in actual deployment of the physical data warehouse.

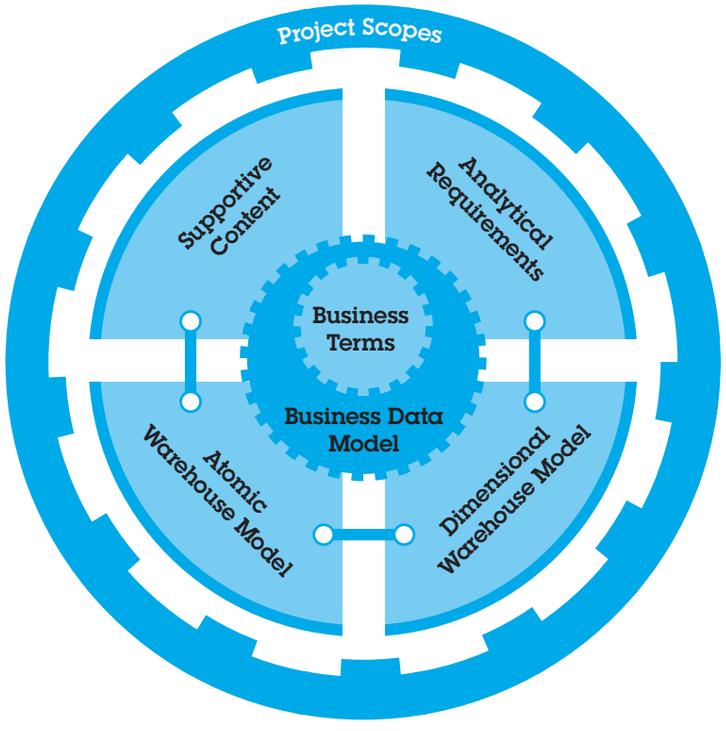


Figure 1. DMEU Solution Components

The Business Data Model is not an implementation model. Instead, it includes common logical constructs that can be transformed into the physical structures suitable for dedicated purposes. These derived models are implemented as installed data repositories.
The key data concepts of the Business Data Model are based on IBM's experiences, achieved over almost two decades of developing industry models in multiple industries, and customizing them to suit the exact needs of hundreds of individual clients.

The Business Data Model contains content in the following areas:

Accounting
- Account, Balance & Note
- Account Reconciliation
- Accounting Line & Structure
- Journal & Account Entry
- Financial Transaction

Asset
- Asset & Asset Model
- Asset Configuration
- Inspection, Score, Treatment
- Financial Information

Power Asset
- Wire and Cable
- Structure
- Transformer
- Breaker, Cutout, Recloser, Fuse, Jumper
- Shunt compensators
- Voltage & Current Transducers
- Generation and Production

Gas Asset
- Regulator
- Valve
- Coupling, Bend, End Cap, Tap, Tee
- Anode & Anode Bed
- Compressor, Heater, Cooler, Odorizor

Common
- Person, Organization & Organization Unit
- Contact Point and Location
- Communication, Segment & Subject
- Event, Event Impact Area
- Power Fault & Power Fault Cause
- Location & Asset Location Marker

Customer
- Customer Account and Transaction
- Agreement, Customer Agreement
- Load Profile, Electric Usage Point & Gas Usage Point
- Billing, Collections, Payments, Point of Sale
- Tariffs and Charges
- Supplier and Wholesale Agreement

Human Resources
- Employment Agreement
- Employment Position & Job Spec
- Performance Review

Measurement
- Power & Gas Measurement
- Measurement Value, Value Quality
- SCADA

Metering
- Meter, Meter Reading and Quality
- Interval Usage and Interval Value
- Electric Meter & Gas Meter

Outage
- Outage and Outage Restoration
- Estimated Restoration, Outage Region
- Gas Leak Report

Supply Chain
- Catalog Item
- Material Request, Purchase Order
- Inventory Transaction & Level
- Warehouse Bin & Item

System Network
- System Resource, Node and Terminal
- Substation, Feeder, Bay
- City Gate, Gas Storage Well

Weather
- Weather Observation and Interval
- Weather Station and Sensor
- Storm , Lightening & Flood
- Weather Alert & Forecast

Work
- Design, Planning, Execution and Cost
- Task, Work Order and Project
- Task Holds
- Worker, Crew and Qualification
- Crew Availability & Job Briefing
- Worker Schedule & Status

Atomic Warehouse Model

The Atomic Warehouse Model is a logical, specialized model derived from the Business Data Model. It is optimized as a data repository which can hold long-term history, usually across the entire enterprise.

The Atomic Warehouse Model provides the data design support needed to create a uniform model of the enterprise level business requirements defined by the Business Data Model into specific, flexible and efficient structures dedicated to the long-term storage of historical facts.

The history structures have been developed over decades of warehouse design and give the efficient storage construction required. It is also designed to supports near real-time loading of data.

Dimensional Warehouse Model

The Dimensional Warehouse Model is a logical model derived from the Business Data Model and is an optimized data repository for supporting analytical queries.

The Dimensional Warehouse Model provides the data design support needed to transform the enterprise level business requirements in the Business Data Model into business-specific and efficient structures dedicated to the design of a dimensional data repository.

This repository holds data to meet the needs of business-user-required analyses. Dimensional models are more easily understood by business users. They are optimized for data querying instead of for transactional speed and their structure means it is easier to extend them to support new data requirements. New queries can be created without having to redesign the data structures, and old queries will still operate without change.

Using either the Atomic or the Dimensional Warehouse Model is a valid option for your enterprise data store, depending on your needs. You can use either for the lowest level of data granularity that supports your solution requirements. Collectively, IBM Data Model for Energy and Utilities helps to mitigate the risk of implementing a data warehouse, while considerably reducing development time and cost.

Analytical Requirements

Analytical Requirements enable rapid scoping and prototyping of data marts, which provide a subject-specific analytical layer in a data warehouse solution. With data warehouse modeling software, business users and analysts can use Analytical Requirements to quickly gather the reporting and analysis requirements of their organization.

Each Analytical Requirement can be divided into measures which are numerical facts that convey quantitative information of importance to the organization and dimensions which then categorize measures.

These measures and dimensions are mapped back to the data warehouse so that the scoping of the reporting and analysis requirements automatically selects the most appropriate data warehouse entities and attributes to support those requirements. The analytics development team can use these Analytical Requirements to create designs for specific data marts or dimensional solutions that can be used as a source for a range of reports and charts.

Analytical Requirements Coverage

Personal Data Protection

- **Data Subject Agreement Status analysis -** An analysis of the status of consents and other agreements regarding use of data and associated restrictions for personal data that is controlled by the organization.
- **Data Subject Request Analysis -** An analysis that focuses on the number of requests by type with associated response times and outcomes.
- **Personal Data Breach Analysis -** An analysis that focuses on data breaches and measures related to handling of these breaches.
- **Personal Data Processing Activity Analysis -** An analysis that focuses on operations that are performed on personal data.
- **Personal Data Protection Risk Assessment Analysis -** An analysis of the procedures undertaken by the organization to identify and quantify risks related to protection of data controlled by the organization.

Accounting & Finance

- **Account Entry Composition Analysis** - An analysis of the financial transaction composition of an account entry. This demonstrates the lower level financial transaction detail that composes an account entry.
- **Account Reconciliation Analysis** - An analysis of account reconciliations within a reconciliation. There can be many reconciliation items in an account reconciliation. This supports analysis of the efficiency of the reconciliation process.
- **Balance Sheet Analysis** - To analyze the organization's Balance Sheets, which report the total assets, total liabilities, and total shareholders equity at a specific time.
- **Cash Flow Analysis** - To analyze an organization's Cash Flow, which is the amount of cash an organization generates and uses during a period, calculated by adding non-cash charges (such as depreciation) to the net income after taxes.
- **Financial Summary Analysis** - To support the organization in the generation and analysis of the Security And Exchange Commissions (SEC) 10Q and 10K reports.
- **Income Statement Analysis** - To analyze an organization's Income Statement, which is a financial report that by summarizing revenues and expenses, and showing the net profit or loss in a specified accounting period it depicts an organization's financial performance due to operations as well as other activities rendering gains or losses. Also known as the profit and loss statement.
- **Journal Account Entry Analysis** - An analysis of the account entries that compose a journal.
- **Journal Approval Analysis** - An analysis of journal approvals by workers.

Asset Financial Planning

- **Distribution Financial Analysis** - An analysis of the project work that focuses on the adherence to the project plan and the distribution maintenance cost per customer and per-asset mile.
- **Maintenance Cost Analysis** - An analysis of the cost of asset maintenance work. The analysis focuses on the split and comparison of the cost that results from preventive maintenance and corrective maintenance, and expresses the cost as a percentage of the total maintenance cost.

Asset Health Assessment

- **Asset Failure Analysis** - An analysis that focuses on instances of asset failure events.
- **Asset Inspection and Health Score Analysis** - An analysis that focuses on asset inspections, asset health scores and recommended treatments that are recorded as inspection results.
- **Asset Installation and Removal Analysis** - An analysis that focuses on asset installation and removal.
- **Asset Lifecycle Analysis** - An analysis that focuses on measurements that are associated with the lifecycle of an asset.
- **Line and Structure Analysis** - An analysis that focuses on overhead lines and the pole and tower structures that support these lines.
- **Network Risk Analysis** - An analysis that focuses on network risk analysis.
- **System Asset Availability Analysis** - An analysis that focuses on the availability and use of assets on the network.
- **Power Fault Analysis** - An analysis that focuses on instances of power failures, related tasks and outages and affected assets.

Asset Management

- **Asset Reliability Analysis** - An analysis of asset reliability.
- **Asset Risk Analysis** - An analysis of asset risk based on the consequence of a failure of the asset and the probability of the failure occurring.
- **Equivalent Annual Cost Analysis** - An analysis of owning and operating an asset over its entire lifespan.

Call Center Management

- **Call Center Performance Analysis** - An analysis of call center call handling performance.
- **Call Center Worker Analysis** - An analysis of call center workers time allocation.
- **Contact Subject Analysis** - An analysis of the subjects of customer communications with the contact center.
- **Shrinkage Analysis** - An analysis of call center shrinkage. Call center shrinkage represents paid worker time that is not allocated to handling calls.

Customer Management

- **Customer Agreement Churn Analysis** - An analysis that focuses on the reasons why customers close agreements with the organization and the impact of such closures on the organization.
- **Customer Bill Analysis** - An analysis of customer bills.
- **Customer Churn Analysis** - An analysis that focuses on the reasons why customers of the organization cease to use its services and the impact this has on the organization.

- **Customer Churn Propensity Analysis** - An analysis that focuses on the tendency and estimated likelihood of customers or types of customers to leave the organization to avail of the services of a competitor.
- **Customer Complaint Analysis** - An analysis that focuses on the pattern of complaints raised by customers of the organization and the effectiveness of the complaint resolution process.
- **Customer Credit Risk Analysis** - An analysis that focuses on the amount of credit in arrears, average balances, credit score and customer balance sheet in order to determine profiles of customer credit risk.
- **Customer Interaction Analysis** - An analysis that focuses on how the organization interacts with its customers, and the effectiveness of various communication types and channels in terms of retaining customers and winning new business.
- **Customer Loyalty Analysis** - An analysis that focuses on the determination customers have for continuing to use the services of the organization, while recognizing the customers have alternative choices.
- **Customer Revenue Analysis** - An analysis that focuses on the available wealth of customers compared to their utilization of services of the organization.
- **Customer Segmentation Analysis** - An analysis that focuses on the identifications of groups of customers based on the various population criteria and other customer characteristics known to the organization.
- **Premise Occupancy Analysis** - An analysis that focuses on the occupancy of the premises that includes the numbers of household members and numbers of people usually present at workplace.
- **Revenue Protection Analysis** - An analysis focused on revenue protection and potential fraud analysis.
- **Social Media Sentiment Analysis** - An analysis that focuses on the social media activity relating to the organization or a particular subject of interest. It looks at measures such as the social media sentiment and the exposure of the social media profile.

Credit Collections

- **Accounts Receivable Analysis** - An analysis of unpaid amounts of all charges billed to the customer account including all due or overdue payments.
- **Collection Activity Analysis** - An analysis that focuses on the collection related communication and activities. The activities included in the analysis are service disconnections, reconnections and deliveries of the door hangers notices.
- **Debt Reduction Analysis** - An analysis that focuses on the uncollectable amounts on the customer accounts.
- **Outbound Collection Communication Analysis** - An analysis that focuses on the collection related outbound communication. The communication types include the outbound calls, letters and other notices delivered to the customer residence in person.
- **Overdue Balance Analysis** - An analysis that focuses on overdue balances on residential and non-residential customer accounts.

- **Payment Assistance Agreement Analysis** - An analysis that focuses on the participation of customers in all payment assistance plans offered by the organization or other agencies, the new and active payment assistance agreements as well as the agreed payment amounts and the unpaid bills amounts of the program participants.
- **Revenue Analysis** - An analysis of revenue derived from customer billing in the context of credit collections.

Customer Load

- **City Gate Metering Analysis** - An analysis of gas volumes entering and leaving the city gate facilities based on the measurements from the input and output meters, an input measuring meter owned by the transmission supplier and an output measuring meter on the distribution side owned by the utility.
- **City Gate Sendout Analysis** - An analysis of expected demand for gas for a given service area. Forecasts are used to predict demand placed on city gate facilities.
- **Customer Usage Factor Analysis** - An analysis that focuses on how metered usage by a given customer differs from the typical usage of similar types of customers. New customers are usually given a default usage factor of one. Once the new customer's actual usage is measured, it is then possible to assess the degree to which this customer uses more or less than the average.
- **Gas Storage Sendout Forecast Analysis** - An analysis of expected demand for gas for a given service area. Forecasts are used to predict demand placed on gas storage facilities.
- **Load Planning Analysis** - An analysis of budgeted and actual sales and the difference between these values for a given period.
- **Peak Load Analysis** - An analysis of expected demand from customers based on peak hour usage. This analysis and reporting facilitates coordination with energy suppliers.

Distributed Generation

- **Distributed Generation Agreement Analysis** - An analysis of net metering agreements with customers.
- **Distributed Generation Analysis** - An analysis focused on the amount and value of power generated by distributed generation customers.
- **Distributed Generation Equipment Analysis** - An analysis focused on the type of distributed power generation equipment used by net metering customers.

Human Resource Management

- **Employee Performance Analysis** - An analysis that focuses on the employee performance assessments.
- **Worker Agreement Analysis** - An analysis that focuses on the agreements between the utility and their employees and the contract workers.
- **Worker Cost Analysis** - An analysis that focuses on the cost related with active agreements of both the employees and the contract workers.
- **Worker Turnover Analysis** - An analysis that focuses on the turnover of both the employees and the contract workers.

Meter Operations

- **Advanced Metering Analysis** - An analysis focused on the operational integrity of meter data collection. The analysis centers on meter readings that are out of normal reading value ranges.
- **Meter Deployment Analysis** - An analysis used to analyze the rate of progress of meter deployments.
- **Meter Deployment Failure Analysis** - An analysis of meters that have repeated testing failures in the context of meter deployment.
- **Metered Usage Analysis** - An analysis of energy usage based on meter readings. The analysis measures both usage by customers as well as energy generated and delivered to the grid by customers.
- **Meter in Possession of Employee Analysis** - An analysis that focuses on meters that are removed from inventory for installation in the field. This facilitates reporting of situations where a meter is checked out more than a standard number of days and in not yet installed.
- **Meter Inventory Analysis** - An analysis used to analyze meter inventory.
- **Meter Reading Analysis** - An analysis of energy usage based on meter readings.
- **Meter Reading Correction Analysis** - An analysis of corrections of inaccurate meter readings.
- **Meter Reading Estimates Analysis** - An analysis of instances of estimated meter readings.
- **Meter Reading Route Optimization Analysis** - An analysis supporting optimization of meter reading routes. Route optimization ensures optimal usage of reading resources and supports reduced inaccurate manual meter readings.
- **Meter Transformer Connectivity Analysis** - This demonstrates some of the analysis that is possible based on the connectivity of a meter to its transformer.

Outage and Reliability

- **CEMI Analysis** - An analysis of customers experiencing multiple interruptions (CEMI) metrics.
- **Estimated Restoration Time Analysis** - An analysis that focuses on the outage-related outbound communication and accuracy of communicated estimated restoration time.
- **Leak Report Analysis** - An analysis that focuses on leak reports and measures related to managing of confirmed leaks.
- **MAIFI Analysis** - An analysis of Momentary Average Interruption Frequency Index metrics.
- **SAIDI Analysis** - An analysis of System Average Interruption Duration Index metrics.
- **SAIFI Analysis** - An analysis of System Average Interruption Frequency Index metrics.

Supply Chain Management

- **Catalog Item Analysis** - An analysis of catalog items. A catalog item is an item that can be or was ordered from a supplier or suppliers.
- **Cycle Count Analysis** - A periodic physical count of inventory items in a warehouse facility.
- **Daily Inventory Level Analysis** - An analysis of inventory levels on a periodic basis. For example, the level of warehouse inventory at end of day.
- **Inventory Transaction Analysis** - An analysis of financial and non-financial inventory transactions.

- **Material Request Analysis** - An analysis of material requests for inventory and non-inventory items required to complete work order tasks.
- **Warehouse Item Analysis** - An analysis of warehouse items. A warehouse item describes a catalog item as stored at a particular warehouse.

Weather and Storm

- **Storm Area Impact Analysis** - An analysis of areas with outages caused by storms or otherwise impacted by storms.
- **Storm Outage Forecast Analysis** - An analysis of outages forecasted for storms compared to actual outages caused by storms.
- **Weather Alerts Analysis** - An analysis of the weather alert accuracy that focuses on the comparison of issued alerts and confirmed actual impacts of event to alerted areas.
- **Weather Forecast Analysis** - An analysis of the weather forecast accuracy that focuses on the comparison of forecasted and actual measurements that describe the weather conditions.
- **Weather Analysis** - An analysis of measurements that describe the weather conditions.
- **Weather Impact on Asset Failure Analysis** - An analysis that focuses on the influence of weather on the number of asset failures.

Work Management

- **Asset Maintenance Analysis** - An analysis that focuses on asset maintenance. The analysis captures measures that are specific to the maintenance type of the work.
- **Asset Work Resource Cost Analysis** - An analysis that focuses on the variety of cost of the work that is based on the type of resource that is consumed or used in the assessed period.
- **Asset Work Labor Analysis** - An analysis that focuses on the labor information that is recorded for the work on asset. The analysis examines overtime and unplanned labor as well as the relationship between the labor and the contracted work.
- **City Gate Maintenance Analysis** - An analysis that focuses on the maintenance work carried out on the assets in city gate facilities.
- **Crew Availability and Utilization Analysis** - An analysis of the hours that the crew is available for work and the efficiency of the crew labor planning and crew utilization.
- **Crew Outage and Readiness Analysis** - An analysis that combines forecasted outages and forecasted number of customers impacted by outage with crew available hours in the assessed period and location.
- **Engineering Accuracy Analysis** - An analysis of the design and planning of a type of work task. The analysis focuses on comparing the task template standard resources with resources planned and resources actually used for tasks. Resource types include labor, contractor work, material, equipment (tool) and asset.
- **Gas Emergency Work Analysis** - An analysis that focuses on the gas emergency work orders. The analysis captures measures that are specific to the leak, fire and carbon monoxide related emergencies occurred in the assessed period.
- **Gas Inspection Job Analysis** - An analysis that focuses on gas network inspections, and work arising from the inspection results.

- **Hold Analysis** - An analysis of the holds that prevent the work from continuing. The analysis shows the holds that are active or were created or removed in the assessed period.
- **Project Financial Analysis** - An analysis of the financial status of a project. The overall project can be undertaken by more than one subcontractor.
- **Service Disconnection Work Analysis** - An analysis of the completed jobs related to fieldwork involved in customer service disconnections and reconnections.
- **Standard Unit Analysis** - An analysis of the task type templates with the focus on standard material quantity and standard labor duration.
- **Task Planning Analysis** - An analysis of the planning of a type of work task. The analysis focuses on comparing the planned and actual task start and completion date and the labor duration that is associated with the task execution.
- **Work Cost Budget and Forecast Analysis** - An analysis that focuses on the cost of work that is budgeted, forecasted or actual in the context of the assessed period. The work cost can be recorded at the level of task, work order or project. The individual cost items that are collected from multiple sources, and can be used for costs that are standard, budgeted, forecasted, planned and actual.
- **Work Order Completion Analysis** - An analysis of the work order completion that focuses on the number of work orders, the duration of the work and accuracy of work planning for the completed work.
- **Work Order Dispatching Analysis** - An analysis that focuses on the performance that is related to the dispatching and resolution of unplanned work.
- **Work Order Scheduling Analysis** - An analysis of the scheduling of a type of work order. The analysis captures the number of work orders that are created and scheduled, and includes the number of measures that are based on the work status changes.

Deploying

Typically, data structures are not available or accessible to create a broader, innovative analytics data warehouse or business intelligence platform. Current investments in analytics platforms which were designed to support solely regulatory and quality reporting have started your journey, but they are often engineered and optimized for that purpose.

As you move from current tactical needs into the future the data access and consistency across the systems that capture and manage customer, product and operations data will probably not speak the same language.

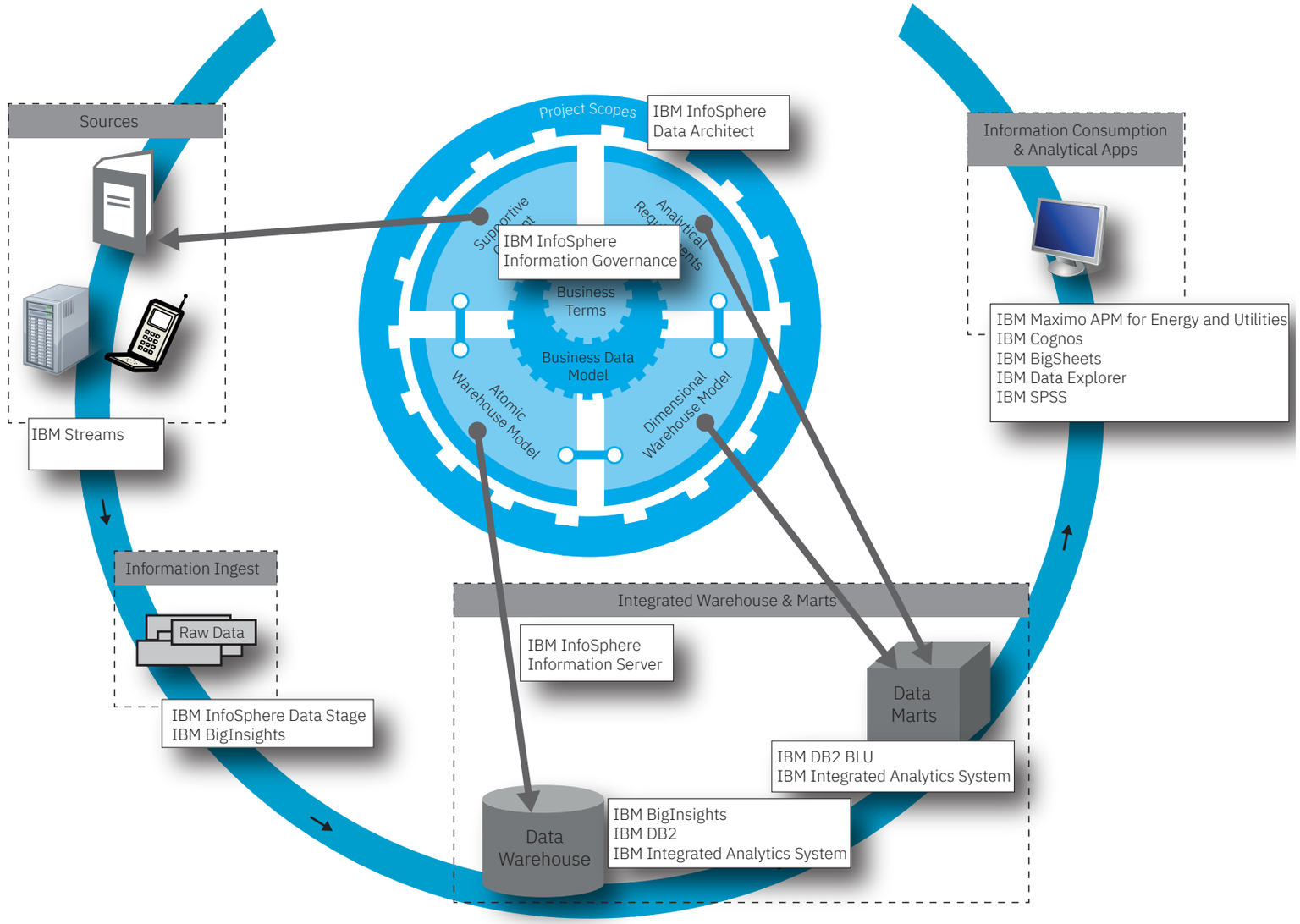


Figure 2. Typical implementation architecture and associated IBM software products

More specifically:

- The data you need is available across more than one application but the data cannot be joined across systems that collect the information. The same data elements may be defined inconsistently, or you may not even have insights into the database - and a significant normalization exercise is necessary to align the data definitions that you can run analytics against.
- The same data elements may be defined inconsistently, or you may not even have insights into the database - and a significant normalization exercise is necessary to align the data definitions that you can run analytics against.
- You do not want to place your agility and ability to innovate in the hands of a single software component - you want to leverage the value those solutions provide - but keep your options open and flexible to implement new scenarios, data sets and analytics as you need them.

Building a data management infrastructure is a complex team effort, requiring contributions across multiple department heads, business analysts and data architects. Establishing a common terminology and target model designed for current and future analytics needs can be an expensive and time consuming effort requiring new resources and skills you may not have in house today dedicated to supporting future programs. Often those resources are tied up supporting day to day operational and planning for tactical initiatives.

A data warehouse is a central repository of summarized data from disparate internal operational systems and external sources. Operational and external source data is extracted, integrated, summarized and stored in a data warehouse that can be accessed by users in a consistent and subject-oriented format. Data organized around business entities is more useful for analysis than data committed to applications that support vertical functions of the business.

A data warehouse provides systems of insights rather than systems of record. Users wishing to gain insight can access many records per transaction, while system of record users can only access one record at a time. Analytical users rarely update data and can cope with response times that are not instantaneous, while system of record users constantly update individual records and expect sub-second response times. A system of insight supports analytical queries against data, representing an organization’s state at a specific point in time or over a period of time, since support of history is a key element of data warehousing. This type of tool also allows users to drill down to the summarized information for further detail.

The data warehouse is a single source of consolidated data that provides an enterprise-wide view of the business that becomes the main source of information for reporting and analyzing data marts that are usually departmental, line-of-business-oriented or business-function-oriented.

The data warehouse overcomes limitations of older style decision-support systems:

- Complex, ad-hoc queries are submitted and executed rapidly because the data is stored in a consistent format
- Queries do not interfere with ongoing operations because the system is dedicated to serving as a data warehouse
- Data is consolidated from multiple sources, enabling organization by useful categories such as customer or product.

The data warehouse holds data about the business that can be used as the basis for supporting a detailed analysis of the areas of most concern to organizations today. This allows organizations to exploit the potential of information previously locked in legacy systems inaccessible to the business user.

The data warehouse promotes an open architecture in which each component adheres to industry standards. This allows organizations to implement the data warehouse using existing tools or preferred tools.

The physical environment of the data warehouse provides organizations with a physical data warehouse infrastructure that is tightly integrated with the logical environment incorporating both the data warehouse model and Analytical Requirements. Organizations can automatically generate the required data structures for a full data warehouse physical environment.

Analytical Requirements provide the basis for the design of physical structures that support OLAP analysis, such as star schemas. Analytical Requirements provide substantial domain expertise to fast start projects, assisting in bringing them to rapid implementation and benefits realization.

The use of the data warehouse enables enterprise-wide standard definitions and consistency for all business intelligence data, while delivering this data across the organization on consolidated or multiple platforms.

This allows for lower-cost maintenance and centralized control of all data, while retaining the flexibility to enable users to select their preferred analytical applications for ease of use, preformed reports or complex analytics capabilities.

IBM Maximo APM for Energy and Utilities

IBM Maximo APM for Energy and Utilities brings together in one solution a core set of capabilities and building blocks for new analytic applications. IBM Maximo APM for Energy and Utilities enables operational excellence improvements such as reducing asset failures, improving asset utilization, optimizing network availability, decreasing loss of service and potentially reducing costs.

IBM Maximo APM for Energy and Utilities is a data management, visualization and analytics software solution that includes a broad range of pre-integrated analytic technologies. It also is a foundation for an ecosystem of new analytic applications from IBM and partners.

IBM Maximo APM for Energy and Utilities and IBM Data Model for Energy and Utilities are designed to work together to address key components of the new overall analytics landscape.

DMEU is designed to provide the basis for the data warehouse component that provides the central consolidation point the different types of data coming into this new analytics landscape. DMEU is designed to address the definition both of traditional data warehouses as well as additional unstructured stores that both need to be managed in consistent fashion. It also designed to provide the basis for business issue-specific data marts.

IBM Maximo APM for Energy and Utilities provides the downstream integrated platform for the management of the various advanced analytical needs. The role of the DMEU-derived data warehouse as the central consolidation point for data for use across this analytics platform is very complementary with the specific IBM Maximo APM for Energy and Utilities focus on the delivery of advanced analytical insights into that data.

IBM Predictive Customer Intelligence

IBM Predictive Customer Intelligence personalizes the customer experience by making recommendations that are most relevant to each unique customer based on their buying behavior, web activity, social media presence and much more.

Using automation, this integrated software solution gathers customer information from multiple internal and external sources and models customer behavior. Scoring then provides you with customized actions you can take to provide the right offer to the right customer at the right time.

As with IBM Maximo APM for Energy and Utilities, PCI and IBM Data Model for Energy and Utilities are designed to work together, with DMEU providing the central consolidation point for the different types of data and PCI providing an integrated platform for the management of advanced analytical needs.

Deploying with IBM Analytics software

IBM Streams is an advanced analytic platform that allows user-developed applications to quickly ingest, analyze and correlate information as it arrives from thousands of real-time sources. The solution can handle very high data throughput rates, up to millions of events or messages per second.

IBM InfoSphere Information Server is a data integration platform that helps customers understand, cleanse, transform & deliver trusted information to business initiatives including business analytics and data warehousing. IBM InfoSphere DataStage® integrates data across multiple systems using a high performance parallel framework, and it supports extended metadata management and enterprise connectivity.

The scalable platform provides more flexible integration of all types of data, including big data at rest (Hadoop-based) or in motion (stream-based), on distributed and mainframe platforms.

IBM InfoSphere BigInsights® brings the power of Hadoop to the enterprise. Apache™ Hadoop® is the open source software framework, used to reliably managing large volumes of structured and unstructured data.

IBM Integrated Analytics System provides simple deployment, out-of-the-box optimization, no tuning and minimal on-going maintenance. It is a purpose-built, standards-based data warehouse appliance that architecturally integrates database, advanced analytics, server and storage into a single, easy-to-manage system that offers significant performance and scalability.

IBM DB2® provides scalable database server software to handle the demanding workloads of large and midsize enterprise servers. It delivers high performance across multiple workloads, while helping to reduce administration, storage, development and server costs.

IBM DB2 with BLU Acceleration combines advanced, innovative capabilities to accelerate analytic workloads for databases and data warehouses. It also integrates with IBM Cognos® Business Intelligence to provide reporting and deeper analysis. You can analyze key facts and freely explore information from multiple angles and perspectives to make more informed decisions.

IBM InfoSphere Data Architect is a collaborative data design solution that helps you discover, model, relate, standardize, and integrate diverse and distributed data assets. It can be used to manage and extend the Models.

IBM InfoSphere Information Governance Catalog enables the creating and managing an enterprise vocabulary and classification system, with ready to use industry standard terms and definitions.

IBM business analytics software, such as IBM Cognos, IBM BigSheets, IBM SPSS®, Watson Content Analytics, and IBM Data Explorer, uniquely enables your organization to apply analytics to decision-making, anytime, anywhere.

IBM InfoSphere Master Data Management manages master data for single or multiple domains – customers, patients, citizens, suppliers, locations, products, services offerings, accounts and more – for improving application & business process effectiveness. IBM InfoSphere MDM Reference Data Management Hub is a powerful, high value solution for centrally managing and distributing reference data across the enterprise. It extends IBM's InfoSphere MDM portfolio with a built-for-purpose, ready-to-run hub and stewardship application for managing reference data.

[1] Notice: Clients are responsible for ensuring their own compliance with various laws and regulations, including the European Union General Data Protection Regulation. Clients are solely responsibility for obtaining advice of competent legal counsel as to the identification and interpretation of any relevant laws and regulations that may affect the clients' business and any actions the clients may need to take to comply with such laws and regulations. The products, services, and other capabilities described herein are not suitable for all client situations and may have restricted availability. IBM does not provide legal, accounting or auditing advice or represent or warrant that its services or products will ensure that clients are in compliance with any law or regulation.

IBM Corporation
IBM Anlaytics
Route 100
Somers, NY 10589

Produced in the United States of America
December 2019

IMB14176-USEN-06