IBM

# Discovering the Business Value Patterns of Chemical and Petroleum Integrated Information Framework

Achieve optimized integrated operations

Reduce cycle time, reduce expense, optimize resources increase

Increase performance, increase production

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International Technical Support Organization

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This edition applies to IBM WebSphere Business Modeler v6.2, IBM WebSphere Integration Developer v6.2, IBM WebSphere Process Server v6.2, Chemical and Petroleum Integrated Information Framework v1.3, WebSphere Application Server v7.0, IBM WebSphere Enterprise Service Bus v6.2, WebSphere Message Broker v6.1, and WebSphere Partner Gateway v6.2.

# Contents





 

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# Preface

This IBM® Redbooks® publication is a comprehensive service-oriented architecture (SOA) offering that is designed to extend the IBM Business Process Management platform to deliver flexible composite business applications.

In this book, we provide the complete overview of the chemical and petroleum industry and solutions provided through C&P IIF that can help overcome the business challenges through value identification.

This book covers the business and functional architecture of the chemical and petroleum industry. In particular, this book provides a market segmentation of the petroleum industry and how IBM C&P IIF can lead to better productivity and profitability. This book is for an audience that include chemical and petroleum industry professionals, business and functional architects who are looking for ways of improving efficiencies and operating margins.

IBM C&P IIF provides a strategic advantage to the chemical and petroleum industry by reducing costs and increasing revenues.

## The team that wrote this book

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# Introduction

Based on the IBM® 2008 Global CEO study, results show a need for a business to be able to respond quickly to market dynamics. This is seen both at the business and IT level. Yet, the ability to implement these changes quickly is not there. The reason that businesses cannot change quickly is the current IT environment is not built for change. Business applications have been purchased or built over a period of time to solve individual issues.

These applications are not easily changed, and adding additional applications just makes the integration problem worse. The ability to make changes to the process quickly is the key. It is not the specific changes that are important, but the fact that you have planned ahead for change and can make these quickly to achieve business agility. Flexible business requires flexible information technology (IT). Think about your business in terms of components, optimize a business process, and ensure you have the IT resources to support the flexibility you need. It has been said before but it bears repeating: Your business is only as flexible as your information technology. IT supports everything your company does and if your IT cannot change quickly and cost effectively, neither can your business. And with the rate of change of today's business, you cannot afford inflexibility.

First, you can start with a full business view. Break your business into components and decide which components set your business apart and are cost effective for you to own. Then, you can optimize the support of the prioritized processes by distributing them among the best service providers including

outsourcing the service. The third part is deciding what kind of IT infrastructure, software, skills and support you need to make this a reality. Service-oriented architecture (SOA) bridges this gap and allows you to use existing IT investments and achieve the flexible, distributed business processes we discussed.

## SOA makes it possible for IT organizations to keep pace with the needs of the business

The marketplace, the press, and the analysts are recognizing the tremendous power of SOA to do what no other technology has been able to accomplish, which is align IT and business. In fact, this alignment is the premise behind SOA. SOA holds the promise of allowing IT to deliver solutions when the business needs them in a matter of weeks, not years.

SOA is, by definition, an architectural approach to business process design and implementation. At the same time, SOA is an approach to IT that can help solve immediate business challenges. SOA can begin paying for itself quickly. For example, many businesses are unaware of the number of duplicate processes that occur in separate departments and applications, and how much these duplicate processes are costing them. When you examine the costs and lost revenue attributable to redundant functions and duplicated effort, you begin to see the value of centralized services over having to manage multiple competing and overlapping functions.

Most industries have numerous applications deployed across the enterprise at both the business and production levels, each with its own unique reference and data model. The result is an incomplete and often inconsistent view of operations, which can make the task of ensuring assets are efficiently managed and maintained that much more challenging. To drive profitability, industries need innovative processes and business models to help improve operational efficiencies and reduce the cost of doing business. The industries need help to enable the type of business innovation that allows organizations to increase production yield while lowering maintenance costs, with comprehensive tools and processes that can help bring quality, profitable products to market and synchronize supply and demand.

As enterprises increasingly connect their critical industrial or production assets to the IT infrastructure, the lines between IT and enterprise asset classes are beginning to disappear. Industries need end-to-end visibility across each of the assets that comprise operations, a unified solution that can offer a way to understand and control how their systems are operating and meet demanding security and compliance requirements.

As part of an effective business and IT integration strategy, the solution needs to focuses on the visibility, control, and automation needed to answer the challenges of providing superior operations, as follows:

- Visibility
  - See business in real-time and gain an understanding of systems, assets and operations.
  - Deliver real-time insight and access rich historical reports.
- Control
  - Govern organization and minimize risk.
  - Integrate assets across business and IT to reduce risks to services and your corporate reputation.
- Automation
  - Accelerate tasks and processes.
  - Build greater agility into operations and speed service delivery by reducing manual intervention.

Industries need a solution that can support the most pressing needs, including operating margins, asset management for both operational and IT assets, creating more efficient processes to drive quality and performance, and meeting safety and compliance requirements.

Many organizations have critical operations information scattered across disparate systems, applications and departments. Few common definitions or standards exist. Offshore applications and other applications often have different configurations of data and data naming conventions. Each application has its own unique reference and data model, and there can be millions of process tag information entities that are not conveyed in the context they represent. The industry needs a comprehensive integrated framework, like the one shown in Figure 1-1 on page 4.

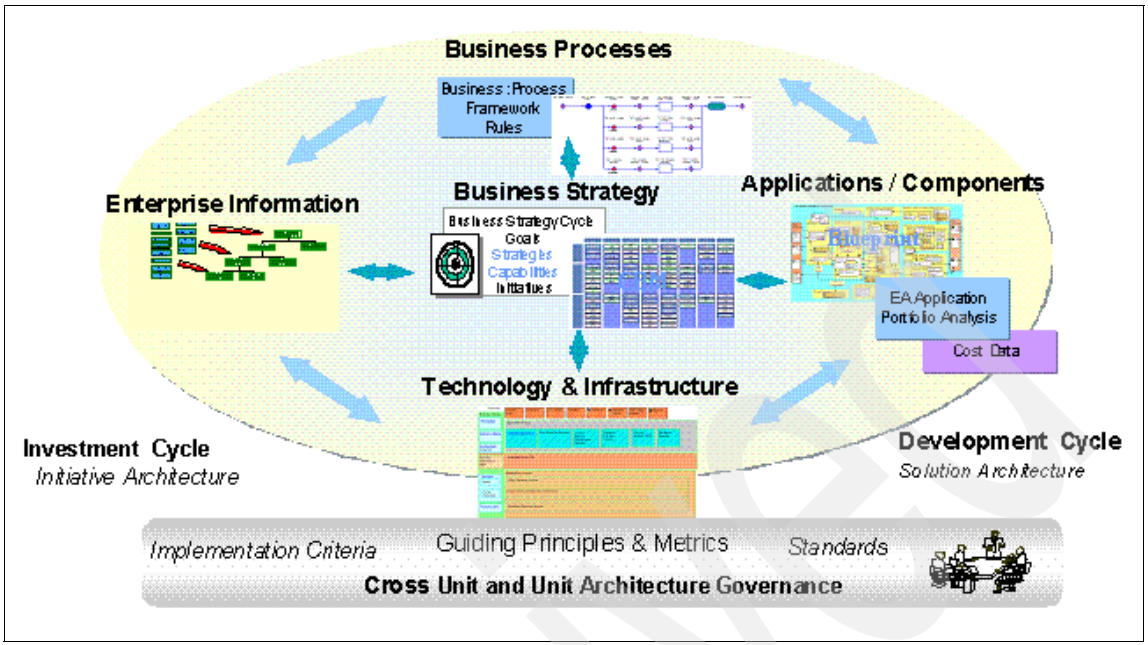


*Figure 1-1 Integrated framework*

The role of technology in supporting the efficient production of hydrocarbons, and hydrocarbon-based products since the advent of the modern age of upstream petroleum, could not be over-emphasized. Research and technological developments have led to the increase in recoverable reserves.There has been a phenomenal increase in the levels of oil and gas recovery because of thousands of incremental technological advances and breakthroughs in development, exploration, and production.

Unprecedented, innovative technological and scientific breakthroughs are the reasons for the significant improvement now being experienced in drilling technology. From the initial depth of about 70 feet, drilling now occurs several miles below the surface, vertically, horizontally, and multidimensionally. Improved technology has wrestled more hydrocarbon resources from the tight grip of unforgiving terrains, which just few years ago were impenetrable.

Technological advancement has propelled petroleum science to an elaborate client-server based calculations where the subsurface could be viewed in four dimensions (4D). The drilling process is no longer a guessing game but a precise targeting of the smaller pockets of fields that are currently producing oil and gas, as well as areas that have never produced any oil.

Innovation and technology has supercharged the chemical and petroleum industry. The way and manner in which oil and gas reserves are identified, developed, and produced has been dramatically altered. Environmental protection and natural resources conservation have been improved because of these innovative, technological advancements. The risk associated with oil and gas exploration has been greatly reduced.

Perhaps the critical factor that led to the embrace and adoption of technology is the percentage increase in oil and gas recovered from existing oil reservoirs. This enhanced recovery of natural resources brought about by technology is considered an economic motivator because it translates into increased revenue for company owners and tax authorities.

Cost reduction by way of crew reduction and improved safety conditions were made possible by technology. Improved relations with surface owners is being experienced, an important improvement. Even though these new technologies require heavy investments, initially, the result of faster, more effective and efficient resource allocation and net economic gain is worth the investment.

Products of innovative research in oil and gas technologies are often destined for hostile, hard-to-reach environments, or in the high temperature and high pressure environments encountered at the bottom of a well. They are therefore subjected to rigorous testing before the market accepts and adopt them.

Efforts are now directed at investing in technological and innovative research in unconventional resources as conventional resources are developing. This does not reduce the critical importance of continuos innovation in conventional development, exploration and production.

A typical exploration and production sequence of activities, with the components, is illustrated in Figure 1-2 on page 6. It is comprised of remote operations for seismic data interpretation, and collaboration with engineers who are building and installing production facilities.

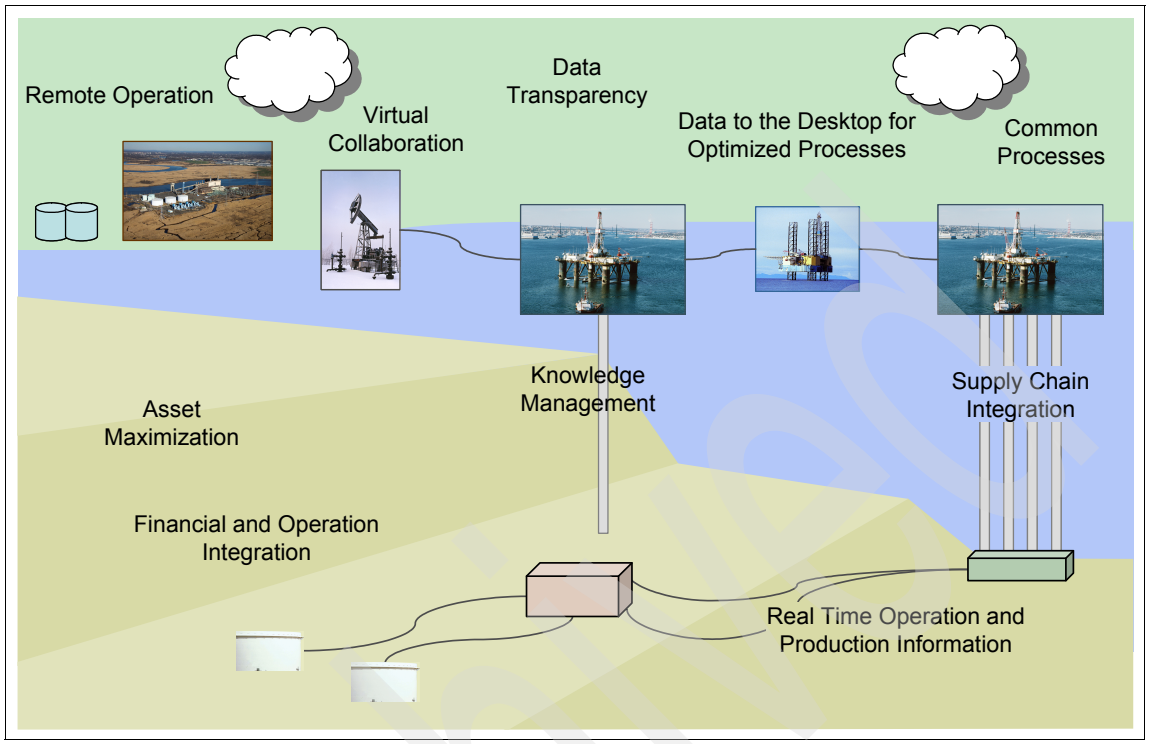


*Figure 1-2 Real-time oil and gas exploration and production sequence of activities*

IBM is providing new software solutions, built upon SOA to help clients redefine and improve their existing business processes. The ability to manage their business processes proactively allows leaders to align their businesses better and make smarter decisions. This can help reduce overall business costs and make a business more responsive to changes in the global marketplace. The main constituents of the solution are as follows:

- People

  Employee productivity, operational efficiency, and the ability to innovate on the fly are paramount to competitiveness and growth. Companies frequently struggle with non-integrated applications and information that prevent customers, employees, and partners from working together effectively. Empowering people through SOA solutions can bridge these challenges and provide a foundation for greater productivity and collaboration. Because people drive the interaction with the SOA services that execute business results, focusing on people is critical to the success of SOA implementations.

This people enablement strategy to SOA can help in the following areas:

- Accelerate productivity, reliability, and safety through new business process support.
- Reduce costs for access to multiple applications and information sources.
- Reduce time to deployment for new services.
- Increase access to process flexibility and orchestration.
- Enable collaboration inside and outside the enterprise.

► Process

Do your processes allow you to respond quickly to changing market conditions? By streamlining your processes you can align your business and IT goals, reducing the complexity of building processes. Using SOA with a focus on process can help your business in the following areas:

- Improve employee productivity.
- Increased collaboration.
- Accelerate speed to market.
- Respond quickly to business challenges.
- Implement new processes in less time.
- Maximize return on investment.

► Information

Establish information as a service to ensure consistent definitions, packaging, and governance of key business data. Provide information services that can be easily reused across processes and independently maintained to enable more business flexibility and increase IT resource productivity. This element of SOA strategy can help in the following areas:

- Collect, clean and make your data accessible:
  - Develop a unified view of their business with inline access to analytical data for improved transparency and business insight.
  - Generate and govern authoritative master data records with shared metadata and data quality services for master data management.
- Reduce cost and risk
  - Reduce costs associated with infrastructure rationalization and migration by decoupling information from siloed information sources.
  - Reduce risk exposure through in-line analytics and auditable data quality for risk and compliance initiatives.

- Increase your organizations agility
  - Increase the agility for business transformation by providing reusable information services, spanning structured and unstructured information that can be plugged into applications, business processes, and portals. At the same time lower development costs associated with accessing and transforming data.

- Reuse

  Improve efficiency. Reduce risk. Cut cost. The IBM entry strategy to SOA through service creation and reuse can help in the following areas:

  - Reduce the amount of new code that must be created for business initiatives.
  - Lower maintenance cost by eliminating redundant systems.
  - Expedite the roll-out of new business functions by creating composite function from within your applications.
  - Integrate tasks performed by your existing applications into broader business functions to establish a simple and effective means to enhance usefulness of mainframe-based systems.

- Connectivity

  For a business taking its steps into SOA, opening your doors to customers and partners as a way to interact easily with your company is of high importance. Enabling exceptional connectivity through your SOA can deliver a consistent user experience regardless of what business channel they choose. Also, by linking your own business units or divisions across the multiple parts of your company, you can build a foundation for success and benefit from the agility of a SOA approach. IBM entry strategy to SOA through service connectivity can help in the following areas:

  - Ensure seamless flow of messages from anywhere at anytime using anything.
  - Execute broad business processes that span your company and out to business partners.
  - Build trusted relationships with existing and new partners.
  - Scale your business to become more flexible and dynamic.
  - Deliver a consistent user experience regardless of channel or device.
  - Simplify existing applications to focus on business logic instead of connectivity.
  - Increase access to existing functions without changes to applications.
  - Reduce the maintenance needed when your business changes.

Today's organizations rely on IT to provide the data and capabilities to overcome operational disconnects, unnecessary risk, and incomplete decision making. IBM Chemical and Petroleum Integrated Information Framework (C&P IIF) can help optimize infrastructure utilization and availability through a flexible and configurable integration model, to help reduce costs and exploit new opportunities. Through visibility, control, and automation, these solutions can help address some of the biggest issues in the industry today and prepare for the challenges of tomorrow as follows:

- Visibility
  - View entire oil field, plant, or refinery metrics in a fast and intuitive graphical interface and drill down into operational details
  - Create and maintain consistent representations for equipment state, relationships, unit operations, measurement data, reports, vendor specifications, and more
  - Perform deeper and more sophisticated analysis of production and manufacturing operations viewing all key process indicators and measurements in the right business context, for both real-time decision making and operational planning
- Control
  - Monitor data and key process indicators based on thresholds and sophisticated historical models
  - Simplify massive real-time data based on configurable settings with events and alerts
  - Facilitate collaboration across field supervisors, process engineers, maintenance supervisors, and asset owners
  - Centrally manage security and audit policy for enforcement points
- Automation
  - Invoke predefined actions for both system-based processes and human interactions
  - Work with intelligent, predictive, sophisticated alerts that drive information and action to both human and system participants
  - Provide an open enterprise data and process automation integration framework for existing and new manufacturing applications

The components of the IBM Framework solution offer the following features:

- Track, monitor, and manage all critical assets, including IT, to support and improve asset availability, reliability, utilization, and performance
- Understand and evaluate interdependencies and risks between IT components and supported business processes
- Support high availability through comprehensive monitoring and event correlation.
- Protect data from failures and other errors by storing backup, archive, compliance, and disaster-recovery data
- Provide executive dashboard visibility.
- Ensure only authorized individuals can access project assets, from simple sign-on to more complex security infrastructure deployments.
- Automatically gather data from IT systems log files to analyze and report on policy exceptions.
- Offer IT threat management to help network and server infrastructure attack
- Monitor the Web services layer of IT architectures and drill down to application or resource layers to identify the source of bottlenecks or failures and pinpoint services that take the most time or use the most resources.
- Optimize performance and availability of the IT infrastructure. Through a single, customizable workspace portal, proactively manage health and availability of the infrastructure, including operating systems, databases, and servers, across distributed and host environments. Detect bottlenecks and potential problems in essential system resources and help recover from critical situations to ensure business-critical applications are up and running.
- Manage, identify, and access resources that span companies or security domains.
- Provide a secure, policy-based way to set up new accounts and passwords quickly for employees and customers.
- Offer a security information and event management (SIEM) platform designed to improve the effectiveness, efficiency, and visibility of security operations and information risk management.
- Deliver real-time, centralized monitoring of complex networks and IT domains.
- Help visualize the health of critical business services and associated service level agreements (SLA).
- Help increase operational agility by aligning IT operations to business priorities.

2

# Introduction to the chemical and petroleum industry

This chapter is an introduction to the chemical and petroleum industry. Introduction to the petroleum industry will be discussed first, details about the chemical industry will be discussed later in the chapter.

The petroleum industry is one of the world's largest and most important industries. Two-thirds of the world's energy comes from oil and natural gas. Not only are most industrialized nations' energy needs supplied by petroleum-based products, but about 30,000 different chemicals are petroleum-based.

## 2.1 Fundamentals of the petroleum industry

The petroleum industry is divided into three businesses, as shown in Figure 2-1 on page 13:

- Upstream business

  The upstream business comprises of exploration, development, and production.

- Midstream business

  The midstream business includes the tankers and pipelines that carry crude oil to refineries.

- Downstream business

  The downstream business includes refining, marketing, and distribution, down to the corner gasoline station or convenience store.

The petroleum industry with the help of the oil services companies, together are involved in four different types of functions:

- Exploration, development, and production
- Transportation
- Refining and gas processing
- Marketing and distribution

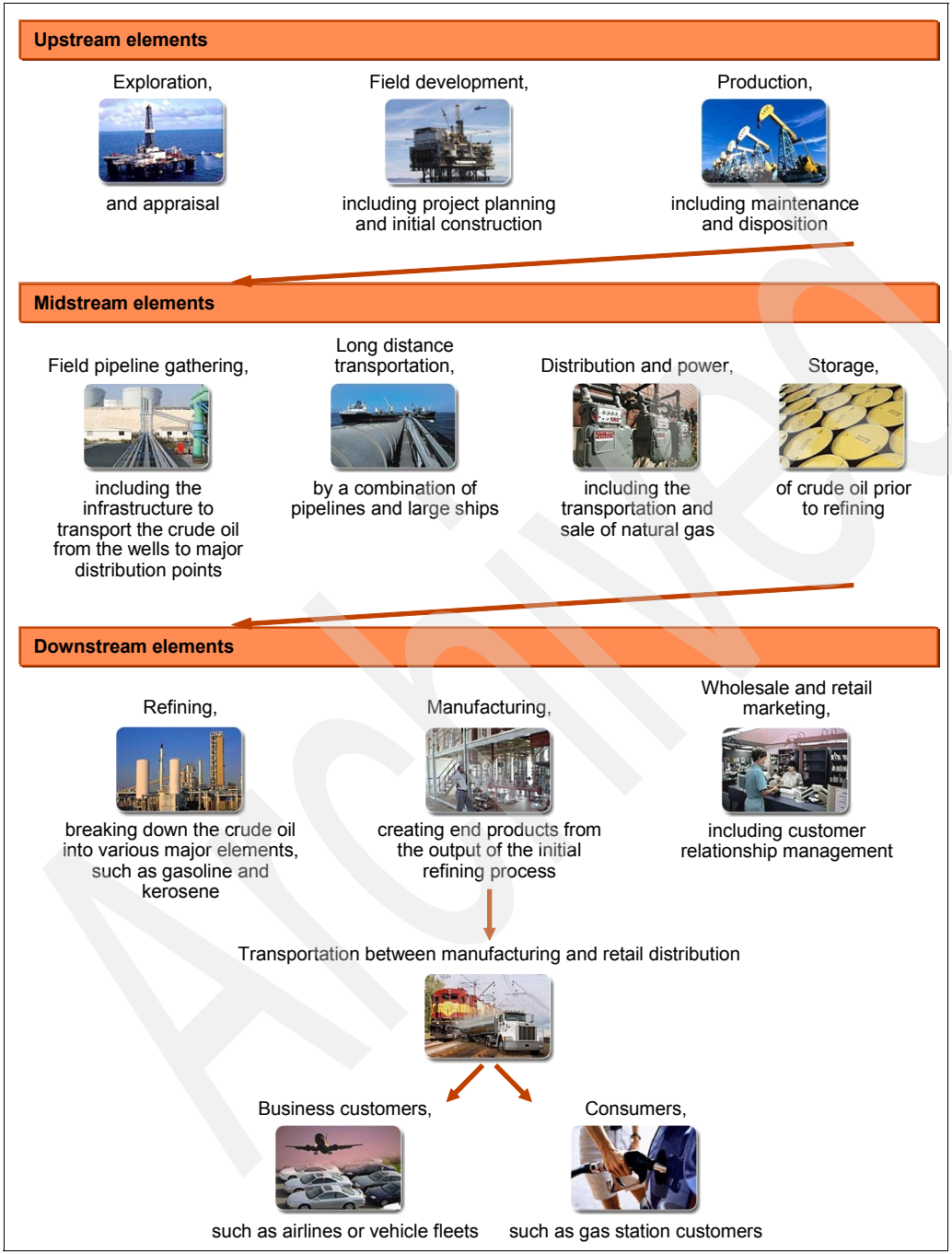


*Figure 2-1 Activities in oil and gas segments*

## 2.2 Industry segment

If an oil company combines significant upstream and downstream activities, it is said to be *integrated*. These large, integrated oil companies often have a chemicals business that uses hydrocarbons and by-products for fertilizers, plastics, and other products. Many smaller companies specialize in one or a few of the upstream, midstream, or downstream elements of the industry. Figure 2-2 is a pictorial representation of how the chemical and petroleum industry is segmented. This is often called the *value chain*.

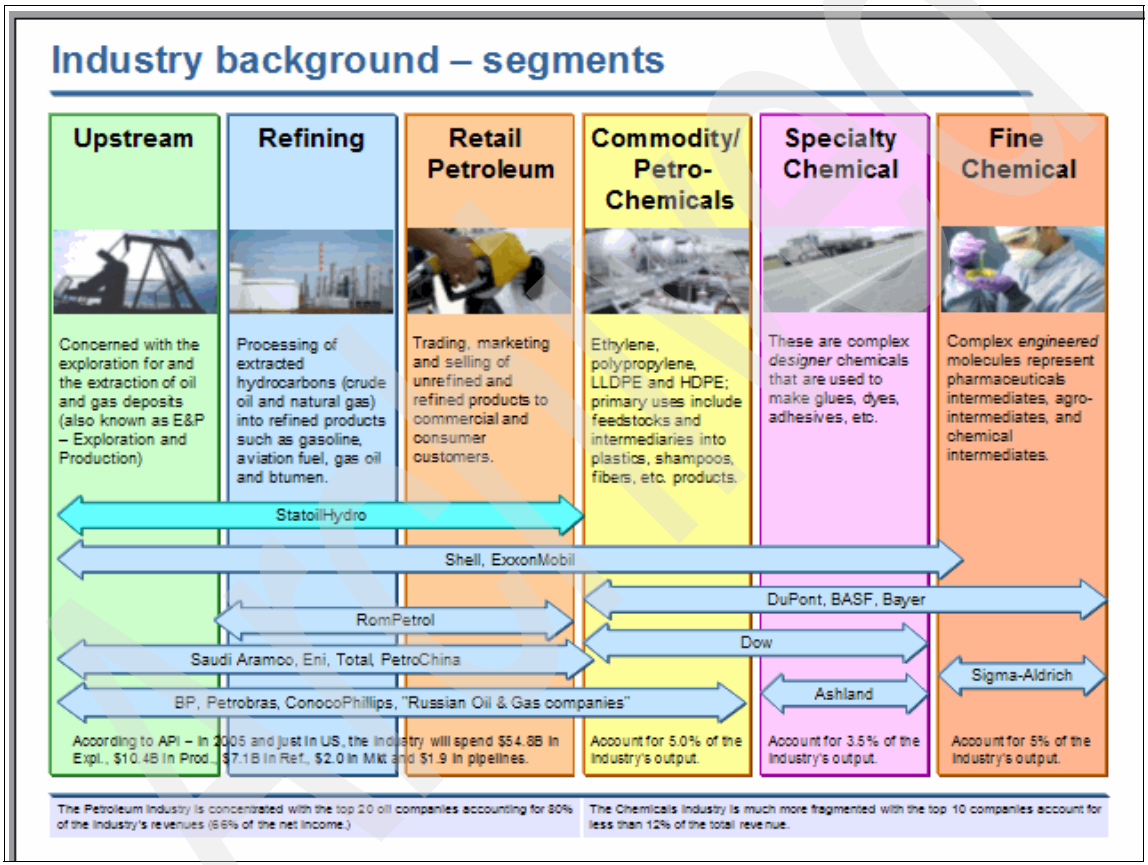


*Figure 2-2 Value chain diagram*

Other activities that go on in the oil industry segments are as follows:

- Upstream (development, exploration, and production)
  - Petroleum geology

    Principal activity done by petroleum geologists include the analysis of source rocks and reservoirs using special instruments.
  - Exploration technology

    Includes geophysical seismic data acquisition (3D and 4D) including sea floor data used for appraisal and development
  - Well drilling operations

    This is when the drilling engineer (as part of the technical crew of geologists, reservoir engineers, production engineers, facilities engineers) develops a plan for reaching the targeted oil and gas formation at the bottom of the hole, within a specified budget.
  - Reservoir drive mechanisms

    This is the physical movement of gas and liquids through the porous reservoir structure
  - Surface facilities

    A storage location for equipment like power generators, compressor, and so forth)
  - Offshore operations

    Drilling and production of oil and gas in areas of over 7000 feet deep and 200 miles from shore
  - Drilling rig schematic

    This is the detailed technical drawing of a particular rig type
  - Drill ship schematic

    The detail technical drawing of ultra-deep water drilling vessel
  - Well completion schematic

    Detail technical drawing of a completed well
  - Production surface operations schematic

    Detail technical drawing of active equipments in use in a production surface operations

- Midstream (gas processing and transportation):
  - Natural gas processing

    This is the elimination of water and other contaminants from natural gas, to enable it to meet specific quality requirements required by the high-pressure, long-distance pipeline
  - Waterborne movements of oil and gas

    Transportation of oil in double-hauled tankers across continents
  - Refined product shipments

    Movement of gasoline, automotive gas oil, kerosene and heating oils, in ships across the continent.
- Downstream (refining and marketing)
  - Refined products

    These are the products derived from various forms of refining, for example, kerosene, diesel, gasoline, aviation fuel, and so forth.
  - Refinery operations

    Separation of crude oil hydrocarbon molecules by distillation and other methods.
  - Refinery complexity

    This is the ranking of refineries according to their complexities using replacement costs and relative value addition ability.
  - Refined product marketing

    Refined products are moved from the refineries by pipelines, tankers, and tank trucks to retail service stations for marketing.
  - Gasoline marketing

    Gasoline marketing is characterized by low margins, low profitability, and high probability of inability to recoup investment.
  - Refinery flowsheet

    Refinery flowsheet simulates the chemical process that happens in different units of a refinery but does not provide the needed reaction data.

## 2.3 Fundamentals of chemical industry

The chemical industry is one of the largest and most diverse industries in the world. Although large companies such as Dow and DuPont produce hundreds of chemicals, most companies specialize in a smaller number of product lines. The industry has thousands of companies concentrating in many segments and customer sets.

Although the thousands of companies that comprise the chemical industry are diverse in nature, they share many common attributes as an industry: It is asset intensive and depends heavily on a return on its assets. It is highly dependent on energy for transportation and processing and the cost of that energy becomes a key driver of profitability in the industry.

The global chemical industry represents a $2.5 trillion market growing at a long-term rate of 3% annually. The center of the business is currently in the US, but growth is focused in emerging markets, for example, China, India, and Japan

Europe and Japan, with growth in the Middle East and Northeast Asia, are starting to outpace other regions. India is rapidly becoming a key player in that geography. This shift is due to cheaper feedstock availability, differential rates of economic growth and environmental regulations. The chemical industry in the Asia Pacific region has been growing faster than the rest of the global chemical industry. From 1994 to 2005, production growth in the chemical industry rose significantly, with Europe leading the pace of growth.

### 2.3.1 Product segmentation

The chemical products are generally characterized as either commodity/bulk or find/specialty.

Commodity/bulk products are characterized as follows:

- *Bulk organic chemicals*

  Bulk organic chemicals derived from carbon or hydrocarbon sources (such as coal and oil). Included in this category are products such as benzenes, alcohols, methanes, anhydrides, and esters. These products are used in the manufacture of solvents, pesticides, fertilizers, and plastics.

- *Bulk inorganic chemicals*

  Bulk inorganic chemicals are those not containing carbon and carbon derivatives (excluding compounds such as carbon monoxide and carbon dioxide). Acids, alkalis, chlorine compounds, hydroxides, metallic compounds,

fluorides, and so forth. fall into this category. They are commonly used as raw materials for detergents, glass manufacture, water treatment, food preservation, and so on.

The Fine/Speciality chemicals are also often further defined into categories describing their basic natures:

- Specialty chemicals

  Specialty chemicals provide high-value performance in the production of other products. They are often shipped in drums, tote bins, or bags, and carry a higher price and margin than commodity products.

- Fine chemicals

  Fine chemicals are products such as reagents that are used in various higher-value formulations. Various industries depend on different chemicals for their manufacturing and packaging.

3

# Business challenges

The chemical and petroleum industry faces many challenges. The biggest of them is information visibility and accessibility. See Figure 3-1 on page 20.

The ability to make timely, smart business decisions about operations and production performance directly drives the overall effectiveness, efficiency, and production that comes from a plant, a field, and the equipment and assets supporting them. Unfortunately, in most chemical and oil production operations, the information needed to make these vital business decisions is often too little too late to be truly effective.

Production supervisors, engineers, and operators face many challenges getting the information they need. They do not have timely and contextual visibility of their field assets. They often have to perform their calculations in a piecemeal fashion as their data is delivered in different measurements and formats, with some information barely available at all. Critical business information may be delivered through crude alarms or belated reports, and often not in a context that promotes better understanding or action. Sharing information cross functional (collaboration) and cross location and acting on it is poorly supported by today's systems and architecture.

Figure 3-1 on page 20 is a collection and representation from various articles on the Internet, for example, *Gartner & Forbes* studies.

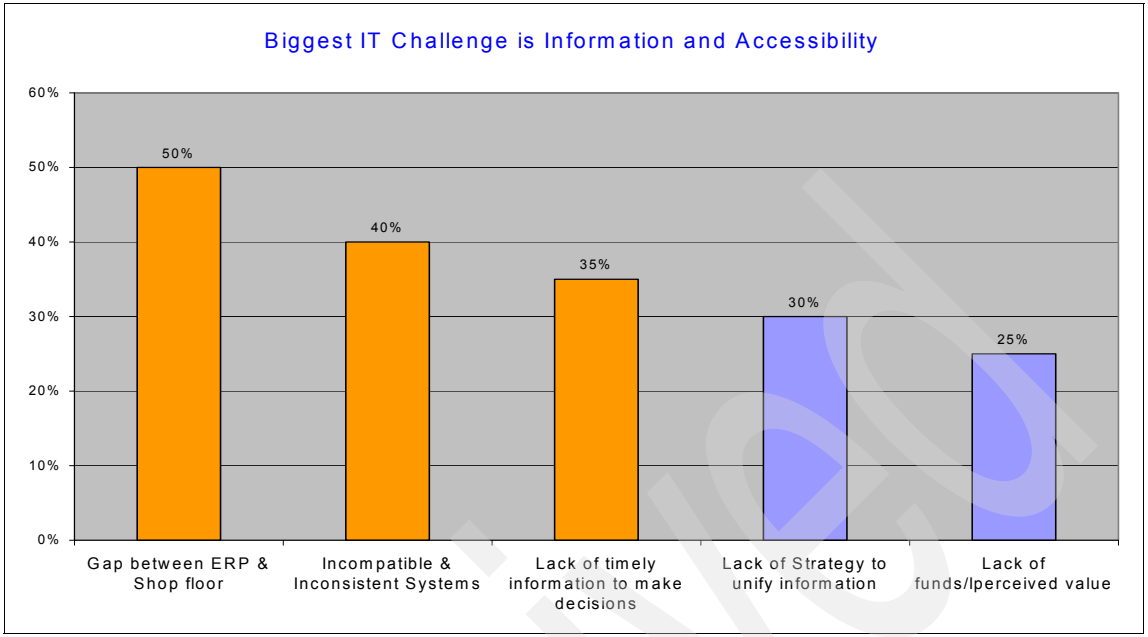


*Figure 3-1 The Biggest IT challenge is information visibility and accessibility*

Specific challenges are as follows:

- Numerous applications deployed across the enterprise at both the business and production levels to manage and record operations performance.
- Each application instance has its own unique reference and data model.
- Process tag information and its context to equipment is not conveyed in real time system integration, thus a heavy reliance on engineering interpretation.
- Process events, alerts cannot be easily defined, distributed, and subscribed to across the enterprise to initiate business processes or personnel collaboration or prompt attention.
- Production analysis calculations are done off-line, requiring data replication and are not accessible for reuse and access by dashboards, portals, KPIs, and so forth.
- Cross location and cross work process transactions and events are not captured in the context of equipment configurations or production relevant events.
- Operational views are incomplete. Overall analysis is sub-optimal and localized by the domain coverage of applications. Complex views spanning divisions/plants/process areas requires new application developments.

Integrating additional facilities or introducing new functionality is often difficult, time consuming and costly.

- Multiple vendor solutions in place are incompatible and inconsistent.
- Experiencing a high cost of maintaining equipment object models and tag mappings.
- Experiencing a high cost of on-boarding new and acquired plants or adding new functionality to existing plant applications.
- Cross-plant applications for performance and operations management are difficult to implement and maintain.
- Experiencing limited interoperability between applications correlated views of quality, operations, supply chain, and equipment performance and events.

To meet current market challenges and deliver sustainable bottom-line cost savings, the chemical and petroleum industry must embark on projects that yield significant return on investment (ROI) with short implementation lead time. See Figure 3-2.

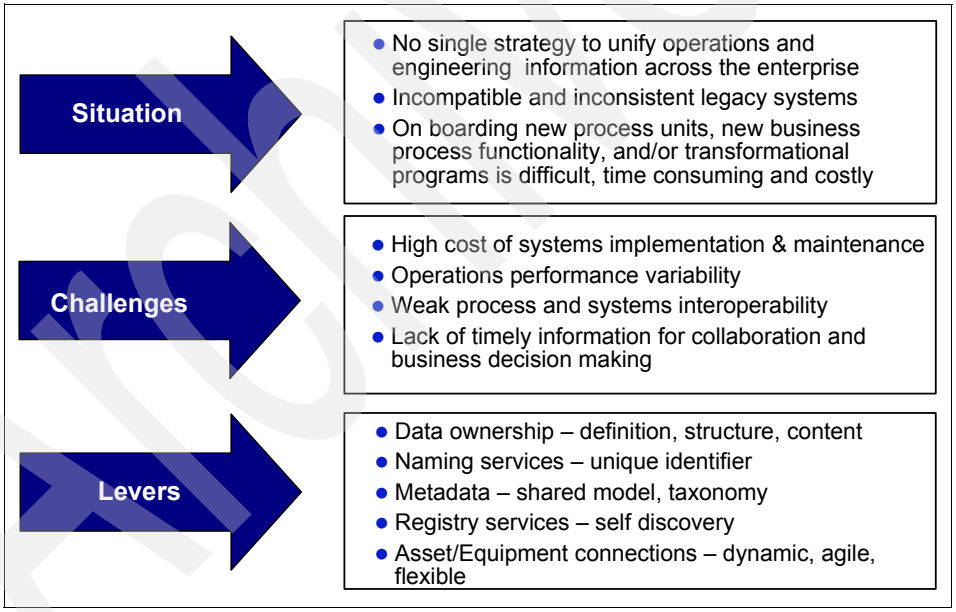


*Figure 3-2 The industry faces significant business integration challenges*

Many oil industry installations have disparate applications and configurations, processing tags, and data naming conventions. Standard applications and processes should be integrated for effective management and operations of

these installations. An IT architecture to support a fast and cost-efficient rollout of standardized applications and processes is a prerequisite for more effective integrated operations.

Lean, standard business processes help companies identify and realize improvements in the effectiveness, efficiency, and flexibility of their organizations.

The downstream segment of the petroleum industry is facing major changes in the marketplace because of factors beyond their control. New and innovative strategies need to be adopted to mitigate the changes. They need to adapt to external pressures through innovation to ensure growth and to maintain leadership position.

Downstream petroleum companies are becoming more focused on customer demand fulfillment and value chain integration in their drive to improve top-line growth. While downstream petroleum companies are focusing on growth, they are facing a major change in the industry landscape and will need to adapt to maintain a leadership position. Comprehensive integration of business and technology is imperative for the downstream petroleum industry to maintain competitiveness and enhance growth.

Downstream petroleum companies are lagging behind their counterparts in other industry segments in making use of collaboration and partnering both within the value chain and across the ecosystem. Downstream petroleum companies need to increase both the depth and the scope of their collaboration to gain strategic flexibility and focus on core capabilities.

Companies that operate multiple refineries have unique challenges. Downstream petroleum companies will need to develop new business models and enhance existing capabilities in order to manage the anticipated magnitude of change and increase shareholder value.

Additional factors include the emergence and growth of niche retail players, such as Wal-Mart in the U.S., Tesco in the U.K., and Coles Myer and Woolworths in Australia, which continue to push downstream petroleum companies to collaborate and partner with others to ensure growth.

Expansion of downstream petroleum companies through mergers and acquisitions has also led to ever more disparate business processes and technologies across organizations.

Pressure from companies in emerging markets and focus on operational cost reduction will continue to force downstream petroleum companies to re-evaluate and strengthen their core competencies.

## 3.1 Productivity challenges

The chemical and petroleum industry needs to create new work processes using new technology in support of safer, more reliable, higher yield operations and SCM/fulfilment, as depicted in Figure 3-3 on page 24.

Production and performance reporting needs to be enhanced by conducting deeper and more sophisticated analysis of operations, production, viewing all Key Performance Indicators (KPIs) and measurements in the right business context, for both real-time decision-making and operational planning. This provides a single access point for users to manage all applications, services, and functions across the enterprise using an intuitive, hierarchal, and visual interface.

This capability will enable production personnel to perform the following tasks:

- Visualize contextual oil field information. View the entire oil field in a fast and intuitive graphical interface where data from every sensor and machine is available in hierarchal levels of detail, ready for analysis and decision making.
- Create situational awareness and understanding to make better and faster decisions on factors such as production efficiency, drilling efficiency, or overall cost control.
- Obtain a single point of information access for the entire plant, production operation, well platform or field.
- Provide a defined synoptic (summary of the principal parts) or graphic for all aspects of operation in an area with drill downs to lower levels of an aggregated area to look at measurement details.
- Create and modify graphical displays to best fit business needs.


*Figure 3-3 Chemicals and petroleum firms must be innovative and agile*

## 3.2 Aging workforce challenges

Significant numbers of skilled workers are exiting the chemical and petroleum industry due to demographic patterns in this cyclical industry. The entire work force is aging and the industry needs to do something about it. The petroleum industry has many traditional companies with a relatively older work force. As that work force retires, these companies need to attract younger talent to their work force, and recruit new college graduates from universities globally in geo-science, chemical, and petroleum engineering. They also need to compress the seven years time to value for new engineers coming into the industry, or alternatively, they will need to do even more outsourcing.

## 3.3 Data management challenges

Real time operations are being made possible by the advent of massive amounts of sensing equipment in the overall hydrocarbon value chain. As a result, tremendous amounts of data are generated (Figure 3-4 on page 25), which

needs to be absorbed into the enterprise framework for further analysis. An automated process is therefore created where decision-making cycle time is reduced.

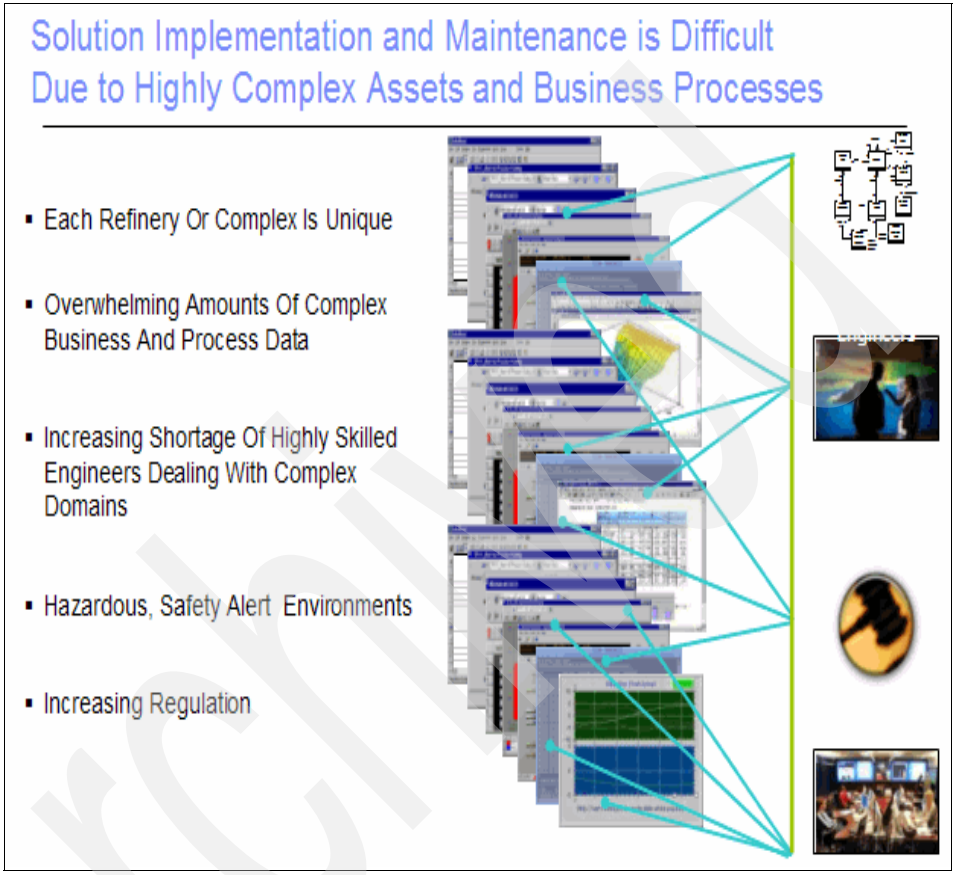


*Figure 3-4 Data management issues*

Operational data must be integrated with business data to create synergy, as depicted in Figure 3-5.

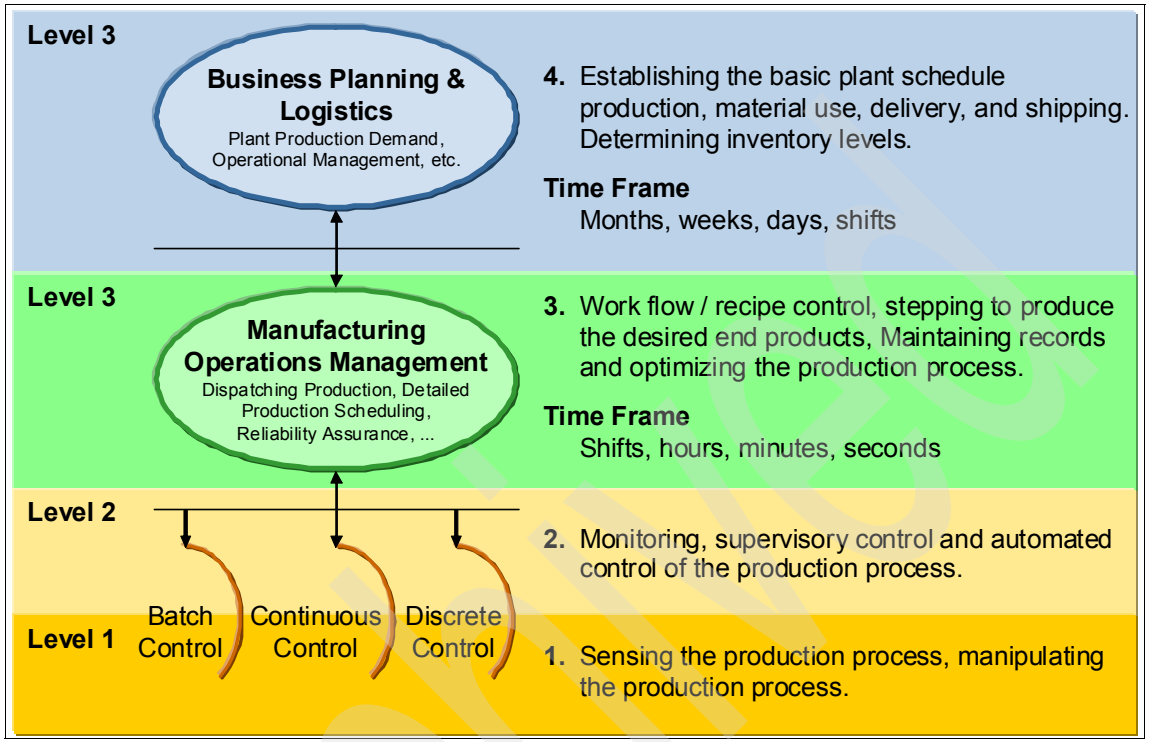


*Figure 3-5 Operational - Business Data Integration*

## 3.4 Information management challenges

The chemical and petroleum industry is faced with overwhelming amounts of complex business and process data, which are often not well-linked through structured and automated business processes:

- Data from the upstream sector applications (exploration and production), where engineers, geologists, and operators decide on the most efficient and economical action to take.
- Data from the midstream sector include extensive logistics and commercial information (exchanged data with other oil companies).
- Data from the downstream sector (marketing) is used to match supply and production planning to complex demand forecasting.

Conversion of this data into real-time information for decision making is a significant challenge. C&P IIF can help in solving this problem. (See Figure 3-6).

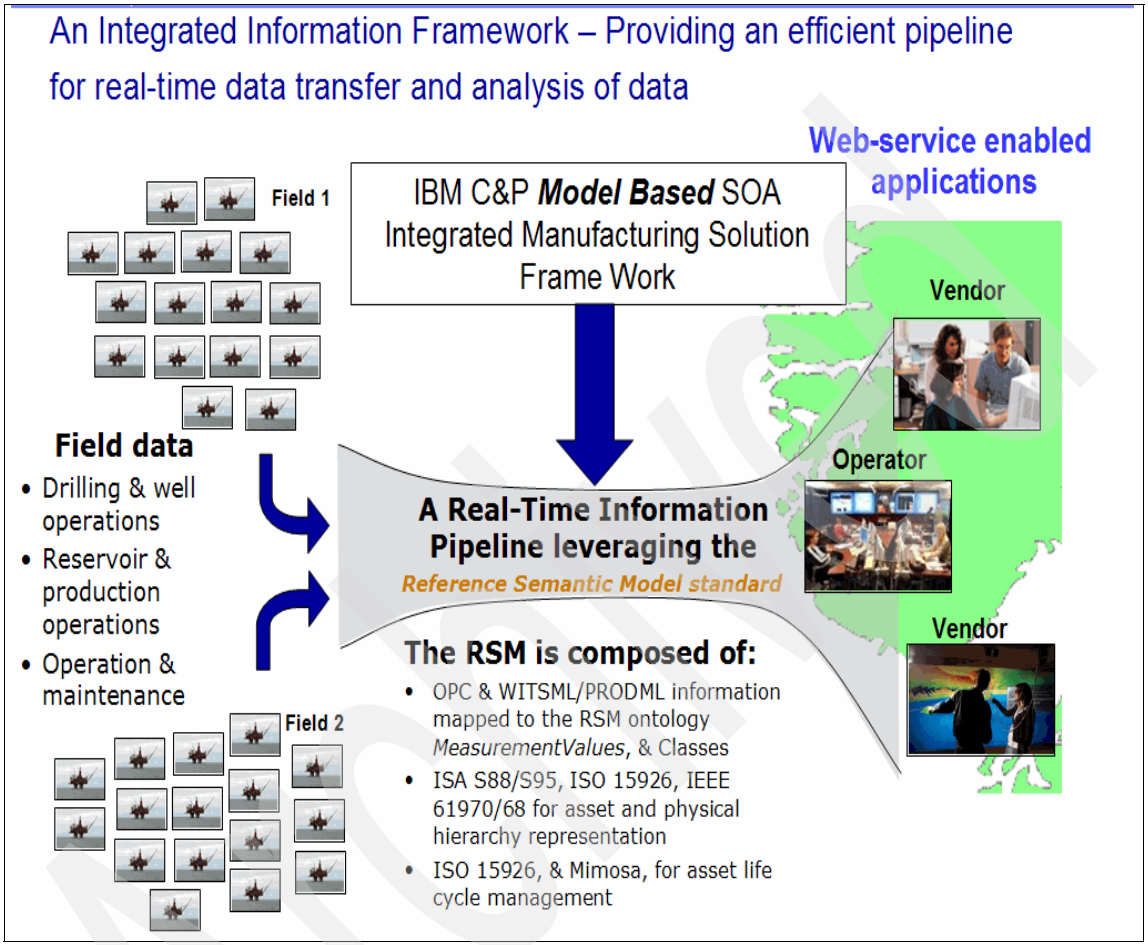


*Figure 3-6 Converting data to information*

## 3.5 Cost management challenges

As the exploration production environment grows more diverse and remote, the terrains are more unforgiving, and the business challenges are more complex. Development, exploration, and production costs are rising, by hundreds of billions of dollars in a decade. Therefore, more visibility into CAPEX and OPEX spending is essential to analyze costs effectively to develop programs to reduce cost, improve margin, drive compliance, and sustain benefits.

Financial objectives for a typical oil company are as follows:

- Increase production
- Reduce operating cost
- Contribute to improve health, safety, environmental performance
- Reduce equipment maintenance and improve performance-decision support solution
- Optimize facility turnarounds and reduce unplanned shutdowns

Downstream companies must achieve the above goals while manufacturing value adding products in similarly capital intensive operators. In downstream, the goal is to fulfill demand more flexibly, to gain higher product margin, by better supply and demand management, selling the right products for each market every day.

## 3.6 Process integration challenges

One of the most important challenges facing the chemical and petroleum industry is to provide an efficient collaborative environment. In Upstream, most of the development, exploration, and production projects involve many professionals and partners from the oil services companies, who are spread across a country or may even be located on different continents, working together on interrelated applications. The objective for cross functional team members is to make timely and accurate decisions by collaborating effectively. The specific challenges are as follows:

- Numerous different applications deployed across the enterprise at both the business and production levels to manage and record operations performance.
- Each application instance has its own unique reference and data model.
- Process tag information and its context to equipment is not conveyed in real time system integration, thus a heavy reliance on engineering interpretation.

- Process events, alerts cannot be easily defined, distributed and subscribed to across the enterprise to initiate business processes or personnel collaboration or prompt attention.
- Production analysis calculations are done off-line requiring data replication and are not accessible for reuse and access by dashboards, portals, KPIs, and so forth.
- Cross-location and cross-work process transactions and events are not captured in the context of equipment configurations or production relevant events.
- Operational views are incomplete. Overall analysis is sub-optimal and localized by the domain coverage of applications. Complex views spanning divisions/plants/process areas requires new one-off application developments. Integrating additional facilities or introducing new functionality is often difficult, time consuming, and costly.

## 3.7 Operational and financial challenges

Chemical and petroleum companies do not fully understand how to respond to the volatility in the cost of materials used in both the turn around maintenance and new construction of petroleum and petrochemical projects. They need to take a far more strategic approach to optimize the material elements of the large major capital projects (MCP) and turnaround maintenance. For example, ethylene crackers, furnace equipment repairs, and so forth.

One way to address that problem is through strategic sourcing in a supply chain. There are three main areas of challenge in strategic sourcing that require attention:

- Refiners need to understand the complex nature of the components that make up the material supply market.
- The factors that drive key component prices and how to track them, need to be fully understood.
- The need to develop strategies to manage better the sourcing process and drive down costs through the supply chain.

4

# Value identification

Today's economy is forcing chemical and petroleum companies to address complex issues to enhance shareholder value. Companies need to gain access to new reserves and improve recovery from existing reserves, and find ways to increase production levels while controlling operating expenses.

Value identification, as shown in Figure 4-1 on page 32, is focused on helping chemical and petroleum organizations to increase business value.

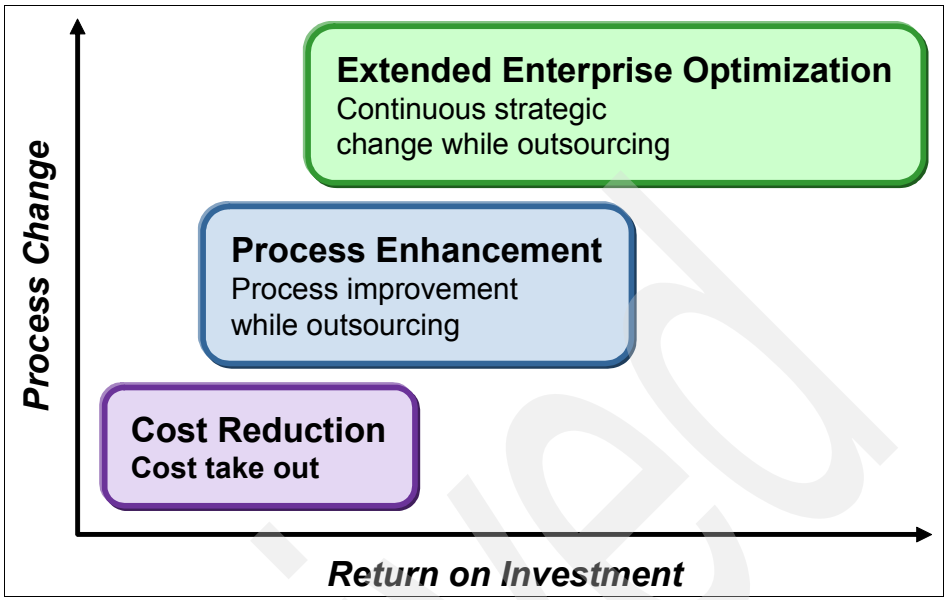


*Figure 4-1 Value identification*

Information technology (IT) can help companies resolve these issues. Global chemical and petroleum organizations need a robust, secure, and flexible IT capability to help them capture, analyze, communicate and apply the information needed for effective decision making. These can be addressed through following approaches:

- Strategic needs

  Companies need to have competitive intelligence for focusing on the right market and business models. They need to choose opportunities that make the most sense to pursue and also build and strengthen relationships with customers and supply chain partners. This can be achieved as follows:

  – Improved core business focus

    Oil and gas companies realize they must focus on their core business to compete globally. They are beginning to investigate the benefits of human resources and business process outsourcing. While important to the overall business strategy, areas like compensation, benefits management, recruitment, and employee retention can be better managed by companies with expertise in that area. Finance, logistics, and even operations and maintenance are being successfully outsourced by industry leaders.

– Increased operating model flexibility

  Integrated frameworks help in achieving greater operating flexibility by rapidly evolving business models to add new application functionality, integrate disparate systems and applications with customers, partners and suppliers. An intelligent and integrated architecture helps with the end-to-end solution, designed for multidiscipline control and information with the ability to address many specific business requirements including Automation Platforms, Collaborative Manufacturing, Enterprise Systems, Process Safety, and Power Control.

– Transformed business design

  Business transformation for chemicals and petroleum industries is possible by providing expertise at the point of interaction and driving performance through multi-enterprise integration. Continuous improvement in people, process and technologies helps the business gain. On Demand Customer Interaction Centers help clients deliver automated business process for self-service in customer service interaction.

– Additional dollars invested in higher value projects

  Large capital projects-building infrastructural elements including pipelines, platforms, or refineries take years before they are complete and an ROI is realized. As a result, the industry depends on the capital markets to provide the funding necessary to sustain and grow its business. Organizations worldwide are looking for better return on investments intelligence. The solution is to provide tools that oil companies can use to accelerate the capital project life cycle, better manage their investments and by providing streamlined communication and collaboration, improved project transparency, reduced financial risks.

► Financial needs

For handling oil and gas processes successfully, we need to ensure the proper financial and operational health of the company. This can be ensured as follows:

– Reduce and control operating costs

  Oil and gas industries are striving to control costs in the following areas:

  • Operations that deal with bringing the oil and gas to the surface and preparing them for transportation to the refinery or processing plant
  • Operations that deal with moving the oil and gas from the field to the refinery or processing plant.
  • Converting crude oil and gas in their raw state to marketable products.
  • Operations that include storage and handling, transportation, and delivery to the user.

– Improve cash flow

To sustain oil and gas industries, we need an accurate view of future income statements, balance sheets, and key performance indicators. We also need support in such areas as modelling distributions and dividends, developing hedging and financing strategies, and managing acquisitions and dispositions. Companies are consolidating these from various applications into a spreadsheet environment. The need of the industry is for operations, finance, and accounting to communicate and validate data on an ongoing basis. IBM helps to simplify budgeting and forecasting by supporting the following functions:

- Automation of workflow and aggregation by collecting volume and financial data from source systems
- Collaboration among finance, operations, and other stakeholders, reducing budgeting/forecasting workload and improving strategic analysis

► Management needs

Chemical and petroleum companies are being bombarded by change. Many are struggling to keep up with increasingly demanding regulatory, financial, and customer need. To overcome these, we need constantly to analyze the internal and external value chains for better control of the business and market. These can be better achieved by the following approaches:

– Improved operating performance with fewer resources

The global financial market meltdown has resulted in major setbacks to the oil and gas industry. It has forced the industry to look for leaner operating models and processes.

– Real-time decision support analytics and tools

Production and operation facilities often located in remote areas make it difficult to organize and access real time data. The industry needs an expert decision support system for monitoring, control, and diagnosis. Data from various components need to be automatically collected and transmitted to decision support system for analysis.

– Flexibility

These industries require handling the complex tasks of developing services and applications that integrate disparate enterprise applications, databases, and existing systems. Flexibility in integration of these tasks plays a key role in development of distributed systems that span networks, Web, and partner systems. This will help in integrating packaged applications, custom software and existing systems. It is also important that these services are flexible across IT platforms and operating systems to optimize reuse which will result in lower costs.

## 4.1 Development costs

Chemicals and petroleum companies see value coming from the following areas:

- Reducing costs

  The key to reducing costs lies in maximizing the use of standard equipment and materials and the application of standard designs and procedures. This leads to improved reliability, safety, and higher yields.

- Increasing flexibility to adapt quickly

  Even though the chemicals and petroleum industry is becoming more and more standardized, it needs to adopt a standardized enterprise architecture for faster go to market strategy and reduced time to implement all business process transformation.

- Innovating and improving versus cost cutting

  In times of growing demand and expensive production, the oil and gas industry is seeking new and innovative ways of production and operations. Development and production costs have increased many fold, and as a result companies are not only looking at reducing cost but new ways of doing things to reduce cycle time and to enhance marketing strategies.

In order to achieve these, C&P IIF provides model-based, industry standard access to real-time information about production, equipment, and performance from processing and operational units across the organization. The integration of data from control and monitoring systems with the overall administrative systems, and support of corporate as well as plant-specific work processes and goals will strengthen the integration between various platforms. For developing such a solution, the requirements are as follows:

- An automated process for the Reference Semantic Instance Model (RSM™) to be populated from a system of authority.
- Ability to monitor instance and historical data acquisition and act on all data streams from operations.
- Define and monitor significant complex events and alerts, graphically compose events and event subscription, connect Web services and business processes, and define data payload.
- Support and invoke Web services, composite services, and all participating existing applications.
- Provide a single visual access method for users to manage applications, services, and C&P IIF functions visually across the enterprise through a work bench.

- Manage alarms and alerts, alarm and alerts aggregation, event logging for alarms, and event actions.
- Define KPIs and associated complex calculations. Provide a graphical means to generate key performance indicators. Enable the definition of inputs to be real time process measurements or derived calculations in emitting systems such as historians. This will help to specify the frequency to trigger KPI calculations based on events, and write the KPIs back to an historian. Specify the input of pseudo-static data for comparison to the calculated. Accept a Web services application input as one of the KPI input parameters.

In order to achieve the above, C&P IIF is divided into three distinct areas:

- Build

  The Build component consists of a Solution Studio, used by a non-programmer to create production configurations. These configurations consist of an enterprise/asset model, P&ID diagrams, KPI definitions, event definitions, process definitions, data mappings, and event-to-process associations. The studio allows the user to import and categorize available services. It is these services that are used to construct the business processes. The studio also manages configuration deployments and undeployments.
- Run

  The Run component consists of a complex rules engine to filter events, and a highly available and scalable event processing engine that mediates, routes, processes, and logs the events. The Run portion is responsible for processing all the events in the manufacturing environment and logging those events in a standard way.
- Manage

  The Manage component consists of a standards based client that is easily used by any service or application in the framework, a server side component which receives and processes logged events, and a set of filterable views of the log information. Additionally, the Manage component includes selected products from Tivoli® that are used to monitor and manage the elements of the C&P IIF solution. The Manage component is based on the IBM Common Event Infrastructure and Tivoli System Management software.

The following list details features of the solution:

- Implementation of an industry-aligned standard for real-time production data.
- Integration solution based on a service-oriented architecture (SOA) and XML.
- Application integration provided through an integration infrastructure.
- Acquisition of real-time data.

- Feasibility of the solution implementation process for a staged company-wide implementation.
- How the integration layer should interact and communicate with IMS systems and relevant data sources in a technical net.
- Permanent supporting roles and work processes that are needed to keep this integration up to date with regards to availability, changes, monitoring.
- Support for composite work processes.
- Model-based integration of application and devices.
- Configurability and maintainability of model.

In order to achieve the above features, the activities are broken down by complexity and duration, which helps in budget, resource, and schedule planning for the following macro phases:

- Requirements definition
- Modelling, configuration, and build
- Assembly and deployment of solution

## 4.2 Value addition by improved productivity

The chemicals and petroleum industries require a comprehensive, integrated software system that not only optimizes performance, but can be implemented quickly and adapted to plant-specific procedures and processes. The chemicals and petroleum industry is unique in terms of investments, operations, trading, marketing, and other industry dynamics. Because of the intrinsic nature of the business, the chemicals and petroleum industries face a number of challenges. The challenges are discussed in detail in Chapter 3, “Business challenges” on page 19.

Over the years, oil and gas companies have been striving to reduce the life cycle for better efficiency, as shown in Figure 4-2 on page 38.

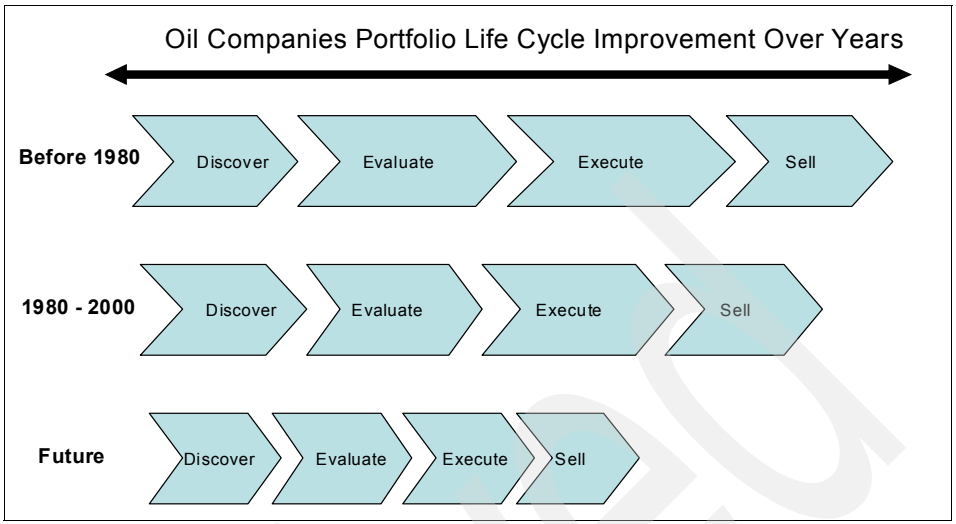


*Figure 4-2 Improved efficiencies for oil companies*

The chemicals and petroleum industry needs a data acquisition and analysis tool designed to automate the tasks of collecting, storing, and analyzing equipment operating data from operator rounds. The tool needs to provide personnel responsible for plant operation with a powerful yet easy to use tool for following:

- Collecting and analyzing massive amounts of equipment operating data quickly and efficiently,
- The power and flexibility of complex calculations, trending, and analysis at the fingertips of operators both at the desktop and in the field. The likelihood of detecting and preventing equipment problems is greatly enhanced, thus maximizing plant reliability.

To enable integration of enterprise data systems, IBM C&P IIF helps in the following manner:

- Leading where we have world class expertise in business transformation, offering clients expert help
- Being accountable for the operation of business processes, people and technology, reducing client risk
- Innovating and continuously improving through leverage we bring from our solutions, our experience and skills, and our global delivery network, transforming our clients' business with them
- Delivering significantly improved business value and outcomes for our client
- Accelerating and sustaining business transformation enabling our clients to focus on their core competencies.

- Providing flexible deal structures and financial constructs based on business outcomes (risk and gain sharing) within long term (7–10 yrs) trusted provider agreements

The chemicals and petroleum industry, in collaboration with information technology companies and service providers, are able to overcome their challenging areas for improved productivity and better efficiencies. Table 4-1 lists the oil industry challenges, solutions, and applications for overcoming them.

*Table 4-1 Oil industry challenges, solutions, and applications*

| Challenges | Solution | Application |
|---|---|---|
| ► Improve Finding Rates (Increase probability of success)<br>► Reduce Finding Costs | Cost effective Linux® technology together with HPC will improve productivity and hence success rates and reduce finding costs | ► Deep computing<br>► Upstream applications |
| Reduce Time to First Oil | Better Collaboration across the value net through knowledge networks and shared utilities will reduce field developments times | Asset Life Cycle Management |
| Reduce Lifting Costs | Real-time collection, collation and analysis of facilities and reservoir data will improve operational decision making and reduce lifting costs | Intelligent oilfield |
| Improve Return on Assets | Solution and infrastructure that integrate, visualize, and visualize information across the life cycle of the asset together with the development of learning organizations will improve ROCE and ROI | ► Deep computing<br>► Visualization<br>► Linux<br>► GRID<br>► Wireless |
| Improve Shareholder Value | Oil companies need to be profitable across their portfolio of assets at an average oil price of $10 /bbl | Global performance management |
| ► Improve Health Safety and Environmental performance<br>► Demonstrate compliance | On-Demand will not only provide cost effective infrastructure but will act as a catalyst to link the value net and transform the upstream industry | Deep computing on demand |

Table 4-2 lists the gas industry challenges, solutions, and applications.

*Table 4-2 Gas industry challenges, solutions, and applications*

| Challenge | Solution | Application |
|---|---|---|
| Improve Refinery Margins | | |
| Improve Customer Responsibilities | To improve ROCE, Oil companies need to integrate information from plant floor to the enterprise systems | Plant floor automation |
| Increased Need for Asset and Personnel Security | | |
| ► Respond to Deterioration in Oil Products Margins<br>► Improve Total Site Profitability | Implementation of integrated technology will reduce cost of operations and provide a platform for innovation | Intelligent gas station |
| Improve Total Site Profitability | Oil Companies need to understand their customers and improve their experience | |

Table 4-3 lists the chemical industry challenges, solution, and applications.

*Table 4-3 Chemical industry challenges, solutions, and applications*

| Challenge | Solution | Application |
|---|---|---|
| ► Improve product<br>► Innovation<br>► Increase % of revenue from new products<br>► Reduce development costs through collaboration | ► Improve<br>► Innovation/Reduce Cycle<br>► Time<br>“The innovation driven chemical company” | |
| ► Improve Return on Assets<br>► Extend useful life and<br>► Improve yield on existing, aging physical assets | ► Improve Return on Assets<br>► Decapitalization<br>► Asset life cycle management, learning org, shared utility infrastructure | ► Asset Life Cycle Management<br>► Plant floor automation |
| ► Improve customer experience, loyalty<br>► Improve realtionships from transactional to value added partnerships | ► Improve customer experience, loyalty<br>► Customer loyalty despite commoditization Flawless Execution of Customer Orders Six Sigma performance | |

| Challenge | Solution | Application |
|---|---|---|
| ► Improve Collaboration with Value Net<br>► Optimize trading margins and asset performance through visibility to real-time supply and demand information all along the value chain<br>► Reduce the complexity of “doing business” | ► Improve Collaboration with Vlaue Net<br>► Remove and / or variablize cost<br>► Profitable operations throughout the business cycle<br>► On Demand | On Demand |
| ► Improve shareholder return<br>► Reduce costs<br>► Improve asset utilization and process | Improve corporate citizenship: Secure information and operations | Security |

Apart from the solutions mentioned in tables above, C&P IIF enables significant technology and business benefits though the following advantages:

- One standard SOA solution across the value chain of an enterprise
- Offers an accelerated data management solution for the business; and, reduces long term data management investments
- Uses and enhances return on existing technology investments by organizing data for consumption by all participating applications
- Accelerates project delivery
- Enables the Intelligent Oil Field Concept and disconnected client services automation
- Enhanced data and Information integrity delivers increased speed and confidence for operational decision making
- Enables demand and replenishment information marshalling for the supply chain
- Enables the ability to identify and replicate, cross-fertilize best practice and thus be able to compare across assets and locations
- Enhances access to asset and application information collection with leave and layer approach.
- The open platform approach enables new tooling and application choices for the future without the need for rip and replace.

## 4.3 Engineer's ability to develop solution, using appropriate context

The oil and gas industry needs a consistent, organized, and integrated approach which affects equipment configuration, system status, and plant operation. This means that the engineers working in them need to provide solutions which provide the following advantages:

- Enhanced efficiency, productivity, and safety

  This will help in significant, measurable gains in efficiency and productivity in operations tasks automated.

- Reduced time and costs of operations activities

  This will help to decrease in the total number of activities required to be processed and reduction in man-hours.

- Consistent and compliant processes

  This will help to create and better manage a consistent framework for operations routine duties across fleet of production facilities, implement a consistent methodology for generating and maintaining staffing requirements and schedules in compliance with complex regulatory work limits, thereby preventing costly regulatory fines. These can be achieved by four strategic imperatives of C&P IIF are as follows:

  – Reduced cycle time

    Real time field operations are being made possible by the advent of massive amounts of sensing equipment in the overall hydrocarbon value chain. The ability to absorb that data into an enterprise framework and perform analysis resulting in automated process and decisions will support the industry objective of decision cycle time reduction across functional groups, product lines and the global enterprise.

  – Reduced expense

    Capital intensity will forever require structured and disciplined investment strategies that support long lived assets in chemicals and petroleum. Strategic objective associated with integrated operations call for a reduction in operating expenses driven by enhanced equipment performance and conditions based monitoring and optimization. Solutions must not be predicated on rip-and-replace

  – Optimized resource

    Significant skilled workers are exiting the business in the next five years, lack of new college graduates from universities globally in geo science, chemicals and petroleum engineering. Need to compress the seven year (typical) speed to value from new engineers coming into the business

  – Increase agility

    Technological advances are allowing new analysis and insight in the operations and production of products globally. Demand for hydrocarbon products will challenge companies to use new and innovative techniques to capture that intelligence and distribute it globally for better, faster and safer decisions

Figure 4-3 shows the dilemma of field operator and engineers. Figure 4-4 on page 45 shows how this dilemma can be overcome with help of integration.

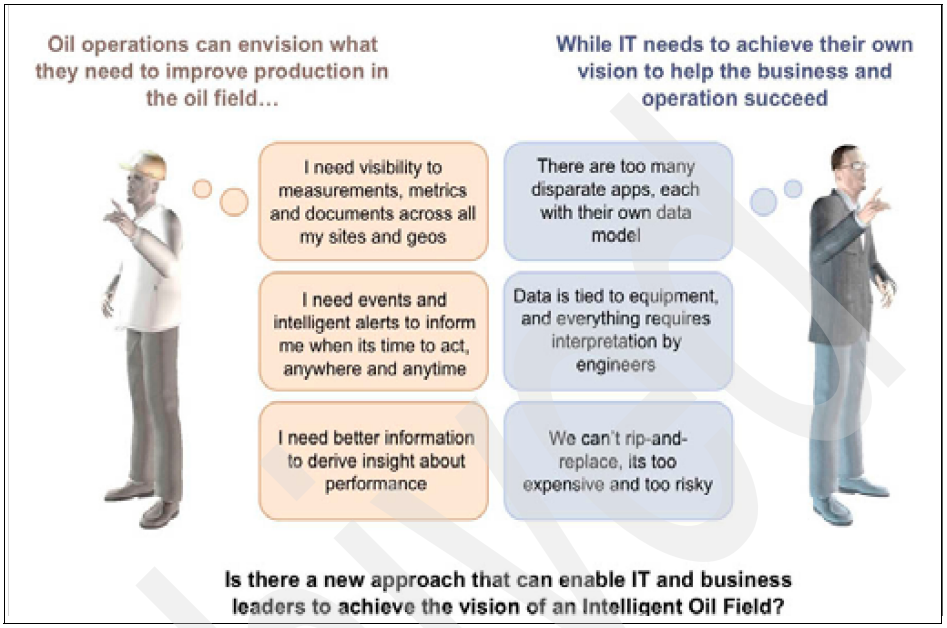


*Figure 4-3 Dilemma of field operator and engineer*

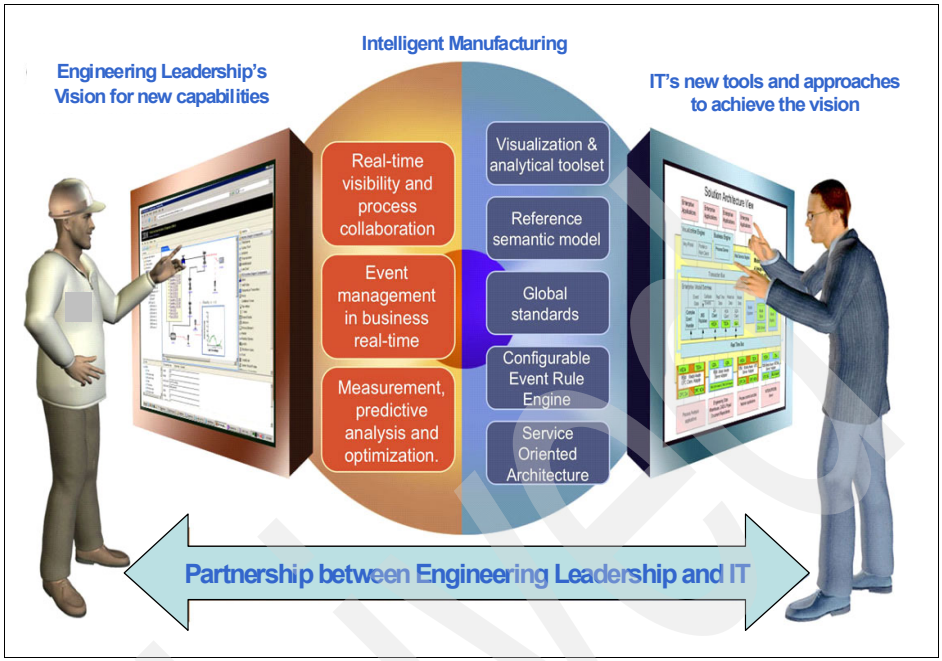


*Figure 4-4 The C&P IIF vision to overcome the dilemma*

Key functionality of a chemicals and petroleum SOA-based Integrated Framework are as follows:

- Provide a standards-based model and enterprise taxonomy/ontology that yields enterprise name space management/maintenance/visual access to process data and documents/specifications/reports
- Provision it as a federated and distributed online model allowing multiple methods for data access, model data location query through Web services
- Provide agile adapters, for example, adapters that are model aware, supporting automated configuration and model updates from the systems of authority
- Provide independent and rich client Scalable Vector Graphics (SVG)-based visualization to view query and represent document: reports, data specifications, and equipment, process variables
- Provide a services/utilities to configure/define graphically and subscribe to the delivery of real time data, process events, and KPIs
- Provide adaptive process workflow, based on industry standards, that allows a means to create and customize and start business rules/requirements within the framework of the ISA-95/88 activity models

- Keep a persistent instance model representing data artifacts and processes and past state history without applistructure dependence
- Provide a means for multiple levels of security
- Provide a means for incremental rollout the solution
- Provide a means for maintenance and enhancement which does not require shutdowns

Key architecture components are as follows:

- Reference Semantic Model (RSM)
  - Unified object model built in Rational® Software Architect (RSA)
  - Coming together of multiple standards using linkages
  - ISA-95, ISA-88, Open Applications Group Integration Specification (OAGIS), ISO 15926, OLE for Process Control (OPC), MIMOSA, Common Information Model (CIM), UN/CEFACT…
  - Current runtime using SISCO UIB (Utilities Information Bus) product
  - SISCO model Aware Client and Server OPC adapters
- Chemical and Petroleum Integrated Information Framework (C&P IIF) Solution Studio
  - IBM iLog technologies
  - Complex Event Processor (CEP) based on IBM WebSphere® Business Events (WBE)
  - Integrated to RSM using the IBM Enterprise Model adapter
  - Unified viewer and editor across plants for real time, historical, event data, documents and reports
  - RSA, Enterprise Service Bus, Process Server

As shown in Figure 4-5 on page 47, C&P IIF helps production and supply integration.

C&P IIF for upstream consists of the following factors:

- Integrating production control enhances production efficiency and provides a tight feedback loop
- Integrating supply logistics reduces cost and uncertainty
- Integrating crude trading increases profit and reduces risk, while supporting the supply plan

C&P IIF can provide the following advantages:

- Reducing operation costs

- Reducing logistics costs
- Increasing output

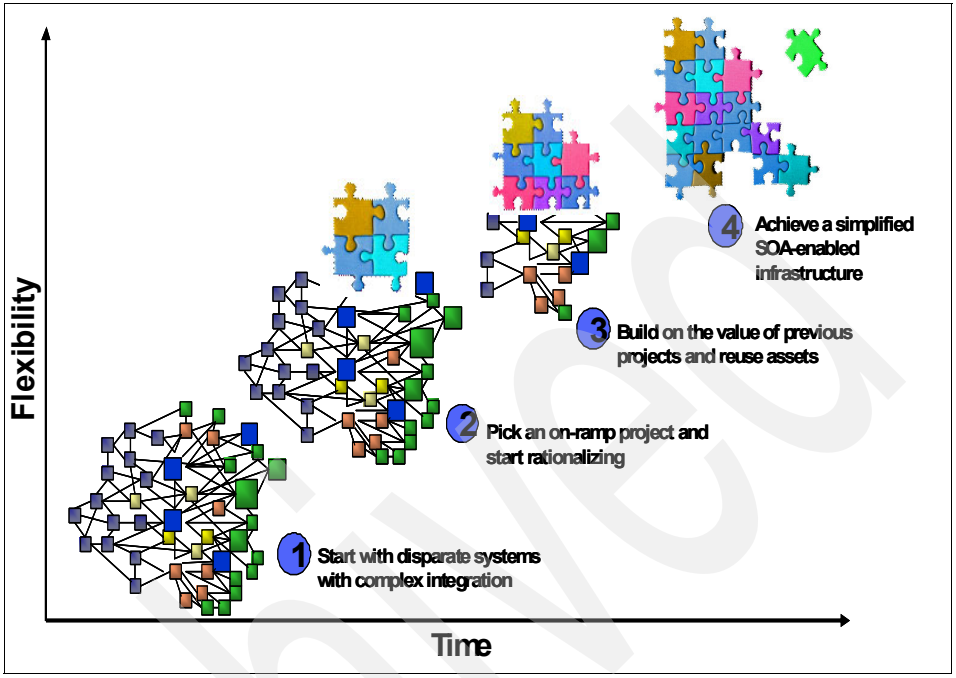


*Figure 4-5 C&P IIF Benefits*

C&P IIF for Downstream consists of the following features:

- An integrated plan and schedule module which can achieve substantial productivity increases from existing assets, while improving refinery agility.
- A smart manufacturing module efficiently and consistently executes production directives, insuring the right product is made at the right time and at the right cost
- An integrated information management module monitors the heartbeat of the refinery, collecting, storing, and analyzing process data

C&P IIF can provide the following advantages:

- Increase production capacity
- Reduce production costs
- Improve product quality

As shown in Figure 4-6, C&P IIF helps to integrate across geographies, applications, people, processes, and systems.

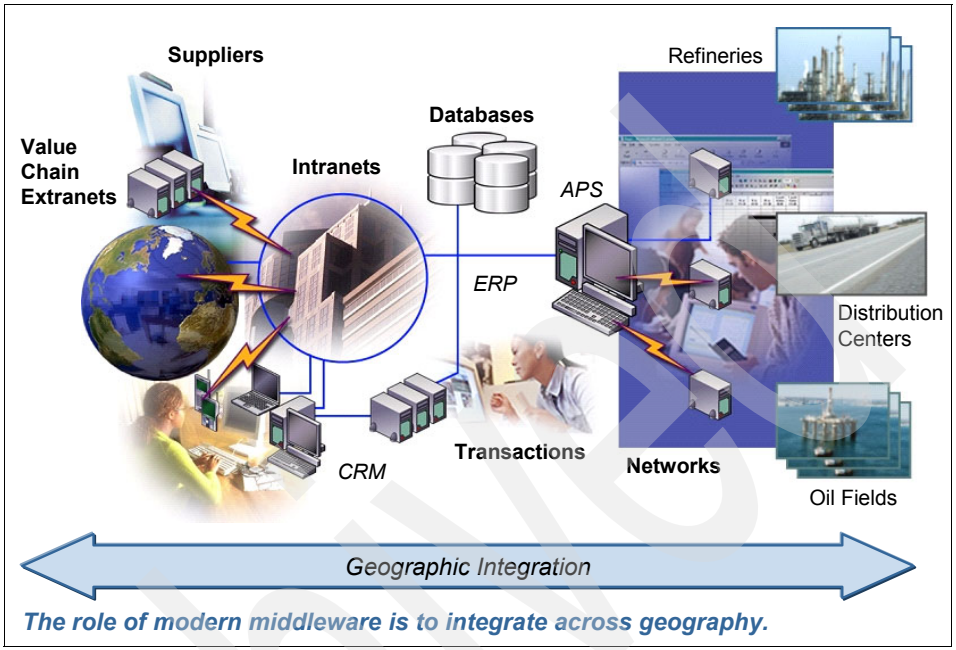


*Figure 4-6 Geographic integration: chemicals and petroleum*

### *Business integration architecture*

Perhaps the biggest challenge is that today's IT environments are becoming increasingly diverse. As the integration focus moves horizontal and extends beyond the boundaries of the individual enterprise to partners, suppliers, and customers, this diversity in IT environments is increasing in complexity. That is where middleware comes in. It is the infrastructure software that simplifies the problem of horizontal integration. It integrates data and applications across and beyond the enterprise to provide benefits throughout the value chain.

Flexible business models have increasingly become a requirement for companies. The focus shifts to building much tighter linkages among core business processes and the applications that support them. Greater business flexibility requires greater flexibility from enabling IT, as shown in Figure 4-7 on page 49. The demand for innovation and flexibility is higher than ever as companies seek to accelerate time-to-market for new products, create new revenue sources, and reduce costs. Flexible business models have increasingly become a requirement for companies. IBM, using its component business modeling (CBM) approach, helps companies create flexibility in their business architecture as they become on demand enterprises. Flexible business, however,

requires more flexible IT environments to support it. SOA enables this flexibility in IT. However, bridging the gap between flexible business models and flexible IT is not addressed by CBM or SOA in isolation. SOMA provides this bridge between business and IT by providing guidance on how to move from the business models created by CBM, or similar business analysis techniques, to the IT models required by SOA.

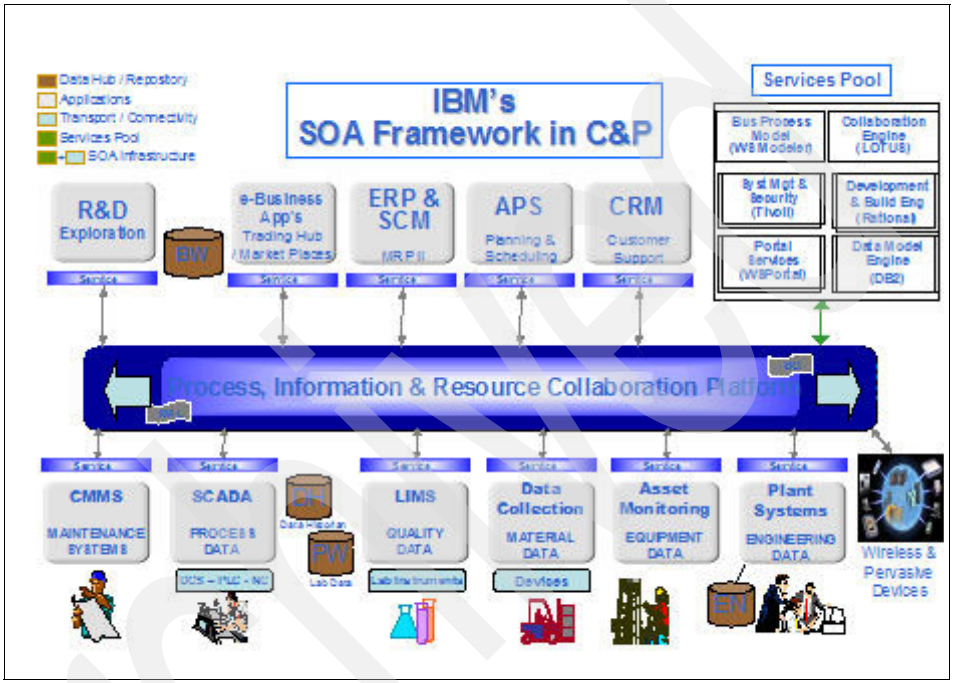


*Figure 4-7 Business integration using IBM C&P IIF*

5

# Solution patterns

To succeed in the competitive upstream oil and gas marketplace, companies must use a diverse set of capabilities involving people, processes, and technology, as shown in Figure 5-1 on page 52. This was being done in disparate environments making the implementation, maintenance, and upgrades complex and difficult.

In addition, competition for natural resources has driven companies to explore for and produce oil and gas in remote and hostile locations. As the environment grows more diverse, the locations more unforgiving, and the business challenges more complex, skilled technical personnel are aging and becoming scarce.

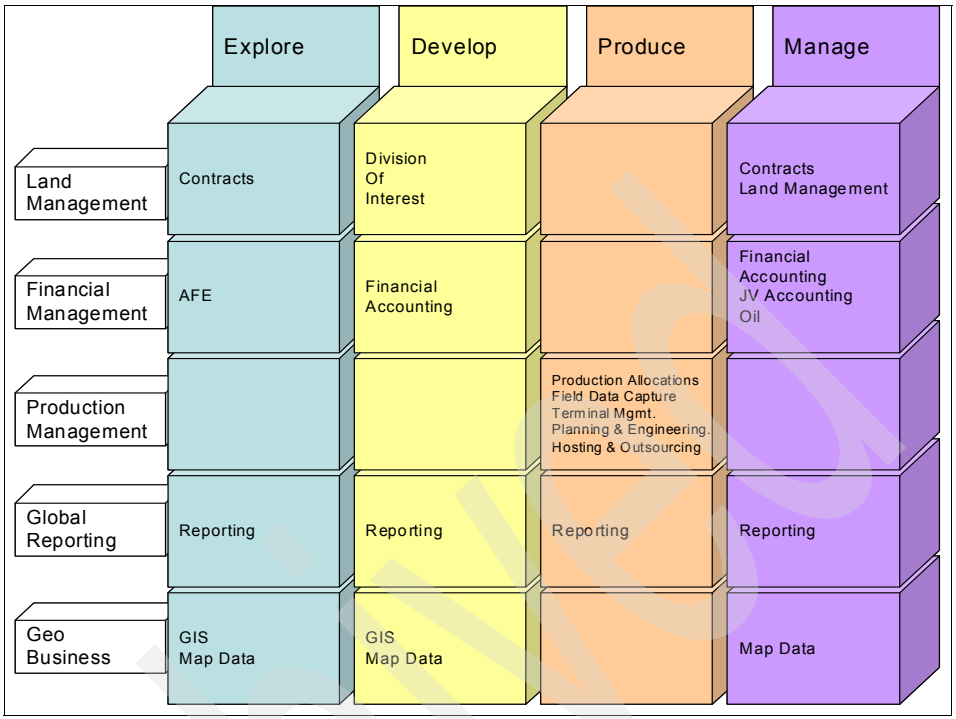


*Figure 5-1 Oil and gas business mapping*

To attract and retain available skilled professionals, companies need to change their corporate cultures. This requires implementing innovative business processes to help people take full advantage of near-real-time oil field data and turn it into actionable information that can increase recovery and production, reduce operating costs, and ultimately increase profitability. To accomplish this, companies must understand and embrace new ways of working. This involves establishing new roles and responsibilities (with rewards and recognition programs) and new work processes to create an environment that facilitates more informed decision making and efficient execution. The ability to enhance decision making is crucial to overcoming many challenges. Increasing energy demand and geopolitical forces are creating a volatile commodity marketplace. Global competition for natural resources continues to drive the need to improve oil and gas reservoir performance. Shareholders are pressuring companies for a return on their investments commensurate with other long-term investments. There is increasing public scrutiny concerning the environment and global warming. Although new technologies have shown promise for meeting industry needs, it can be arduous to integrate new technology with existing processes, systems, organizations and global networks of diverse business collaborators. The convergence of forces, threats, and technologies creates a ripe environment

for an intelligent oil field solution that integrates people, processes, and technology to improve oil field performance by making use of frequently captured data that is delivered, converted to usable knowledge, and acted upon in real time. Successfully implementing the intelligent oil field to take full advantage of all available data requires a sophisticated program of projects designed to integrate key human and technology resources.

The intelligent oil field encompasses a collaborative environment for communication; data collection, reporting and monitoring; and knowledge and information sharing. This environment helps people make informed decisions and take appropriate actions across the enterprise. In addition, it enables alignment, focus, and common understanding to prioritize operations. The benefits of the intelligent oil field can include lower operational costs, earlier and increased production, lower capital investment, increased recovery of oil and gas, and lower abandonment costs. A significant increase in asset value can be achieved if oil and gas reservoirs are managed on demand and in real time. Depending on the oil and gas field size, savings can be generated in the hundreds of millions of dollars. This could result in value creation in the billions of dollars each year. Innovations in various technologies are helping people make the intelligent oil field a reality. For example, massive amounts of sensor data are being delivered to skilled people who search the data, convert it to usable knowledge, and use it through advanced visualization technology, thereby avoiding cumbersome data stores and transmission by allowing raw data to remain at the source. This helps analysts automatically to detect complex data patterns/problems (such as sand production in wells) so the right person can be alerted to initiate a response before a problem occurs. Visualization, modeling and analytics make it easier for decision makers to understand a wealth of complex information, which can lead to improved oil and gas reservoir management.

## 5.1 Current design patterns

Organizations are struggling to capture transactions and other business critical data in real-time, correlate information across applications to establish a clear vision of how current developments are affecting the enterprise, and then take action that exploits market opportunities and deflects competitive threats.

IT architects and managers are being asked to address these urgent requirements of visibility and agility while managing layer upon layer of existing systems that may or may not interoperate with any degree of simplicity.

The essential business objectives of an enterprise application integration solution are to connect systems across horizontal business processes, and integrate applications, business services, and business partners. A model solution focuses on connecting applications together with the right communications and server infrastructure, as well as the right business process capabilities to give IT and enterprise leaders the ability to create composite applications that meet new flexible and dynamic business needs. A well-engineered solution also makes maximum use of existing applications and resources without requiring extensive rework. The solution's integration and security characteristics are tailored to the business needs of the enterprise. It also provides enterprise leaders with tools for monitoring and maintaining system performance through the solution rather than impacting the applications themselves.

The most critical success factor in successfully implementing an EAI solution is to ensure the right alignment between business and IT. Enterprise leaders should systematically consider what mix of technology their particular integration project needs.

### *The IBM approach: Successfully integrating people, processes, and technology*

The IBM solution has five key performance-oriented implementation components:

- Data gathering and control
- Data management and infrastructure
- Integrated systems and applications
- Workflow optimization
- People and collaboration

As shown in Figure 5-2 on page 55, these interdependent components can be essential to achieving significant return on investment from an intelligent oil field. Implementing them facilitates real-time global asset awareness (or access to data from all of the appropriate assets) by enabling proactive asset management using frequently captured data that can be distributed, converted into relevant knowledge, evaluated, and acted upon in real time.

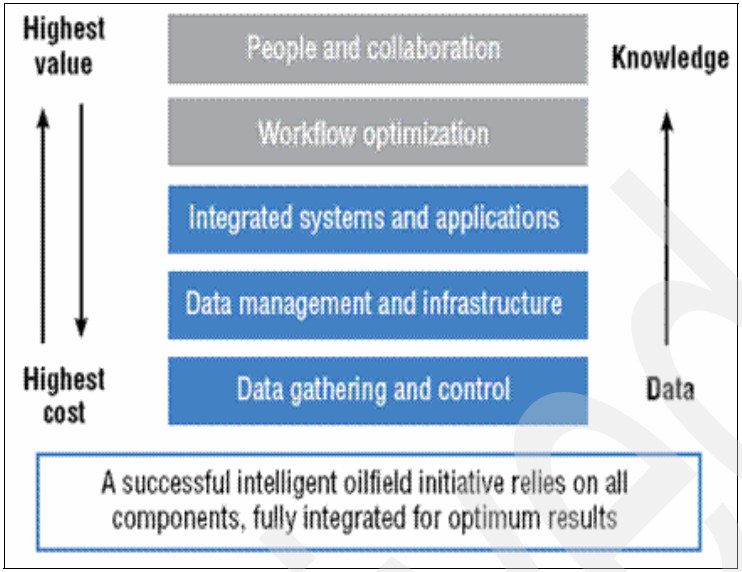


*Figure 5-2 Components integration for maximum value*

With such a program in place, oil and gas companies can use the wealth of information generated from their assets more effectively to make more informed and predictive business decisions. Companies can also remotely and collaboratively manage wells and fields. This helps to save time and money and extends the reach of skilled resources, while also increasing recovery and reducing risks. IBM solutions encompasses the five components and is designed to help people (the highest valued component) work together more effectively, in order to reap the greatest value from the highest-cost component (data gathering and control) and its midlevel by-products. Raw data (bottom right) migrates up through each component until it is converted into knowledge (upper right), which people use for improved decision making. Ultimately, all the technology components support the workflow of skilled personnel. Depending on circumstances, a company may engage with IBM to accomplish any of the five components first. But a successful initiative depends on fully accomplishing all five.

### 5.1.1 How C&P IIF complements data warehousing

Though data warehousing is not a component of C&P IIF, it definitely complements data warehouse models. Most long-standing data warehouses are designed to support a relatively small number of users who access information to support strategic decisions, financial planning, and the production of standard reports that track performance. Today, many more users need to access

information in context and in-line so that critical functions are optimized to run efficiently. Information about customers, both structured and unstructured, must be analyzed and delivered wherever it is needed. Key performance indicators (KPIs) should also be available at all times to monitor performance. In short, business intelligence is becoming embedded in key business processes.

To create a true enterprise view of information that supports strategic and operational functions, enterprise data warehouses must be reinvented as a dynamic source of current and historical information. Dynamic warehousing is an approach that enables organizations to deliver more dynamic business insights by integrating, transforming, harvesting, and analyzing insights from structured and unstructured information. Capable of processing large amounts of information, a dynamic warehousing infrastructure can enable organizations to respond on demand to unscheduled analysis requests, and as events trigger the need for information throughout the day.

A key component of a dynamic warehousing environment is the data warehouse platform. To implement a dynamic warehouse, the platform should be able to perform the following tasks:

- Process transactions and analytical requests.
- Handle varying service level agreements (SLA).
- Scale easily as the number of applications grows.
- Analyze structured as well as unstructured data.
- Provide real-time analytics that can be embedded in business processes.
- Support advanced analytics such as data mining within the data warehouse.

But the requirements for dynamic warehousing go well beyond having the right data warehouse platform. Dynamic warehousing requires an extended infrastructure (Figure 5-3 on page 57) to perform the following tasks:

- Implement changes to the business model without impacting usage.
- Monitor and analyze data sources for structure and content to ensure the best data is being accessed for each application.
- Provide tools that enable business users and IT staff to collaborate on data requirements and definitions.
- Deliver impact analysis and data lineage reports to coordinate changes and provide visibility to critical data flows.
- Deliver data that has been cleansed and harmonized to the warehouse regardless of volume or latency requirements.
- Synchronize master data for key business entities across operational systems.

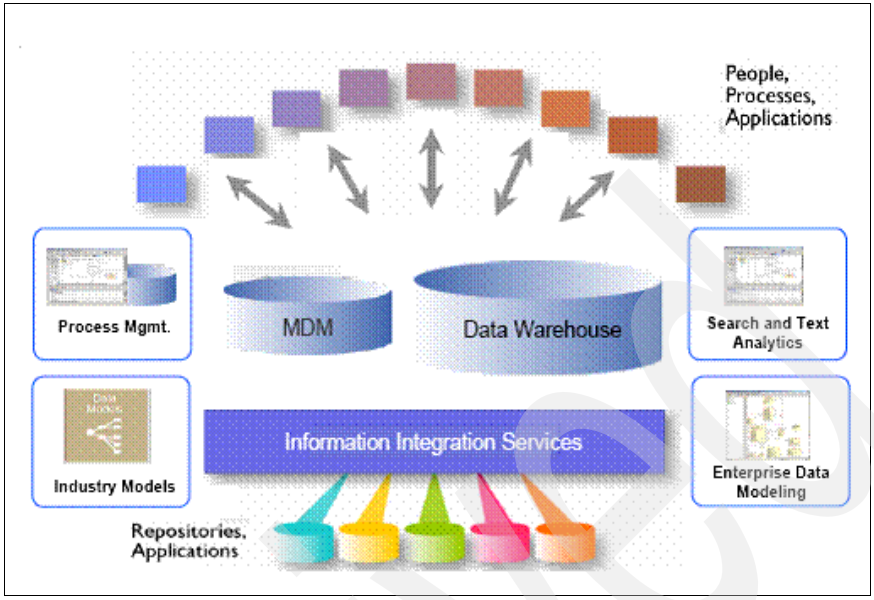


*Figure 5-3 DW platform*

By creating a roadmap for a truly dynamic warehousing infrastructure, organizations can meet their most pressing needs for business intelligence today, while ensuring a data warehouse environment that can help support rapid growth, significant change, and increasing demand for real-time information.

### *Metadata is the cornerstone*

Another critical component to a unified data integration platform is a common metadata repository that links with the data modeling tools and industry data models (see Figure 5-4 on page 58).

A unified, metadata-driven infrastructure facilitates a shared understanding across business and technical domains while helping you reduce the time between specification and build. Furthermore, it can provide a transparent and persistent record of understanding that can drastically reduce future project delivery times and improve overall insight and confidence in information.

An effective, metadata-driven enterprise data integration solution uses the three primary types of metadata typically generated by organizations:

- Operational metadata provides authoring information, creation date, physical location, and other operations-based information.
- Business metadata identifies the business processes and analytical applications to which raw data should be mapped. Business metadata is critical for users or consumers of information, so they can be confident that the data they rely on for making business decisions is what they expected.

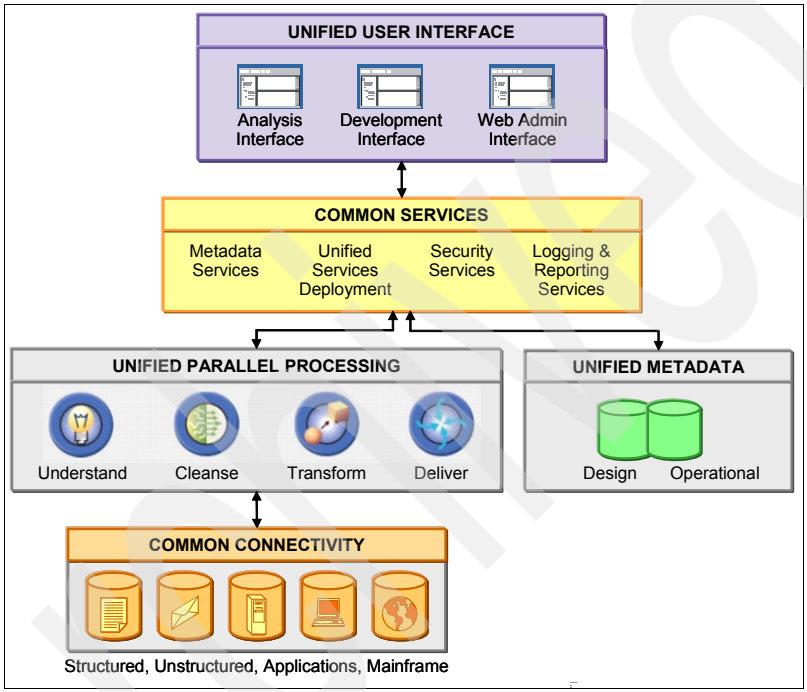


*Figure 5-4 Data Modelling Tools*

- Technical metadata provides information about the applications and systems that are being used to store, verify, aggregate, and cleanse raw data. It helps companies understand what information they have today and the reliability of that information, and streamlines development efforts by providing technical users with information about the data elements and how they are implemented currently across various systems. Additionally, this metadata can help establish a metadata map of source systems that can be used to build federation queries, improve audit capability, and provide visibility through impact analysis and direct lineage reporting.

### *Enable information integration services*

A service-oriented architecture (SOA) takes all of the metadata, methods, and processes inherent in a good enterprise data integration platform and makes them work at their most effective and efficient level. A SOA is capable of working with custom, third-party, and existing systems to extract and deliver data through the ability to turn the integration processes, methods, and tools into services that can be used and reused for virtually every system, every application, and every type of data a business creates. In short, SOA is the enabler that can transform yesterday's incremental gains into tomorrow's data integration breakthrough.

The high-level data flow diagram in the oil industry is depicted in Figure 5-3 on page 57. This depicts the information flow in the oil industry. It starts from oil source detection. The necessary analysis done for the exploration of the oil source found: traversing through the whole schema of development of the oil well, production of oil, storage and transportation, refining of the crude oil, arriving at various products, marketing them and finally the process of consumption of products and re-usability techniques.

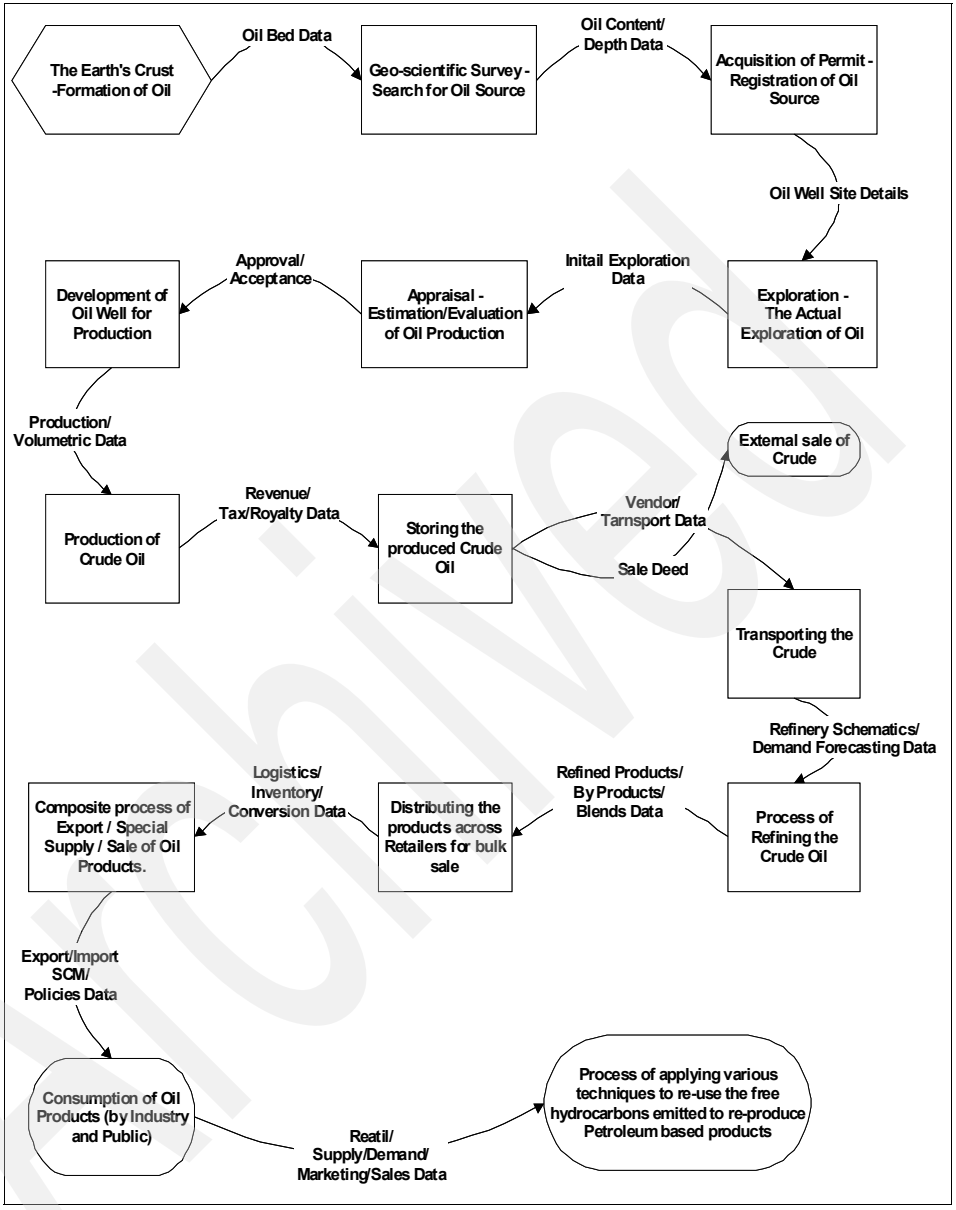


*Figure 5-5 Data flow in oil industry*

Oil and gas industries go through ever increasingly difficult processes to identify, collect, analyze, manage, and monitor information. Many applications that process specific data and create enormous amounts of detail information have emerged, which has made it nearly impossible to collect and analyze all the data

about a property. The percentage of information being turned into knowledge today is probably much less than a decade ago.

The industry has unintentionally created islands of information for years but the dilemma now is of having all the information necessary to make business decisions. Considering the volume, frequency, and complexity of data available, there is a major need for paradigm shift in tools, capabilities, and skills required for analyzing all these as competition for depleting resources continues to drive the need to lower operating costs and increase finding and recovery rates.

In order to take preventative measures to help avoid production downtime, new and innovative technologies help companies remotely and automatically monitor wells and fields. Visualization, modeling, and analytics are helping complex data patterns to be detected automatically so that the designated individual can be alerted and a response can be initiated before a production problem occurs. Integration business processes across the company and with key partners, distributors and suppliers help industries in improving net present value through cost-effective deployment of automated surveillance systems and issue detection and resolution systems. These also help in better well management solutions, which leads to improved hydrocarbon production. Oil recovery rates can dramatically improve through more effective reservoir management.

The need of industry is a comprehensive suite to support processes related to the exploration, development, and production of crude petroleum, as shown in Figure 5-4 on page 58. Some of the key aspects of upstream where ERP can help in Information management are as follows:

- Exploration and appraisal

  Exploration and appraisal activities focus on how to achieve petroleum reserve replacement by finding new reserves, which includes portfolio and risk analysis, identifying potential exploration targets, acquiring leases and licenses, surveying, positioning and evaluation, appraisal drilling and boundary determination, and building reservoir models.

- Contract management

  This spells out the requirements of contractors who are often hired to carry out actual drilling activities, which includes joint operating agreement and production sharing contract planning, analysis and development, joint venture management, third party drilling contract development, and management.

- Field development

  This is a development phase that includes reservoir and field planning and development, project, and quality management, development drilling, facility construction, and life of field modeling.

- Liquid and gas production

  Crude oil and gas production is a highly asset intensive activity, where all facilities from wellheads, to the living quarters on an offshore platform must be consistently maintained and kept in good working order, these include plan and capture field, well mapping, volume determination, capacity management, QA/QC, super-heavy element (SHE), depletion, abandonment, restoration.

- Allocation and Settlement

  Once petroleum is produced, it must be accounted for, including both total volumes produced and the value of the products produced. These must be allocated to the relevant owners. The pipeline capacities must be correctly monitored and maintained. If royalties exist, they must be calculated to avoid late and under penalties. As production uses up known reserves, re-estimations of remaining reserves need to be performed and the reserves accounted. The activities involved are contractual allocation, ownership allocation, lease fuel development, revenue accounting, gas plant accounting, regulatory reporting, reserves accounting, and reporting.

- Oil field service and repair operations

  Oil field service and repair operations enable the long-term planning and optimization of resources (people, tools, and parts) as well as their deployment, short-term scheduling, and customer service requests or planned service activities occur. Outsourcing of services, service sourcing and procurement, billing, and payment processes are part of the overall solution. The activities involved are strategic service planning, service contract management, installed base management, billing, depot repair, and so forth.

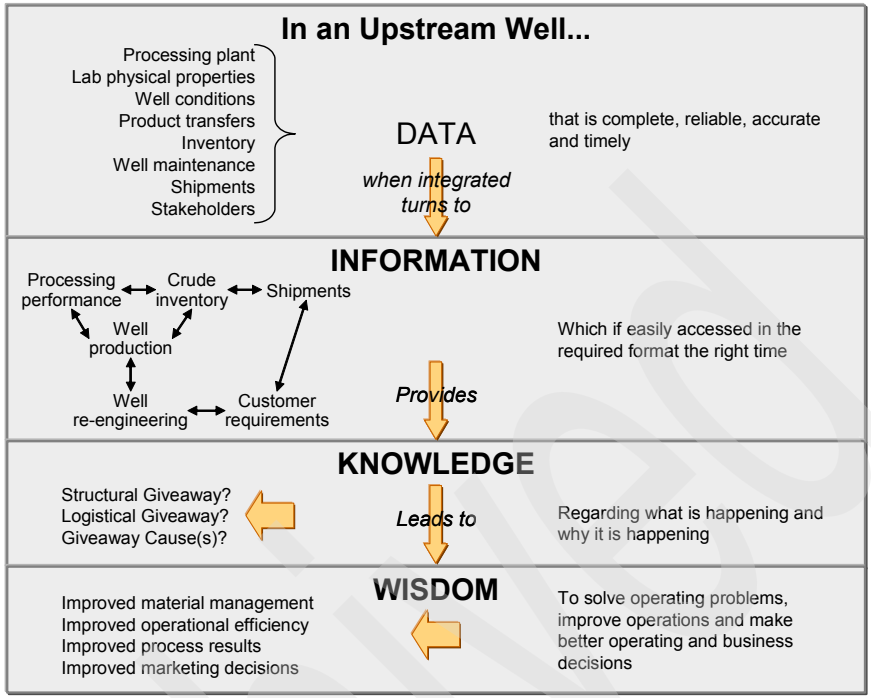


*Figure 5-6 Oil industry data management*

### *Data management and infrastructure: Managing data better*

Most of today's upstream oil and gas companies struggle with data management. This struggle will grow acute as companies establish operations centers in more remote locations and increase their demands for quality information, timely decisions, and response from these locations. To decrease the cycle time from an adverse occurrence in the field to a decision and its proper execution, companies (and specifically the right people) need accurate, real-time, and remote access to all data and information related to wells, reservoirs, and the associated equipment. Once gathered, intelligent oil field data must be transmitted, sometimes over vast distances, to enable more resources (people and computers) to assist in evaluation and decision making. Increased collection frequency leads to greatly increased data volumes. Currently, as much as a third of a skilled oil and gas engineer's time is spent on data mining. With more raw data constantly arriving, more data mining time is required. This, in turn, demands a high-bandwidth communications infrastructure and more robust data management. By combining analytics and business intelligence tools with this high-bandwidth infrastructure that helps to turn raw data into useful information, upstream oil and gas companies can increase business benefits from productivity and efficiency gains. The intelligent oil field can effectively address these data management challenges. Hierarchical analysis of the wealth of data

that a field generates can help to create knowledge that helps analysts predict adverse and beneficial occurrences more accurately. Analysts can intervene based on historical data already captured, analyzed, and archived. Furthermore, they can conduct reservoir analysis at any time, based on the data stream, rather than having to wait for major milestones. The intelligent oil field can facilitate integration of existing internal and external systems, such as asset management, workflow, and finance. It can provide analysts with an enterprise wide view of data that dramatically enhances long-term strategic planning and performance.

#### *Data gathering and control: Collecting the right stuff*

Data, and the information derived from it, sustain the entire oil field effort. Rates, cuts, pressures, acoustics, and temperatures are the most basic data points. Companies deal with many other significant data points as well. But many companies today collect data with uncertain frequency and deliver it for conversion into actionable knowledge with similar uncertainty. In the intelligent oil field, however, data is not just collected and stored. It is scrubbed, normalized, and calibrated. Raw data remains at the source. Metadata is transmitted across the entire IT infrastructure. Information is fused and analyzed with multiple data streams around the clock, in near real time, helping companies prevent costly occurrences such as pump failures. By analyzing the information derived from data against multiple historical references, oil and gas companies can more accurately predict future performance and proactively solve problems. Anomalous patterns can be detected and sent to the appropriate person for investigation. The analyst can then reprogram the appropriate software, if necessary, to help improve future accuracy. Autonomic data analysis (for example, self-configured, self-adaptive analysis) runs unaided, providing early warning of critical issues such as sand and water breakthrough and fluid composition changes.

### 5.1.2 Process integration created for each instance of application

The IBM end-to-end business consulting and technology capabilities make IBM highly qualified to deliver solutions designed to help upstream oil and gas companies achieve sustainable profits from producing assets. These capabilities extend from onshore to deepwater oil and from shallow-water to onshore gas. IBM capabilities also help upstream companies better use their workforces today and into the future. IBM distinctive offerings for the intelligent oil field are built around service solutions focused on people, processes, and technology areas. Although these three core components have been recognized for some time, innovation, integration, research and develpment, and industry expertise are what differentiate IBM.

### *People*

- Change management

  IBM has considerable experience and expertise in facilitating business innovation by helping organizations manage organizational change and the dynamics of people and process to bring about business transformation. This is a key competency in an intelligent oil field program, where the company must change its work processes, including its rewards and recognition system, to foster a corporate culture geared to proactive prevention of oil field problems and failures, as opposed to a traditional, reactive culture focused on addressing problems and repairing failures after the fact. IBM helps to establish a blueprint for the implementation of such productive change. Successful readiness planning helps to identify risk areas over the life of the project. And by understanding the implementation environment (including related processes, oil field technology, and IT projects) IBM can help to mitigate risks in these areas. IBM can identify integration points, dependencies. and synergies between the intelligent oil field and other company initiatives.

- Executive sponsorship and stakeholder alignment

  To achieve intelligent oil field implementation and its associated business benefits, key leaders from disparate internal organizations must share a common vision. Leaders must be willing to translate this vision into visible, tangible program support. Large numbers of potentially affected stakeholders, individual contributors, leaders, and teams from wide-ranging geographies must be aligned with a common vision that keeps the greater good in mind. IBM has deep experience in recognizing key change issues and in bringing proven practices to bear to develop and maintain the necessary alignment.

### *Process*

- Program and project management and roadmap development

  Understanding what must happen in each phase, and why it is necessary, lies at the heart of change management, particularly in an undertaking as large and complex as an intelligent oil field. Such an initiative demands full-time coordination throughout an organization, along with a clearly articulated solutions strategy and a plan to deploy it. IBM can help by using its rigorous program and project management capabilities. These capabilities help to create a vision and roadmap designed to bring an intelligent oil field initiative to fruition in a way that integrates the crucial components of people, processes, and technology. IBM can help develop a roadmap that capitalizes on lessons learned, leading practices, and a client's unique corporate culture. The roadmap is designed to provide a holistic view to accelerate implementation. IBM also helps clients sequence projects to realize the most significant benefits for both greenfields and brownfields early in the program life cycle.

- More efficient integration between IT and the business

  IBM has found that the intelligent oil field can bridge the business-to-IT technology gap and facilitate the introduction of new and more effective business processes. IBM capabilities simplify intelligent oil field implementation by addressing the integration and rationalization of relevant petrochemical and business applications, systems, and databases. This can include developing single-point data entry, simplifying or eliminating point-to-point interfaces, and building a more flexible IT infrastructure.

### *Technology*

- Innovative technologies

  IBM offers a broad range of innovative technology solutions that can help upstream oil and gas companies anticipate problems such as equipment and production impairment or failure before they happen, which can help reduce the costs associated with downtime and repairs. One such technology is a federated early-warning system designed to provide near-real-time data cleansing, calibration, and normalization; pattern detection; and ontology management. (Ontology, in this context, means relatively generic data that can be reused by different kinds of applications or tasks.) By implementing other technologies such as middleware, a data warehouse, or IBM SOA capabilities, IBM can simplify the intelligent oil field IT architecture. These innovative technologies provide plug-and-play processes and information capabilities in a framework designed to enable an organization and its people to collaborate on a deeper, more efficient, global level.

- The single version of the truth

  To the user, the intelligent integration of applications, systems, and databases means a single data point for any given circumstance. No longer will multiple versions of the same data exist in local or unconnected databases. Having a single version of data and the information derived from it eliminates the time-consuming need to explain and reconcile multiple versions of data coming into engineering, accounting, and other departments. It reduces work redundancy, thereby improving efficiency. The single version of the truth becomes a key enabler for people to make higher-quality and repeatable decisions. It is particularly important when regional or global experts, working in remote collaboration centers or control rooms, rely on accessible information to make key decisions. The industry experts at IBM Global Business Services and Ph.D.-level professionals at IBM Research collaborate to supply leading-edge business consulting, rigorous process know-how, and change-management expertise. They couple these capabilities with world-class hardware solutions and innovative, industry-proven software applications, all focused on offering a comprehensive intelligent oil field solution that is applicable today.

Companies can achieve improved and quicker decision-making across chemicals and petroleum business operations through a new real-time integration approach by IBM. Called the C&P IIF, this unique and powerful framework enables solutions providing sophisticated analysis through new business insight, collaboration, and connectivity using the large and complex array of existing disparate assets that chemical and petroleum operations use. Some of the highlights of C&P IIF are as follows:

- Improve productivity from real-time visibility of measurements in the context of equipment
- Reduce costs using federated information providing performance comparison across multiple assets across the enterprise
- Reduce planned and unplanned shutdowns, increase production and decrease maintenance costs based on enterprise wide event based information
- Speed decision making with enterprise wide access to real-time process performance relative to KPIs
- Create agility to incrementally expand across additional assets and processes

### 5.1.3 Wrapping services into Web services to claim SOA

One of the pain areas of oil and gas companies is that they have a broad spectrum of data management needs and work with technologies of varying complexity. These can be overcome using Web services. Web services are software systems designed to support interoperable, machine-to-machine interaction over a network. Web services are a new breed of Web applications that enable companies to automate workflows and access information on demand from within user applications. A key benefit of Web services is interoperability, because Web services enable highly diverse components to exchange information over a network.

In upstream, the right people represents a diverse population from management to marketing to geologists and engineers. Often, these people are globally dispersed, but require access to information stored elsewhere. The right information refers to proprietary, internal data as well as trusted vendor or public information. These requirements tend to encourage greater acceptance of the Internet and Web-based business models.

Many of today's entrenched costs are based on the assumption that employees must store and manage both proprietary and commercial data behind the corporate firewall to achieve desired levels of integration with many different applications. However, the upstream IT spend could be reduced significantly or allocated more effectively if E&P companies used modern Web technologies to

remotely access and seamlessly integrate critical, but non-proprietary, data stored beyond the firewall. This capability would free already stretched IT staff to focus on managing the company's growing volumes of proprietary data.

With Web services, much of the data management effort can be eliminated through automation. Loading, replicating, or synchronizing public data internally becomes unnecessary, because users can access current data on demand over the Internet directly from the vendor. This maintains the information and infrastructure. Automated updates provide users the latest information the moment a commercial vendor loads it to its Web services distribution hub.

Upstream organizations are using Web services in four major integration patterns to perform the following tasks:

- Integrate data on demand with user analytical and interpretive applications;
- Automatically update corporate data management systems;
- Connect users with vital sources of information through E&P portals; and
- Merge multiple spatial data streams through online map and globe visualization tools.

Web services can provide interpretive software with access to data over the Internet in two ways: by automating the update of underlying project databases, and by accessing external data in real time from within the interpretation software.

Another way many companies are seeking to aggregate and integrate numerous applications and data sources is through Web-based portals. One benefit is that the user interface experience is controlled by the customers themselves. The content provider simply makes the information accessible through standard Web services.

Today, Web services are essentially content access services. Going forward, it is likely that more fit-for-purpose Web services will be developed. One example might be a derived data Web services that performs selected calculations on raw data and delivers the result (instead of the raw data) on demand to a user. Web services could also be extended to allow complex searches of unstructured, energy-specific content over the Internet. Schlumberger's recent acquisition of the rights to deploy Metacarta's spatial search technology in the oil and gas industry illustrates the importance vendors are attributing to geographic context-based search capabilities.

While Web services offer promise to the E&P industry and its long-held desire for seamless integration between workflow applications and critical content, they are still in their infancy. Perhaps the most intriguing aspect of Web services is their potential to bridge the gap between the workflow needs of today's current aging

workforce and the workers who have vastly different expectations regarding information access.

Many existing systems traditionally used to manage processes and data are no longer capable of dealing with the complexities of current day-to-day operations or providing the flexibility needed to meet increasing business requirements. Recognizing this reality, many companies are implementing solutions that will allow the creation of composite applications combining numerous business processes from multiple applications into a single user interface. The application is built using SOA.

SOA technology is ideally suited for the oil and gas industry. The SOA approach differs radically from the traditional tiered architecture of large, monolithic software solutions. The main appeal of SOA lies in the ability to reuse existing IT resources, improve interaction among departments, and provide faster and more cost effective process integration. Composite solutions are particularly important to the upstream oil and gas industry because users are constantly accessing disparate systems to manage highly complex and specialized business processes.

A new vision across intelligent oil fields, pipelines, refineries, and chemical plants enables operational leadership to visualize and act upon critical operational data and processes in new ways to make better business decisions, boost production, decrease operational cost, and increase overall efficiency. This vision for better integrated operations and production is enabled by the IBM Chemical and Petroleum Integrated Information Framework (C&P IIF), a new approach for accessing disperse control system, historian, and asset data and delivering it to key users and systems in a context ideal for taking smarter action and improving business process execution. The C&P IIF delivers new business benefits by utilizing distinctive new technology approaches, including the Reference Semantic Model based on industry standards, Web browser visualization software, and enablement in an open SOA. IBM delivers this new framework, composite business services, and approach to leading chemicals and petroleum companies ready to take a next step toward enterprise Web services enablement. We bring the tools, experience, approach, software, and the people to make the C&P IIF a reality at your company through a low cost, incremental, and proven solution approach.

### *The critical objective for information and integration in the oil, gas, and chemical industries*

The ability to make timely, smart business decisions about oil field operations and production performance directly drives the overall effectiveness, efficiency, and production of the range of tasks in upstream or downstream oil fields, plus the key assets working it. Unfortunately, at most chemical and oil production

operations, the information needed to make these vital business decisions is often too little too late to be truly effective. The challenges are many. Operational managers (such as production supervisors) do not have timely and contextual visibility of their field assets. Data standards may be tied to each different equipment type, and critical business information is delivered through crude alarms or belated reports, and often not in a context that promotes better understanding or action. From the technologists' view, the system environment is too diverse and chaotic. Hundreds or thousands of data instances are kept and managed differently. Data is tracked in different conventions and systems, and few common definitions or standards exist. The concept of integrating all of this information seems impossibly expansive or expensive. In many operations, both business and IT leadership must abandon their vision for actionable, integrated, and contextual production data.

With a unique combination of business-focused capabilities and an inventive, leading-edge technology solution, IBM can help chemical and petroleum production operations achieve their vision for integrated operations or smart manufacturing supporting increased profitability and safety. This new approach is called the Chemical and Petroleum Integrated Information Framework (C&P IIF). C&P IIF demonstrates how different users and systems access new business value in the C&P IIF landscape. This is supported by key C&P IIF technology components that bring together information from a diverse and complex system environment.

### *Value of C&P IIF to the chemical and petroleum enterprise*

The C&P IIF transforms how business users view and interact with their oil field assets and teams. The C&P IIF provides production decision-makers with the following new or improved capabilities:

- Visualization of contextual oil field information

  View the entire oil field in a fast and intuitive graphical interface, running on a thin client, where data from every sensor and machine is presentable in clickable, hierarchical levels of detail, ready for analysis and decision making.

- Better decisions utilizing sophisticated measurement and predictive analysis

  Perform deeper and more sophisticated analysis of oil field production, viewing all KPIs and measurements in the right business context, for both real-time decision-making and operational planning.

- Intelligent alerts and event management

  Work with intelligent, predictive, sophisticated alerts that drive information and action to both human and system participants.

- Optimized automation and integration

Provide an open enterprise data and process integration framework for existing and new manufacturing applications

- Expert collaboration

  Enable or extend the ability to collaborate with experts on challenges and solutions instantly through collaboration technologies, shared information, all available from an exciting new vision of the business control room.

- Enterprise connectivity with ERP and other systems

  Share critical operational information with other enterprise applications, such as procurement and ERP, enabling extended business users to better plan, forecast, and respond to business imperatives.

## 5.2 Proposed design patterns

The C&P IIF is enabled by distinctive, leading edge technology practices that make realizing these capabilities viable, affordable, and flexible in even the most complicated system environments. Most importantly, using SOA and other techniques, the approach does not require a replacement or transformation of the existing IT environment, but instead embraces the past IT investments as a foundation for the future, building new and flexible data integration capabilities only previously imagined.

Based on experiences from our global petroleum and chemical projects, IBM has built a Unified Markup Language (UML) model that links to the key industry standards and techniques for representing process equipment and related measurement data, documents, reports, and specifications. C&P IIF enables the management of a previously overwhelming array of disorganized process tag information and creates the ability to name and locate that information for an entire enterprise. The C&P IIF uses this model to manage large volumes of process tags and document information without having to know the specific name of a process tag.

### 5.2.1 Industry standards based meta model

The main architectural component that facilitates C&P IIF is the Solution Studio. The Studio is a Web-based workbench used to design, construct, test, and deploy solution artifacts to the runtime. The Studio is designed to render the framework model (the Framework Meta Model) in different ways to support different levels of users. The C&P IIF technical solution has five distinguishing characteristics:

## Smart SOA approach

A Smart SOA approach is an architectural strategy that enables new functionality to be rapidly deployed without a “rip n' replace” approach to old systems. It creates a win-win for technology and business stakeholders alike: new systems and capabilities can be enabled while technology investments from the past are used.

Services are pieces of application functionality that represent a repeatable, categorically containable business task. In the oil field, an example may be “Check valve pressure” or “Calculate KPIs for Barrels Per Calendar Day (BPCD)”. Services are built once and maintained in one place with interaction through an Enterprise Service Bus (ESB). Services can be combined to form composite applications, and services may be made available for use in other systems. This extensibility is what can effectively integrate the operational data into the core applications, as well as putting into the hands of other business users, such as those using ERP, financial, and transactional systems. The customer determines what components in their environment use these services. The C&P IIF approach extends and improves on a traditional SOA in many ways. C&P IIF is built for the chemicals and petroleum industry, taking into account the specific participating existing applications. The C&P IIF has it own three-mode validation process. It also enables complex alarm and event definition and management that can trigger critical business and technical processes to start or invoke existing applications or calculations.

### *Configurable event rules engine*

The configurable event rules engine enables complex business processes and Web services initiation acting as a nonhuman, intelligent agent. The rules engine monitors data and KPIs based on particular thresholds as well as on sophisticated historical models. The engine has predefined actions it takes when particular criteria is met, such as launching an alert, notifying different users, provisioning information, or launching other system activities. It is completely customizable from the business user, meaning that events and criteria can be defined without IT intervention. This approach takes advantage of the individual's business expertise plus best practice techniques gathered from multiple sources.

### *User visualization, collaboration, and analytical toolset*

The visualization, collaboration, and analytical toolset is the user's portal and metaphor for the field operations, with visual, clickable representations of the field's assets. The user can view the entirety of his oil field metrics by looking at animated summary icons, each with the ability to drill down into further levels of detail. The interface also provides customization tools so that the user can “build their own” oil field, adding new assets, establishing new KPIs, creating business rules, making comments, and logging information into knowledge bases and historians. Top-level functions are as follows:

- Visualization/Manufacturing Intelligence features as follows:
  - Process and instrumentation views;
  - Complex event definition and subscription;
  - KPI definition and tracking;
  - Operations performance views; :
    - Conditioned based monitoring of process equipment,
    - Reporting, dashboard, and analysis tools or collaboration tools:
    - Knowledge sharing
    - Messaging
    - Video conferencing
    - Screen sharing
- Integration and inclusion of extra enterprise businesses and market-facing-units

The interface itself is flexible and extensible. It supports Web 2.0 visualization. The very thin client interface itself is unobtrusive from a system resource stand-point, and can work in nearly every environment, including through SAP® and SharePoint® portals. Due to C&P IIF's use of industry standards, C&P IIF uses the customer's visualization tools, not just IBM visualization tools.

### *How IBM makes C&P IIF a reality for your operation*

The C&P IIF itself is not merely a bundle of software or hardware components. It involves a strategic vision for improved work activities; the coordination of process, people, and technology; and a journey that the enterprise must undertake to realize the vision and benefits. Bringing all of these elements together, from advocacy of senior leadership to the tactical deployment of systems, requires a focused effort on driving real change. IBM understands this, and brings the people, tools, approaches, services, and assets to make the change real for our enterprise clients. The following list details these services and solutions:

- Composite business services that provide solutions to specific business problems on top of C&P IIF. For example, condition monitoring acquires real-time and historical data through integration to distributed control systems (DCS) and historian systems for comparison against engineer-set KPIs and historical performance. Engineers set triggers and monitoring regimes to deliver out-of-tolerance alerts and predictive maintenance information. These services can be reused across assets, speeding the standardization of best practice processes for integrated operations.
- Business analysis, strategy, and planning of the C&P IIF, including understanding the challenges of your unique operation, aligning business strategy with implementation priorities, developing a comprehensive blueprint and roadmap, building stakeholder consensus, and defining a compelling, benefit-driven business case.

- Customization and application of the C&P IIF to bring our proven, pre-built standard models, reference architectures, change plans, and other valuable assets that make up the C&P IIF into your specific business and technology environment to achieve your operational goals.
- Design, build, deploy, and support of the C&P IIF solution, inclusive of technology build-out, technology deployment, design, build and support of new systems and infrastructure.
- Change management, including managing new behavior and competencies within the field personnel, maintaining enthusiasm and advocacy for the change within the leadership team and the company culture, and instilling a formal program of persistent, effective communications.
- Hardware and software solutions from IBM to enable the technology aspects of the C&P IIF.

Oil and gas companies need business intelligence to collect and transfer data that can be analyzed and disseminated to drive business strategy and decision-making. Business intelligence helps to create the potential for hundreds of millions of dollars of business return by using the information created to help improve the way business is done today. Upstream or downstream, business intelligence solutions help to provide chemicals and petroleum companies with the ability to dramatically improve their bottom line by identifying and unlocking hidden value. They can also help spot ways to reduce costs, support greater visibility into current operations and improve the overall performance management process.

Next generation data warehouses provide a generic data structure that separates transaction and reference (business context) data from the current business model, and stores them all as separate entities. This makes it possible to view all of the organization's collected data according to past, current or future business models. A clear view of data in current and future business models is particularly important during merger and acquisition activity, where it enables decision-makers to compare pre- and post-merger performance at high speed and low cost.

Federations of data warehouses are too complex and costly to build and synchronize. Handling multiple business models around the world is a sure-fire way to destroy the integrity of data.

By storing data separately from its model, enterprises can support multiple business models across a federation with greater ease. Synchronization can be handled automatically, with new business models distributed over the Internet, and reporting controlled from a central point for maximal cost-effectiveness.

A major data warehousing project requires significant investments in programming skills, as well as in project management, system architecture, business reporting, Online Analytical Processing (OLAP), and database architecture skills.

By using a pre-built data warehousing application that can quickly be adapted to suit the business, then managed by business users through a simple interface, enterprises can create and run data warehouses without the investment in programming skills normally required, and without needing a skilled database administrator for every local instance.

Building a data warehouse could cost in the millions and take many months, if not years.

Enterprises that use data warehousing applications rather than building from scratch can expect much faster implementation at significantly reduced cost. Next-generation data warehousing software also gives enterprises the opportunity to change the structure and purpose of the data warehouse during the implementation cycle, reducing the need for exhaustive pre-planning and dramatically cutting the risk of project failure.

### 5.2.2 Best practices for context base event management, KPI analysis, and process integration

To handle increasing customer demands and business opportunities, organizations must be flexible and able to adapt to changing requirements. While SOAs and virtualization can help satisfy dynamic business requirements with shared services and composite applications, the complexity of these solutions often creates a significant challenge in quantifying and quickly identifying problems when they occur. With an increasing array of infrastructure applications, devices and connections that must be deployed, tracked, and managed, you can experience poor IT performance and downtime. With so many non-sequential events occurring within your IT environment, there is no easy way to determine whether your business systems are operating properly. Organizations need real-time information about IT infrastructure, but manually collecting, analyzing, and taking appropriate action on key IT infrastructure operational data can be expensive. Organizations need better visibility into business services and information about how infrastructure can support those services. To identify and resolve problems proactively, organizations need help implementing processes and tools to monitor and manage your comprehensive IT environment.

In order to let clients gain the most from their event management and turn multiple monitoring data streams into manageable information, IBM offers Event Management and Monitoring Services for design guidance and deployment services with a focus on event management and monitoring for IT systems, IT services and business performance management. It helps design and implement event automation and correlation with a business-driven view to enable service excellence. IBM applies a proven event management and monitoring (EMM) design methodology along with our EMM workbench. This patented IBM asset for practitioners helps to facilitate collection, normalization and understanding of event and metric data-and convert it into actionable information. By using IBM's proven approach, organizations get improved IT productivity and quality of service through proactive identification and resolution of problems before they impact business performance.

Whether organizations are just getting started or want to expand their existing capabilities, IBM can help you enhance the systems management, services management, and business services management aspects of your business, including support for SOA environments. The services provide the following features:

- High level design services to assess and design event management and monitoring
- Implementation services to implement and deploy event management and monitoring

### *Reducing operational inefficiencies with actionable information*

IBM provides a streamlined, methods-based approach to consolidate, correlate, display, and browse events. IBM's skilled consultants have the experience and expertise from actual customer engagements to design and instrument the key performance indicators (KPIs) and key quality indicators (KQIs) business needs to take appropriate action. This solution can provide real-time information about IT infrastructure, enabling the visibility and control needed to support business adequately, along with the ability to measure and maintain service levels. IBM also help solve the challenge of managing the complex multi-platform and multivendor IT solutions organizations have to support mission-critical business requirements. By using IBM's proven methodology, organizations can synchronize IT services with business objectives. With an integrated approach that includes task and process-level automation, organizations can gain increased organizational efficiency and reliability-across the entire service life cycle.

### *Improving IT performance and availability with rapid identification of problems*

Using automated event management, IBM can help better manage the growing volume of network events that can negatively affect availability and performance. Through anomaly detection, change detection and problem determination, IBM can help reduce down time and improve the availability of your IT service. Organization's staff's ability to perform will no longer be impeded by unforeseen events, undocumented changes, and lack of adequate capacity and planning. In SOA environments, IBM provide ways to monitor and manage composite applications spanning multiple subsystems for quicker problem resolution. With this solution, IT organizations will gain the visibility and control necessary to provide business-relevant information and consistent, uninterrupted service levels.

### *Shortening time to value using IBM proven approach*

IBM can proactively monitor and manage IT environments and automate complex, manual tasks that are time-consuming and prone to failure. Take advantage of IBM's high-level design and implementation services that use proven event management and monitoring methodology to support the development of key event management capabilities. Access service management best practices from extensive experience developing ITIL® enhancements and using them with industry-leading organizations around the world. By applying IBM system and business process insight, organizations can gain enhanced business process flexibility and innovation. Using IBM data-driven event management and monitoring design, event summarization, event throttling and correlation rule generation tools and methodologies, organizations can rapidly experience operational efficiencies. From assessment of the business requirements and existing IT environment through targeted event management and correlation, IBM can help deliver and align a better value of IT infrastructure to business.

KPIs are metrics used to evaluate enterprise performance. Companies use these metrics to measure themselves against other companies in the industry and to report shareholder value. Common KPIs for companies in the petroleum industry are shown in Table 5-1 on page 78.

*Table 5-1 KPIs perspective*

| Perspective | KPI | Description |
|---|---|---|
| Financial Perspective | | |
| | Finding and Development Costs | Costs incurred to survey wells, drill them, infrastructure building, installing production facilities, and so forth. |
| | Gross Refining Margin | The per-barrel composite wholesale product price less the composite refiner acquisition cost of crude oil |
| | Production costs per barrel | Costs incurred in lifting the oil and gas to the surface and in gathering, treating, and storing the oil and gas |
| | Oil Exploration Costs | Costs incurred in exploring property. Exploration involves identifying areas that may warrant examination and examining specific areas, including drilling exploratory wells |
| Customer Perspective | | |
| | Injuries | Number of injuries of staff workers and contractors that require medical treatment and absence from work per million hours |
| | Fatalities | Lives of staff and operators lost during operations |
| | Joint Ventures Success Rate | Several companies pooling capital resources to explore, develop, and produce an offshore tract. |
| | Social Investment | Investment for development of region, country perspective |
| Internal Processes Perspective | | |

| Perspective | KPI | Description |
|---|---|---|
| | Spills | Release of oil into ocean or coastal waters as a result of some human action |
| | Flaring | Act of burning away excess, unwanted gases and liquids released by plant equipment in oil wells or oil rigs (an emission source of green house gases) |
| | Energy Intensity | Metric is not available in trial version |
| | Natural Gas Processing | Metric is not available in trial version |
| Environmental Perspective | | |
| | Green House Gas Emissions | Hazardous gases emitted by oil refineries such as CO2, HFCs, methane and nitrous oxide. |
| | Ozone Depleting Emissions | Harmful gases that cause the depletion of ozone layer such as CFCs and HCFCs. |
| | Freshwater Use | Amount of fresh water used for cleaner environment |
| | Waste Disposal | Means & ways of disposing waste with minimum impact on environment |

Companies today face a constantly increasing pace of change requiring them to be flexible, efficient, and responsive. To meet these challenges, they must be able quickly to integrate, extend, or change their business processes. This can be accomplished by breaking down their monolithic business processes into componentized, reusable steps and assembling them into new, more flexible composite processes. Individual process steps can then be reused or swapped out with minimal effort.

Implementing these composite processes is best accomplished with a SOA. With this approach, the day-to-day business processes are broken down into repeatable business tasks, or services. These services might include manual steps, existing applications, or modules, and Web services. By applying service

orientation, companies can treat business processes simply as a series of services that are linked together. SOA is the IT architectural style that enables the execution of this approach.

IBM WebSphere software provides the integration and infrastructure capabilities required to implement a SOA solution. It provides a flexible, extensible, open standards-based foundation and a suite of integrated tooling that supports the entire SOA life cycle.

The implementation of a service-oriented business process begins when business analysts create a model of the desired process by gathering the requirements, defining the individual process steps, identifying the sequence and interaction of these steps, and optimizing the overall business process.

IBM WebSphere Business Modeler is an easy to use graphical tool enabling business analysts to layout business processes and to define the resources, business objects and data, cost, and other elements that affect business performance.

These models can be shared with other team members for review and refinements.

What separates WebSphere Business Modeler from other graphical design tools is a comprehensive set of simulation capabilities that can be used to analyze the expected process and run what-if scenarios enabling the process to be optimized before deployment. The analyst can also establish metrics that can be captured when the process is executed, enabling them to track KPIs, monitor trends, and address out-of-tolerance situations.

The development of a service-oriented business process consists primarily of assembling the various components and services. IBM WebSphere Integration Developer enables the integration programmer to implement the new process. The assembly begins by importing the previously generated model into WebSphere Integration Developer, ensuring a seamless transfer of requirements between line of business and IT.

The integration programmer can wire together the various components quickly and easily without coding, needing only to know the interfaces of the components, not how the individual service is implemented. The assembled and integrated process can then be deployed to provide new services quickly and efficiently.

IBM WebSphere Process Server provides the integrated runtime for deploying a services oriented process without the complexities associated with traditional integration methodologies. It is built on the reliable and scalable foundation of the industry-leading WebSphere Application Server, and extended with support for

open standards such as BPEL. It provides support for process flows that incorporate existing applications, Web services, and human processing steps. Further flexibility is provided externalizing decision logic into business rules that can be changed without application modification.

By implementing a uniform invocation programming model, called service component architecture, and a common data access method called service data objects, processes can be implemented without knowledge of the existing applications and can be replaced with minimal development effort.

WebSphere Process Server provides a comprehensive solution for deploying service-oriented processes. For customers requiring only an ESB for application connectivity, IBM provides WebSphere ESB. This product can connect applications that use standards-based interfaces such as Web services connectivity and JMS messaging. And WebSphere Message Broker provides an advanced ESB by extending this connectivity to include applications using existing interfaces.

WebSphere Partner Gateway allows users to connect to their global trading partners through the secure exchange between EDI, RosettaNet, XML and other industry standard data exchange formats.

Once a process has been deployed, it must be managed and monitored to ensure it is providing the desired results and benefits.

WebSphere Business Monitor provides an extensive set of metrics for both the line of business user and IT. This includes dashboards offer the following abilities:

- Provide scorecard views of key performance indicators,
- Display costs and times,
- Identify bottlenecks or other out of tolerance situations.

Triggers and notifications are provided to highlight problems and ensure necessary interventions takes place. Monitor's tracking of key performance indicators can identify trends and lead to making continuous process-improvements.

In combination, IBM WebSphere process integration software supports the entire SOA life cycle, enabling companies quickly to model, assemble, deploy, and manage business processes in one integrated environment, while providing customized tooling for the line of business and IT users.

### 5.2.3 Future directions on including collaboration patterns, document management patterns

The importance of getting everyone on the same page has never been more vital to business success. Developments in today's fast-moving markets can occur so quickly that even e-mail seems inadequate for making timely business decisions.

To ensure that new opportunities do not slip by, competitive businesses are now taking a closer look at the new breed of collaboration tools. These technologies help enable geographically dispersed employees and partners to work together as though they are all located in the same room, as well as increasing customer satisfaction by providing immediate service.

#### *Operating in real time becomes a reality*

A recent IBM study on collaboration tools found that nearly 70% of midsize companies indicate employee productivity is a top challenge to growth and profitability. Collaboration tools for information sharing and seamless interaction across multiple locations can provide the boost in productivity these companies seek. Due to more options on the market, real-time capabilities have become affordable for smaller organizations.

The new breed of collaboration tools takes on the need for immediacy with technologies that allow the employees, partners, and suppliers in a business ecosystem to make each other immediately aware of pressing issues. Collaboration capabilities can range from unified communications such as Voice over IP (VoIP) services, instant messaging, and Web conferencing to integrated information delivery tools like portals, intranets, and online team rooms particular to specific projects.

To tie everything together so that information is usable and organized, unified collaboration systems ensure that users can find, connect, and share information in real time and exchange it through devices ranging from PCs to mobile phones.

These tools also allow more collaboration with partners who are vital for business success. Collaboration begins with making information accessible in one place.

#### *Prepackaged cooperation streamlines business processes*

Even though specialized document management allows users to store common files instead of emailing documents back and forth, it is only one aspect of the unified collaboration package. Instant messaging combined with presence awareness now allows teams in Asia and the United States to discuss important matters during the short window of business time for the entire team to communicate in real time.

Presence capabilities also allow team members to invite each other to face-to-face Web conferences, which increases collaboration capabilities without increasing costs.

### *The new group effort requires little effort to implement*

Many of today's collaboration tools require little in-house management, thanks to prebuilt templates and the ability to be implemented alongside existing systems. Subscription services can also help companies manage these tools without requiring more in-house IT expertise.

Considerations about collaboration tools should include the following issues:

- Single, customizable interface
- Address customer-service matters
- Provide a history of all past communications
- Add functions after initial implementation
- Make the solution mobile
- Provide ways to lower the cost of traditional communications

## Document management

Companies with significant investments in operational assets and facilities typically have volumes of technical documents associated with the design, support, maintenance, and operations of these assets. Technical documents exist in multiple locations, various formats, and various versions. Managing these documents, associating the correct version of the document with the right asset, reviewing and approving changes to the documentation, and ensuring the documents reflect the current configuration of the assets can be a daunting task. Any delays in finding or accessing the correct technical documents can impact an organization's operations and impact customer service.

An Enterprise Content Management (ECM) approach to technical document management can remove the complexity associated with managing technical documents and any other critical content associated with assets. IBM solutions for ECM and technical document management can help you perform the following tasks:

- Provide a platform that addresses every stage of the technical document life cycle from creation, reviews, approval, and delivery to archiving and disposal
- Efficiently and securely maintain all relevant content associated with an asset's life cycle, from procurement through retirement
- Facilitate collaboration among globally dispersed users
- Improve maintenance, repair, and operations efficiency through integration with products such as IBM Maximo®

It addresses every stage of the document life cycle, from creation, reviews, and approval to archiving and disposal, and is ideal for managing compound business documents, as shown in Figure 5-7. It offers the following advantages:

- Offers scalable, secure, robust, and rules-based document life cycle management capabilities
- Helps ensure that accurate and up-to-date documents are available on demand and also helps users understand where a document might be in its approval process
- Facilitates collaboration between globally dispersed users through on demand document access
- Supports engineering content (drawings, specifications, contracts and correspondence) that are inherently complex and involve input from multiple constituents
- Delivers integrated records management capabilities with IBM Records Manager for multiple business and engineering applications
- For additional document management capability, also see FileNet® Content Manager
- Operating systems supported: Windows®

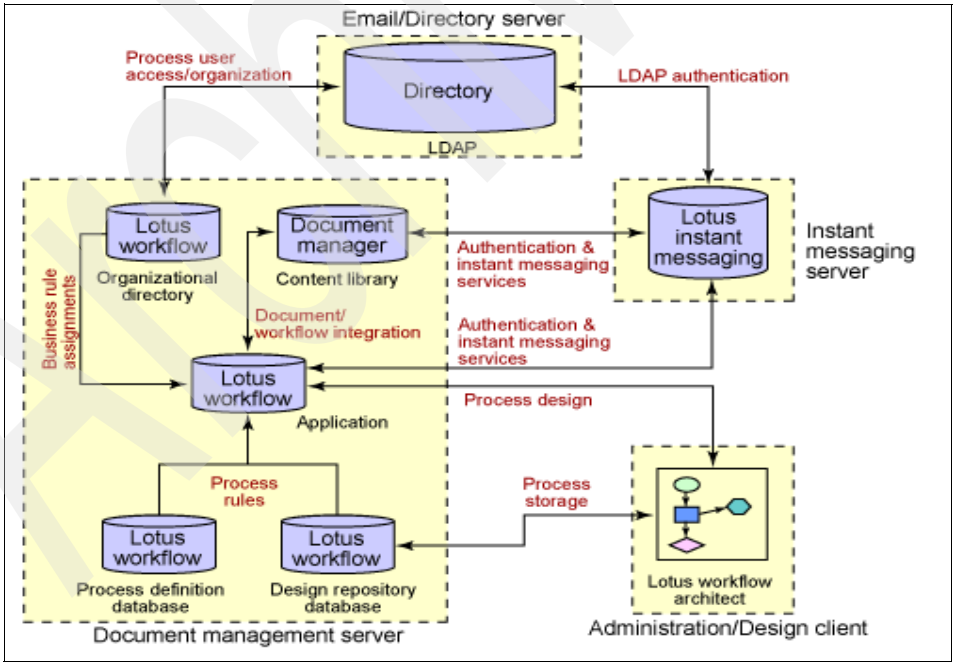


*Figure 5-7 Document management workflow*

6

# Standards in the industry

In any global business, it is important for all participants to agree upon a set of standards. As in many other industries, standards are of critical importance to the petroleum industry from the definition of how much oil is in a barrel (42 U.S. gallons) to how reserves are counted.

Standards help industries to work in a flexible way. The standard consists of models and terminology for structuring the processes and for developing the control of equipment. These can be applied in fully automated, semi-automated and completely manual production processes.

Standards help professionals streamline processes and improve industry safety, efficiency, and profitability. Some of the standards used in the Chemical and Petroleum Integrated Information Framework RSM are as follows:

- ISA-88/BatchML
- ISA-95/B2MML
- Augmented by
  - ISO 15926 (design life cycle and physical connectivity)
  - IEC 61970/68 (electrical model)
  - ISO 13374 (maintenance, for example, MIMOSA)
  - UN/CEFACT (overarching guidance: currency, units, and so forth)
  - UTF (time representation/GMT)
  - OPC (measurements and quality definitions)

## 6.1 OLE for Process Control (OPC)

OPC stands for OLE for Process Control. OLE refers to Object Linking and Embedding (OLE). OPC is the automation industry's version of OLE. The goal of the OPC specification is to provide an open, flexible, plug-and-play software standard for software interoperability in the automation industry. The specification intends to address the specific needs of the automation industry (such as data access (for example, drivers), alarming, historical data access and trending, batch, and more).

The Chemical and Petroleum Integrated Information Framework (C&P IIF) OPC Toolbox provides access to the Value, Quality, and TimeStamp properties of a server item through properties of the data item object associated with that server item.

Every server item on an OPC server has three properties that describe the status of the device or memory location associated with that server item:

- Value

  The value of the server item is the last value that the OPC server stored for that particular item. The value in the cache is updated whenever the server reads from the device. The server reads values from the device at the update rate specified by the dagroup object's UpdateRate property, and only when the item and group are both active. You control the active status of an item or group using that object's Active property.

  In addition, for analog type data (data with the additional OPC Foundation Recommended Properties High EU and Low EU) the percentage change between the cached value and the device value must exceed the DeadbandPercent property specified for that item for the cached value to be updated.

- Quality

  The quality of the server item is a string that represents information about how well the cache value matches the device value. The quality is made up of two parts: a major quality, which can be Good, Bad, or Uncertain, and a minor quality, which describes the reason for the major quality.

  The quality of the server item can change without the value changing. For instance, if the OPC server attempts to obtain a value from the device but that operation fails, the quality will be set to Bad. Also, when you change the client's Active property, the quality will change.

  You must always examine the quality of an item before using the value property of that item.

- TimeStamp

  The time stamp of a server item represents the most recent time that the server assessed that the device set the value and quality properties of that server item. The time stamp can change without the value changing. For example, if the OPC server obtains a value from the device that is the same as the current value, the time stamp property will still be updated, even if the value property is not.

## 6.2 ISA 88-95

ISA-88 is an international standard. It helps industries to produce in a flexible way. The standard consists of models and terminology for structuring the production process and for developing the control of equipment. ISA-88 can be applied in fully automated, semi-automated and completely manual production processes.

BatchML is an XML implementation of the ANSI/ISA 88 family of standards (ISA-88), known internationally as IEC 61512. BatchML consists of a set of XML schemas written using the World Wide Web Consortium's XML Schema Definition (XSD) that implement the models and terminology in the ISA-88 standard.

The ISA-88 standard is recognized worldwide as the standard for the batch processing industry. BatchML provides a set of XML type and element definitions that may be used in part or in whole for batch, master recipe and equipment data. BatchML is an excellent tool to use when exchanging ISA-88 based data.

ISA-95 is the international standard for the integration of enterprise and control systems. ISA-95 consists of models and terminology. These can be used to determine which information has to be exchanged between systems for sales, finance and logistics, and systems for production, maintenance, and quality. This information is structured in Unified Modelling Language (UML) models, which are the basis for the development of standard interfaces between ERP and manufacturing execution systems (MES) systems. The ISA-95 standard can be used for several purposes, for example as a guide for the definition of user requirements, for the selection of MES suppliers and as a basis for the development of MES systems and databases. B2MML is an XML implementation of the ANSI/ISA 95 family of standards (ISA-95), known internationally as IEC/ISO 62264. B2MML consists of a set of XML schemas written using the World Wide Web Consortium's XML Schema Definition (XSD) that implement the data models in the ISA-95 standard. Companies interested in following ISA-95 for integration projects may use B2MML to integrate business systems such as ERP and supply chain management systems with manufacturing systems such as

control systems and manufacturing execution systems. B2MML is a complete implementation of ISA-95 as documented in the completeness, compliance, and conformance statement, which is part of the B2MML download. Any company may use B2MML royalty-free provided credit is given to the WBF, the organization for production technology.

## 6.3 MIMOSA, Open O&M

A new international standard aims to make it easier to assess the health of industrial machinery by improving the way diagnostic information is processed through a software system. Condition monitoring and diagnostics of machines (CM&D) is the process of assessing the health (integrity) of equipment with a view to determining its remaining life. The various computer software programs written for CM&D cannot easily exchange data or operate in a plug-and-play fashion without an extensive integration effort. This makes it difficult to integrate systems and provide users with the bill of health of the asset.

MIMOSA is a non-profit trade association with strong ties to industry and formal international standards bodies such as ISO to develop and promote standards for open operations and maintenance. MIMOSA publishes ISO-compliant open information standards for practical interoperability of on-board and ground condition monitoring and health assessment systems with enterprise-level maintenance, reliability, and operational logistics applications.

For more information about MIMOSA, visit their Web page:

http://www.mimosa.org

MIMOSA's Open Systems Architecture for Condition-Based Maintenance (OSA-CBM) specification is an ISO 13374-compliant on-board condition monitoring and diagnostic (CM&D) processing architecture specification. MIMOSA's Open Systems Architecture for Enterprise Application Integration (OSA-EAI) is compliant as a CM&D information architecture specification with ISO 13374 Parts 1 & 2 and facilitates the integration of CM&D information into enterprise systems. Both OEMs and users are now adopting MIMOSA-compliant systems to facilitate the cost-effective integration of information on platform and throughout their enterprise.

## 6.4 ISO 15926

ISO 15926, *Industrial automation systems and integration-Integration of life-cycle data for process plants including oil and gas production facilities*, is a standard for data integration, sharing, exchange, and hand-over between computer systems.about

This title is regarded too narrow by the present ISO 15926 developers. Having developed a generic data model and reference data library for process plants. It turned out that this subject is already so wide that actually any state information may be modelled with it.

ISO 15926 has nine parts:

- Part 1: Introduction, information concerning engineering, construction and operation of production facilities is created, used and modified by many different organizations throughout a facility's lifetime. The purpose of ISO 15926 is to facilitate integration of data to support the life cycle activities and processes of production facilities.
- Part 2: Data Model. a generic 4D model that can support all disciplines, supply chain company types and life cycle stages, regarding information about functional requirements, physical solutions, types of objects and individual objects as well as activities.
- Part 3: Geometry and Topology, defining, in OWL, the geometrical constructs of ISO 10303-42.
- Parts 4, 5, 6: Reference Data, the terms used within facilities for the process industry.
- Part 7: Implementation methods for the integration of distributed systems, defining an implementation architecture that is based on the W3C Recommendations for the Semantic Web.
- Part 8: OWL and RDF implementation schema for the semantic Web (OWL stands for Web Ontology Language, while RDF is Resource Description Framework)
- Part 9: Façade implementation technology

The model and the library are suitable for representing life cycle information about technical installations and their components.

They can also be used for defining the terms used in product catalogs in e-commerce. Another, more limited, use of the standard is as a reference classification for harmonization purposes between shared databases and product catalogues that are not based on ISO 15926.

The purpose of ISO 15926 is to provide a Lingua Franca for computer systems, thereby integrating the information produced by them. Although set up for the process industries with large projects involving many parties, and involving plant operations and maintenance lasting decades, the technology can be used by anyone willing to set up a proper vocabulary of reference data in line with Part 4.

In Part 7, the concept of Templates is introduced. These are semantic constructs, using Part 2 entities, that represent a small piece of information. These constructs are mapped to more efficient classes of many relations that interlink the nodes that are involved in the represented information.

## 6.5 IEC 61970 / IEC 61968

These international standards for Energy Management Systems (EMS - IEC 61970) and Distribution Managements Systems (DMS - IEC 61968), respectively, specify a Common Information Model (CIM) for utility data exchange, applications programming interfaces (API) for application integration GID - (generic interface definition). Figure 6-1 shows GID versus OPC UA.

| GID Service | OPC |
|---|---|
| HSDA<br>High Speed Data Access | DA<br>Data Access |
| TSDA<br>Time Series Data Access | HDA<br>Historical Data Access |
| GDA<br>Generic Data Access | UA Query<br>Unified Architecture |
| GES<br>Generic Eventing and Subscriptions | AE<br>Alarms & Events |

*Figure 6-1 GID versus OPSC UA*

GID is platform independent and model-driven:

- OPC uses vendor determined namespace for data
- GID uses a namespace derived from the CIM for all data

## 6.6 UN/CEFACT core components

This specification describes and specifies a semantic-based approach to the well-understood problem of the lack of information interoperability within and between applications and data bases in the e-business arena. Traditionally, data has been designed for specific applications and databases without regard to interoperability. Standards for the exchange of that business data between applications and databases have been focused on static message definitions that have not enabled a sufficient degree of interoperability or flexibility. A more flexible and interoperable way of standardizing business semantics has long been required.

The UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business) core component solution described in this technical specification presents just such a methodology. This Core Component Technical Specification (CCTS) describes a revolutionary approach for developing a common set of semantic building blocks that represent the general types of business data in use today. This approach provides for the creation of new business vocabularies as well as restructuring of existing business vocabularies to achieve semantic interoperability of data.

## 6.7 WITSML and PRODML

A modern drilling rig or offshore platform uses a diverse array of specialist contractors, each of whom need to communicate data to the oil company operating the rig, and to each other. Historically, this was done with serial transfer of ascii data, but as the volume of information grows, a new technology is needed.

Wellsite information transfer standard markup language (WITSML) is a standard for transmitting technical data between organizations in the petroleum industry. It is being developed by a Energistics-facilitated special interest group to develop XML standards for petrotechnical data exchange. Groups at which WITSML is targeted include oil companies, service companies, drilling contractors, application vendors, and regulatory agencies.

Production Markup Language (PRODML) is an XML-based standard from Energistics. It is used in the oil and gas industry for exchanging production data between applications. It is an evolution of the drilling and completions standard, WITSML.

In C&P IIF these standards are used to accomplish the following goals:

- Define measurements/reports of interest as follows:
  - RSM has a measurement model.
  - RSM has a generalized document.
- Define how to access the information (for example, protocol) to obtain real-time or historical information.
  - RSM targets GID/OPC/OPC UA for these types of activates.
  - It has been demonstrated that WITSML information can be mapped into and accessed within the RSM context.

## 6.8 OAGIS

The Open Applications Group Integration Specification (OAGIS) is an effort to provide a canonical business language for information integration. It uses XML as the common alphabet for defining business messages, and for identifying business processes (scenarios) that allow businesses and business applications to communicate. Not only is OAGIS the most complete set of XML business messages currently available, but it also accommodates the additional requirements of specific industries by partnering with various vertical industry groups.

The Open Applications Group (OAGi), the organization that oversees the OAGIS, was formed in November 1994 in an effort to ease everywhere-to-everywhere integration (inside and outside of the enterprise, as well as across the supply chain). OAGi has done this by crafting standards where necessary and by recommending standards where they already exist.

## 6.9 What the RSM is attempting to do

RSM is attempting to harmonize S95 and S88. These standards were designed to be used together and closer coupling is needed to make them interoperable on an enterprise and multivendor scale. Linkage to other standards for needed process asset representation. Embraced UNCEFACT Core Components and concepts therein. This is shown in Figure 6-2 on page 93.

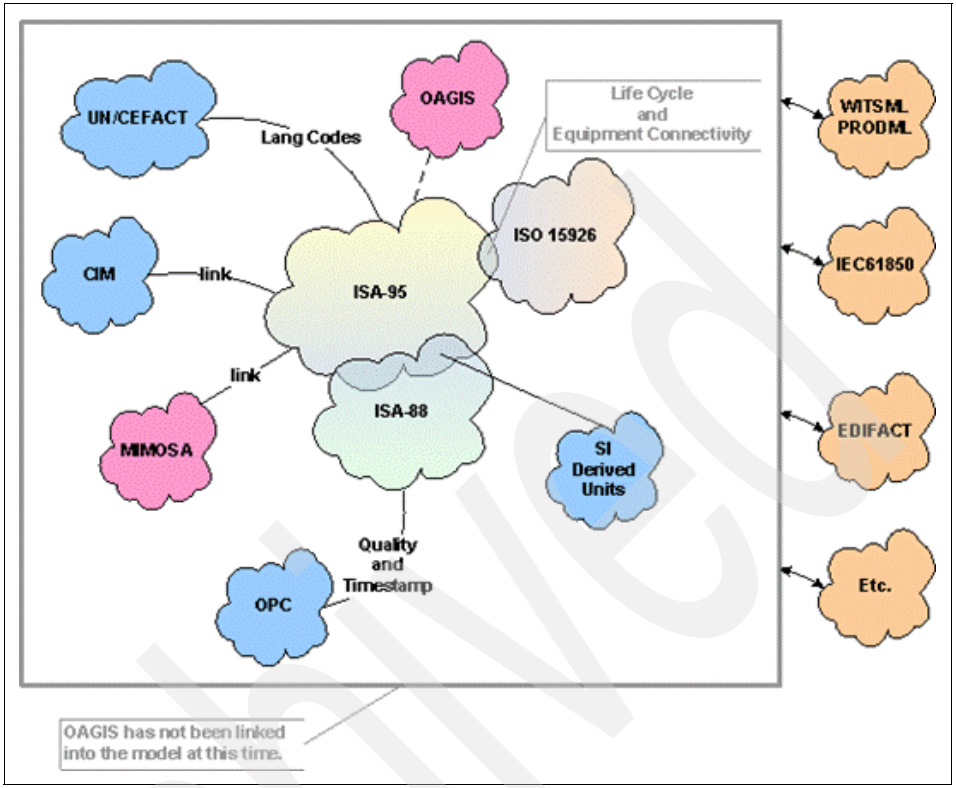


*Figure 6-2 Conceptual RSM*

Harmonization to link important standards into a base model representation to provide complete view of any enterprise from top to bottom. Internal representation of equipment measurement instances and documents, report, specs, and so forth.

RSM has been submitted to the various standards committee for review, comment, and approval as follows:

- Identified ISA-95/88 Standards disconnects and ambiguities and enhanced the vertical linkage between them for a seamless online process equipment and measurement instance representation
- Added the use of enumerations based on core components rather the strings (no free form data types). Note enumeration is the key to enterprise enforcement and utility
- Added a defined measurement type, standardized on SI formats
- Added OPC quality characterization to the measurement type

- Added a general document class that is decomposable and can be queried
- Generalized the physical site hierarchy and the generalized location of entities within the that hierarchy
- Added equipment connectivity to support visualization. Can use the model for an as installed P&IdDiagram
- Added electrical transmission and distribution (power measurement, breaker location, and so forth)
- Added links to the MIMOSA standard for representation of assets (adds maintenance life cycle tracking capability to the model representation)> Figure 6-3 on page 95 shows how ISA 95 and MIMOSA function together.
- Added multiple languages
- Standardized on GMT time
- Enabled model base case to industry to company instance tailoring/extensibility while keeping the contributing model standards sacrosanct/pure (for example, no new standards just linkages and extensions defined though enumeration)

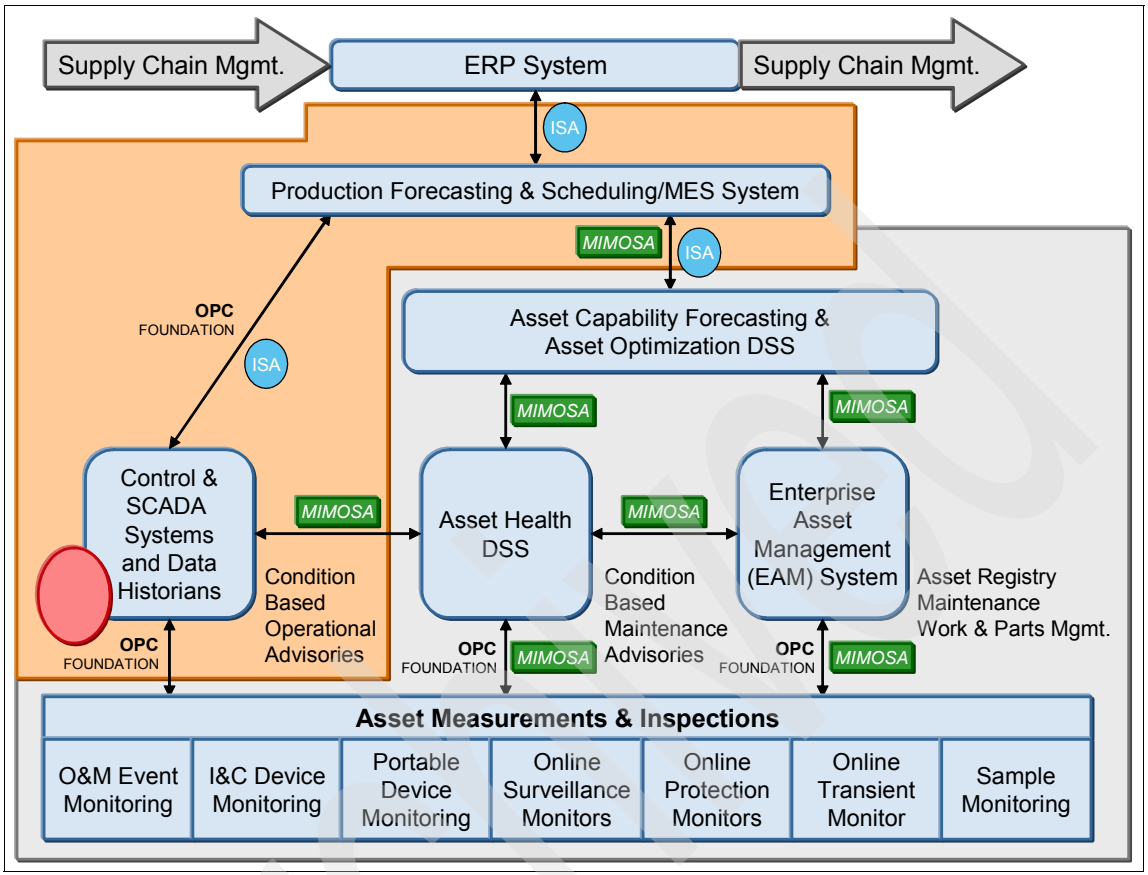


*Figure 6-3 Relation between IS-95 and MIMOSA*

7

# Flexibility of these business value patterns

The Chemical and Petroleum Integrated Information Framework (C&P IIF) is not merely a bundle of software or hardware components. It involves a strategic vision for improved work activities; the coordination of process, people, and technology; and a journey that the industries must undertake to realize the vision and benefits. Bringing all of these elements together, from advocacy of senior leadership to the tactical deployment of systems, requires a focused effort on driving real change. IBM understands this, and brings the people, tools, approaches, services, and assets to make the change real for our industry clients. These services and solutions are as follows:

- Composite business services that provide specific capabilities on top of the C&P IIF. For example, asset condition monitoring acquires real time and historical data through integration to distributed control systems (DCS) and historian systems for comparison against engineer-set KPIs and historical performance. Engineers set triggers and monitoring regimes to deliver out of tolerance alerts and predictive maintenance information. These services can be reused across assets, speeding the standardization of best practice processes for integrated operations.
- Business analysis, strategy, and planning, including understanding the challenges of your unique operation, aligning business strategy with implementation priorities, developing a comprehensive blueprint and road

map, building stakeholder consensus, and defining a compelling, benefit-driven business case.

- Customization and application of the C&P IIF to bring our proven, pre-built standard models, reference architectures, change plans, and other valuable assets that make up the C&P IIF into your specific business and technology environment to achieve your operational goals.
- Design, build, deployment, and support of the C&P IIF solution, inclusive of technology build-out, technology deployment, design, build and support of new systems and infrastructure.
- Change management, including managing new behavior and competencies within the field personnel, maintaining enthusiasm and advocacy for the change within the leadership team and the company culture, and instilling a formal program of persistent, effective communications.
- Hardware and software solutions from IBM to enable the technology aspects of the C&P IIF.

## IBM advantage

As one of the world's largest and most successful consulting and technology solutions companies, we certainly have the credentials and capabilities to deliver C&P IIF to your operations. Perhaps what really differentiates IBM is our deep understanding, investment, and experience in delivering the C&P IIF solution to enterprise-class companies around the world. The C&P IIF is not an academic construct, but a proven, implemented framework that is already in the field at top companies delivering real results.

The following list details key advantages that make IBM an ideal provider of C&P IIF:

- A proven, deployed solution

  We have done the detailed design and construction of C&P IIF for the real world, and can bring this model and toolset to our clients, eschewing a “blank page” or theoretical approach.

- Experience

  We are successfully deploying, testing and measuring real results with C&P IIF at leading companies, and the C&P IIF itself was based on learning from mining, and chemical and petroleum engagements with leading companies around the globe.

- Practice depth and breadth

  Our team is uniquely positioned to deliver innovative industry solutions across the value chain based on our deep R&D capabilities, comprehensive

hardware, software and services portfolio, extensive industry experience and unmatched global presence.

- A focus on results, partnership and innovation

IBM prides itself on creating a genuine partnership with our clients focused on business results. We invest heavily in innovation in the various industries, and bring this benefit to our client-partners.

## 7.1 Mining

The section discusses achieving integrated remote operation and unit efficiency for the mining industry.

The global mining industry is going through a major transformation resulting in challenges and opportunities. There is ongoing global industry consolidation requiring adjustment in the business model and flexible information systems to support the operations on a global scale. The industrialization in Asia is creating strong demand for commodities (for example, copper, nickel, aluminium, and iron ore) and has resulted in the rise of Asian mining and metals conglomerates. In response to increased demand, existing mining operations are running at maximum capacity. Expansion projects are being planned and have to be executed.

This is compounded by the tight supply for consumables (for example, tires, explosives) and for heavy equipment required for continuous production. The management of commodity prices, exchange risks, and capacity constraints are increasing in complexity and importance. Mining companies have a increased focus on their corporate social responsibility in managing the impact of their activities on the community, the environment, and people. The number of skilled resources continues to decline and labor costs are increasing. As mining companies operate globally, this dispersed workforce need to apply their expertise locally and regionally. There are different expectations of newer employees; this generation gap needs to be taken seriously.

The IT mining executive faces equally daunting issues and challenges:

- They have many mining sites, in many countries, with many different IT solutions.
- Mine site specific procedures vary from location to location, often within the same site.
- There are difficulties implementing common processes and measurements.
- There is a need for improved process consistency and decision-making standards.

- There is increased pressure to accelerate the implementation and rollout of new processes and IT solutions across sites, with more assurance of success with reduced costs.
- Too many IT projects fail due to complex, expensive and time-consuming interfaces.
- The 'Mining of the Future' initiatives demand increased access and exploitation of IT technology.

With this in mind, IBM has undertaken a new real-time integration approach that allows mining companies to achieve improved and quicker decision-making across mining business operations. Extending the business value patterns of C&P IIF enables solutions providing sophisticated analysis through new business insight, collaboration, and connectivity using the large and complex array of existing disparate assets that mining operations use.

Highlights:

- Improve productivity from real-time, visibility of measurements in the context of equipment.
- Reduce costs using federated information providing operational comparison across multiple assets across the enterprise.
- Improved decision-making on asset and production effectiveness from centralized sites, and process centers of excellence.
- Reduce planned and unplanned shutdowns, increase production and decrease maintenance costs based on enterprise wide event based information.
- Speed decision-making with enterprise wide access to real-time process performance relative to KPIs.
- Create agility to incrementally expand across additional assets and processes.
- Capability to use operations through a centralized remote center using one common standard approach to real-time data for centralized decision-making.

A new vision across multiple mine settings and areas, multiple types of data networks, and multiple vendor applications enables operational leadership to visualize and act upon critical operational data and processes in new ways to make better business decisions, boost production, decrease operational cost, and increase overall efficiency. This vision for better integrated remote operations and production is enabled a new approach for accessing diverse control system, historian, and asset data from multiple suppliers and delivering it to key experts, users, and systems in a context ideal for taking smarter action and improving business process execution. This approach delivers new business benefits by utilizing distinctive new technology approaches, including the Reference

Semantic Model based on mining industry standards, web browser visualization software, and enablement in an open service-oriented architecture (SOA). IBM delivers this new framework, composite business services, and approach to leading mining companies ready to take a next step toward enterprise Web services enablement. We bring the tools, experience, approach, software, and the people to make mining solutions a reality at your company through a low cost, incremental, and proven solution approach.

The ability to make timely, smart business decisions about mining field operations and production performance directly drives the overall effectiveness, efficiency, and production of the range of tasks and key assets at mine sites. Unfortunately, at most mine site operations, the information needed to make these vital business decisions is often too little too late to be truly effective.

The challenges are many. Operational managers such as production supervisors do not have timely and contextual visibility of their site assets. Data standards may be tied to each different equipment type, and critical business information is delivered through crude alarms or belated reports, and often not in a context that promotes better understanding or action. The ability to visualize and analyze these diverse operations from a centralized location, where mining experts and decision-makers reside, is difficult to achieve.

From the technologists' view, the system environment is too diverse and chaotic. Hundreds of data instances are kept and managed differently; data is tracked in different conventions, systems, and custom and proprietary solutions; and few common definitions or standards exist. There are multiple types of communications networks including video networks, PLC, and process control data plus integration with the business back end systems. The concept of integrating all of this information seems impossibly expansive or expensive. In many operations, both business and IT leadership must abandon their vision for actionable, integrated, contextual production data. It is just too hard to achieve.

With a unique combination of business-focused capabilities and an inventive, leading-edge technology solution, IBM can help mining production operations achieve their vision for integrated remote operations or smart manufacturing supporting increased profitability and safety.

Figure 7-1 on page 102 shows how different users and systems access new business value. This is supported by key technology components that bring together information from a diverse and complex system environment.

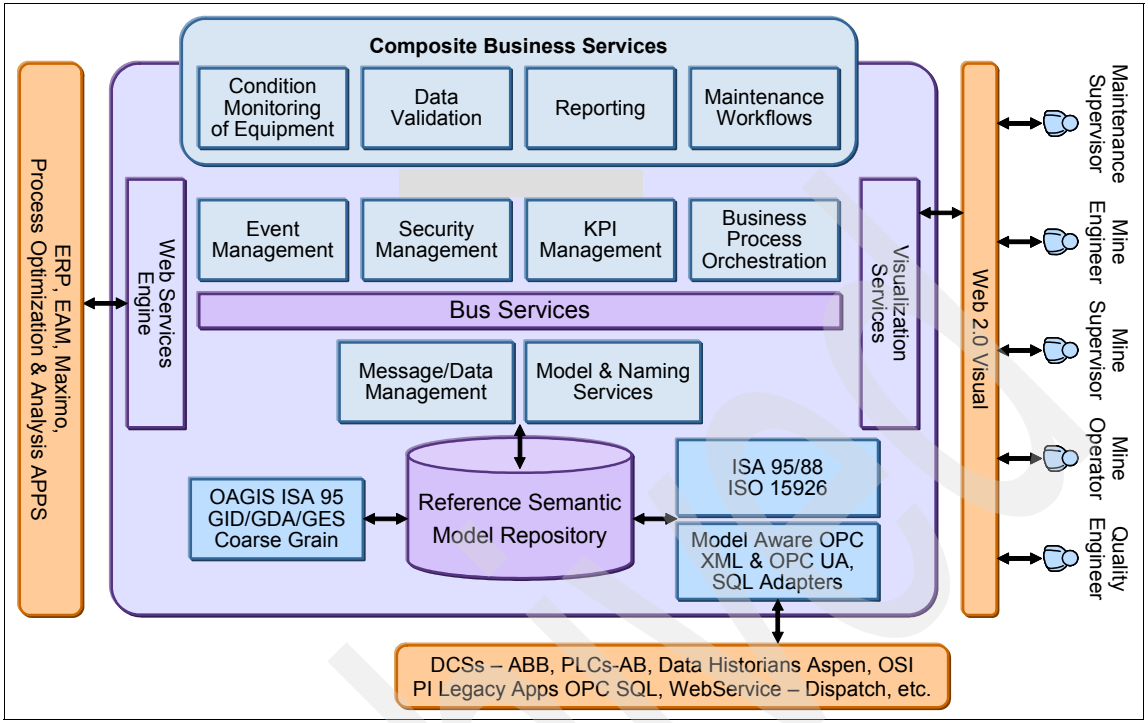


*Figure 7-1 Mining*

## Value to the mining enterprise

This transforms how business users view and interact with their mine site field assets and teams. The mining solutions provide production decision-makers with new or improved capabilities:

- Visualization of contextual mine site information

  View the entire mine site in a fast and intuitive graphical interface, running on a very thin client, where data from every sensor and machine is presentable in clickable, hierarchal levels of detail, ready for analysis and decision making.

- Better decisions utilizing sophisticated measurement and predictive analysis

  Perform deeper and more sophisticated analysis of mine site production, viewing all KPIs and measurements in the right business context, for both real-time decision-making and operational planning.

- Intelligent alerts and event management

  Work with intelligent, predictive, sophisticated alerts that drive information and action to both human and system participants.

- Optimized automation and integration

  Provide an open enterprise data and process integration framework for existing and new mining applications

- Expert collaboration

  Enable or extend the ability to collaborate with experts on challenges and solutions instantly through collaboration technologies, shared information, all available from an exciting new vision of the business control room.

- Remote operations from central location

  Provide the ability for comparison of asset and production information from multiple remote sites to centralized experts and decision-makers

- Enterprise connectivity with ERP and other systems

  Share critical operational information with other enterprise applications, such as procurement and ERP, enabling extended business users to better plan, forecast, and respond to business imperatives.

## 7.2 Automotive

Automotive manufacturing environment is an event driven process where the fundamental problems to solve have the following characteristics:

- Lack of flexibility

  Unable to support process improvements and data accessibility needs. Speed to market of engineering changes and adoption of new business strategies inhibited cannot provide personalized, relevant information in a timely manner to make best decisions

- Obsolete technology

  Technology refresh cycle occurring now globally across automotives. High risk for system outages resulting in production losses. Diminishing skills and parts.

- Lack of system commonality across company

  Vehicle assembly is basically the same world-wide with only minor variants. Inability to replicate process “best practices” and product. Drives up maintenance cost for no added value. Duplicate functionality.

- High support costs

  Maintenance increasing due to existing systems, diverse platforms, duplicate functionality, obsolete technologies, poor data management and point to point integration. Niche manufacturing products with limited support, skills and non-functional capabilities.

The IBM manufacturing productivity software solution is a solution reusing the same business value patterns of this framework, intended to accelerate and facilitate the creation of manufacturing solutions for the automotive industry that integrates the factory floor with suppliers and other systems in the company (such as order management, inventory management, and quality systems). This system does this by providing a framework, templates, and tools for integration of existing applications, and creation of new applications, based on a service-oriented architecture (SOA). The solution is based on two key components of the IBM WebSphere middleware suite: IBM WebSphere Process Server and WebSphere Portal (in 2005, we completed a version of this solution based on WBI/SF 5.1 and Portal 5.1, this document focuses on the new version of the solution being created in 2006). The solution adds value (listed below) on top of the middleware to accelerate the creation and to ease the management of integrated manufacturing solutions:

- Reference architecture and model for integrated manufacturing solutions
- Eclipse-based workbench for configuration of manufacturing processes and associated manufacturing events
- Architecture and solution for end-to-end management of manufacturing business processes
- Implemented templates (from the Global Solution Center and Rockwell Automation) for the following tasks:
  - Order management
  - Broadcast
  - Data collection
  - Work In Progress (WIP) tracking
  - Event management

Additional applicable IBM products (for example the Tivoli suite of system management software or the suite of WebSphere Integration adapters) can be used in conjunction with this solution enabler.

When used with applications from business partners such as Adobe®, Rockwell Automation, and ILS, can greatly accelerate the creation of a manufacturing solution for a customer.

This supports an evolutionary approach to implementing a manufacturing system. Due to the SOA, it is possible to create a solution that includes a combination of functions realized by integrating existing applications, and functions supported by newly created applications. The result is a composite application that uses the portal as a user interface, WebSphere Process Server as an application server for new functions and as an integration hub (based on Web services) for existing applications. A function in the solution (for example, assigning VIN) can begin its life as a Web services wrapper on top of an existing

application that might later be replaced with a new implementation of the service, based on J2EE™. It is in this way that the evolutionary approach is supported.

This is an industry and IT standards-based solution (J2EE, Web services) that supports the strict availability requirements of automotive manufacturing. This is accomplished through the high availability (HA) capabilities of the base middleware products, as well as through the Linux operating system.

This solution views the automotive manufacturing environment as an event driven process where the fundamental problem to solve has the following characteristics:

- A need exists for a means for easy configuration of the system regarding the actions that should be taken as a result of manufacturing events associated with vehicle production (for example, frame on to assembly line).
- Time constraints and the need for evolution of existing systems are driving the need for solution accelerators that enable rapid development of solutions that join new function with existing function in configurable processes.
- Role-based aggregation and viewing of appropriate, information about the manufacturing process is required.

To accomplish this, this solution extends the off-the-shelf capabilities of WebSphere Process Server and WebSphere Portal as shown in Figure 7-2 on page 106. To support the first goal, it includes a portal-based workbench where a nonprogrammer can configure, customize, and reconfigure the processes being used to track and manage production. The second point is supported through SOA, which allows for the functions needed in the system to be componentized as services and then to be orchestrated into event driven processes. Also provided to support the second point is a reference model for automotive manufacturing and sample implementations of that for selected use cases. The third point is supported through the usage of portal server in combination with WebSphere Process Server and the aforementioned accelerators. A suggested organization model for key roles in the solution is also provided, along with a suggested mapping of the portlets to those roles.

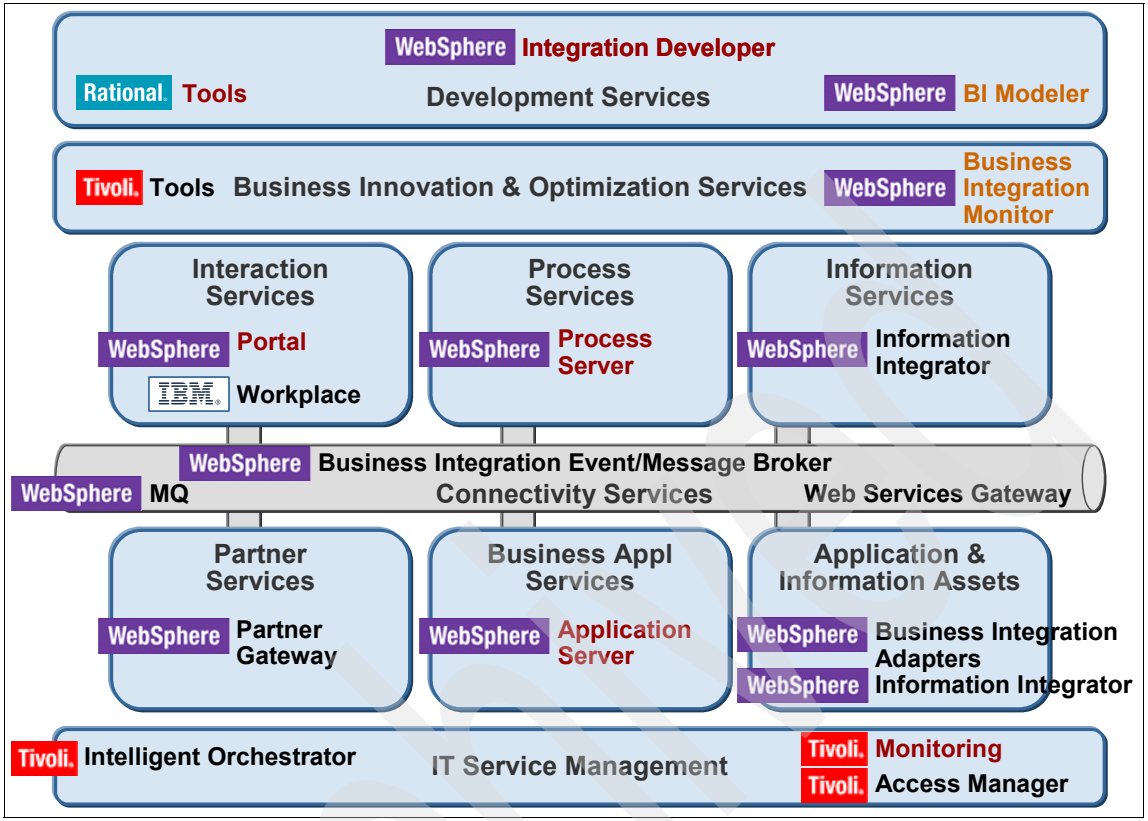


*Figure 7-2 Business integration architecture with overlay*

This solution's implemented templates make it easier to create manufacturing productivity solutions based on SOA. The general idea is to define a set of services that are used as part of the key production processes, and then to knit those together into high level processes that are triggered by key production events (such as a car moving into a station on the line). The first step in doing this is to model the production process to define the processes to be managed and the services required (based on existing or new applications) to realize those processes, as shown in Figure 7-3 on page 107.

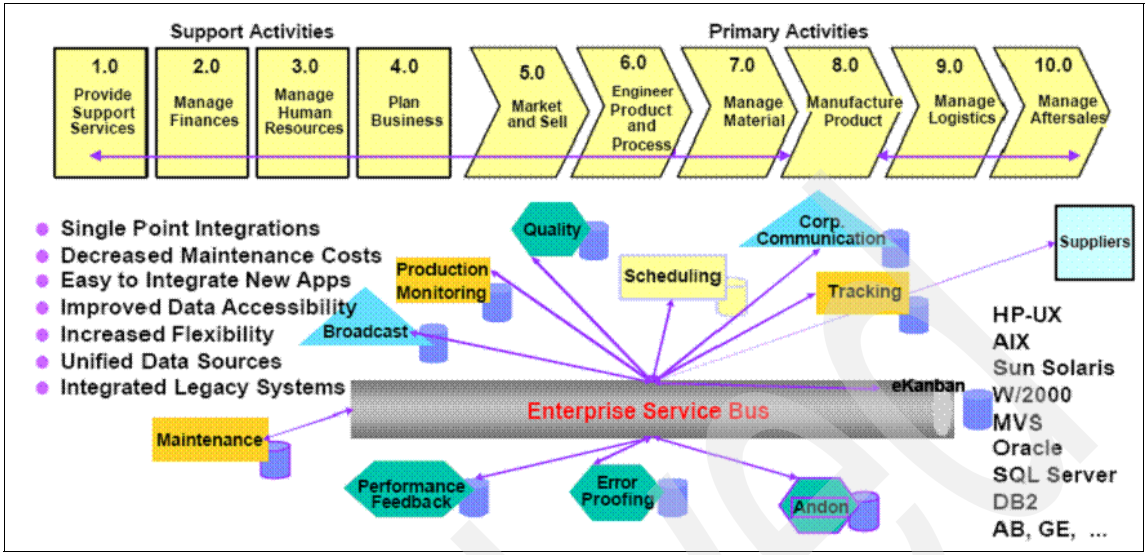


*Figure 7-3 Auto activities as services*

Once the process has been modeled and the services and applications are mapped out, a developer (using tools such as the IBM Rational Software Architect) needs to create services based on new applications, or as wrappers around existing applications, to fill in gaps where services are not already available to realize the processes. Having done that, all of the services can then be catalogued as a pallet of production services, so that a production control user (nonprogrammer) can configure the manufacturing line with regard to key production events that occur on the line, and the corresponding actions the system is to take as a result of those events, as shown in Figure 7-4 on page 108.

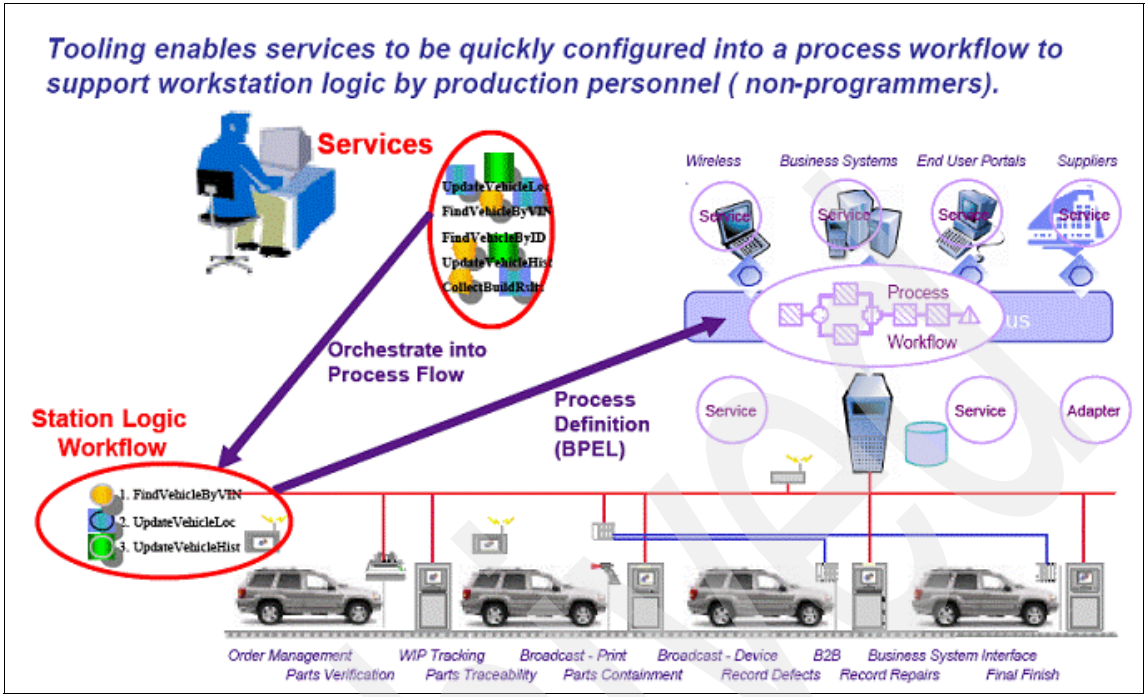


*Figure 7-4 Integrated production services*

Once a configuration has been created in the workbench, it can be deployed to one or more production servers, after which it can be configured to set production parameters specific to that portion of the manufacturing line (for example, the name of a printer to use for labels in that area) and to enable events and processes as needed, depending on current line status. Services referenced in the deployed configuration must be accessible from the production server (but need not be on that server).

## 7.3 Water

While technology plays only a small role in addressing key water issues today, it is increasingly seen as part of the solution to water shortages. Expanding water supplies can help alleviate water scarcity, but the results show that the most promising avenue is likely to be water management reforms, incentive policies, and investments in infrastructure and technology to enhance efficiency in existing uses. Future increases in food production must be achieved without drastic rises in water withdrawal. Improving water efficiency of agriculture and maximizing food output while minimizing water inputs will require better use of technology

and management practices. IBM has come up with an integrated approach to overcome the problems faced by water industry.

Advanced water management is actually a collection of unique areas where IBM has placed focus on controls, integration, analysis, and management techniques. Water quality, storm water management, natural water system protection, water treatment, and industrial water supply protection are all areas where IBM can extend this business value pattern as the fundamental foundation for the overall integrated solution. With a unique combination of business-focused capabilities and an inventive, leading-edge technology solution, IBM can help municipalities, utilities, and environmental protection agencies achieve their vision for managing water resources. Water resources must be managed at many levels and follow closely the management of traffic, automated manufacturing or energy. A complete ecosystem must be set up to understand the effects from weather, gradients, abnormalities in pipelines, and so forth, to create the complete optimization of water.

### Value to water management authorities

Transform how business users view and interact with their overall water resources. Provide production decision-makers with new or improved capabilities:

- Ability to bring together disparate data sources (from GIS and time series, to real-time Supervisory Control And Data Acquisition [SCADA]-based) in a context sensitive methodology. Water must be managed as total system. Bring all these different elements into a single framework.
- Creating a single ecosystem requires merging of many system capabilities with the connection point where services can reside that can be used by every aspect of the system. From modelling the hydrological characteristics of a city to event processing that will drive the automated actions of valves, dams, and dispatchers, they all come together at the framework.
- Visualization is a key aspect of all the advanced water management implementations with a single point for access data owners, so there are never conflicts on active data sources or levels of accessibility. Visualization of contextual water system field information: View the eco-system in a fast and intuitive graphical interface, running on a very thin client, where data from every sensor and machine is presentable in clickable, hierarchical level of detail, ready for analysis and decision making.
- Better decisions utilizing sophisticated measurement and predictive analysis. Perform deeper and more sophisticated analysis of water flow, depth, quality, and so forth, and combining all KPIs and measurements in the right business context, for both real-time decision-making and operational planning.

- Intelligent alerts and event management. Work with intelligent, predictive, sophisticated alerts that drive information and action to both human and system participants. This becomes extremely important as automated controls become the norm. As humans become less involved, it is critical to enable alarms and alerts where automated controls become overwhelmed or where existing situations do not cover the complete gambit of issues.
- Optimized automation and integration. Provide an open enterprise data and process integration framework for existing and new manufacturing applications. One of the most critical systems for linkage is Maximo (or its equivalent asset management system). Dispatching maintenance to emergency areas, predicted failure regions or devices that are malfunctioning is a critical link in the total system.
- Expert collaboration. Enable or extend the ability to collaborate with experts on challenges and solutions instantly through collaboration technologies, shared information, all available from an exciting new vision of the water management dashboards, control rooms, and system-wide decision support tool optimization war rooms.
- Enterprise connectivity with ERP and other systems. Share critical operational information with other enterprise applications, such a procurement and ERP, enabling extended business users to better plan, forecast, and respond to business imperatives. Many industries will go “cold steel” if their water supply is interrupted or altered in quality. Making sure that the larger enterprise is aware and positioned for such an event, and have time to take action (such as stepping up production to cover periods of limited water) is an one of the most fundamental of the optimization engines required.
- Extending the business value pattern provides the framework to make the connections and standardize the services available to make these connections.

## The technical solution

This approach is enabled by distinctive, leading-edge technology practices that make realizing these capabilities viable, affordable, and flexible in even the most complicated system environments. Most importantly, using SOA and other techniques, the approach does not require a replacement or transformation of the existing IT environment, but instead embraces the past IT investments as a foundation for the future, building new and flexible data integration capabilities only previously imagined.

Based on experiences from the chemical and petroleum projects, plans can be made to develop and grow, over time, an equivalent set of Unified Markup Language (UML) models that links to the key, emerging, industry standards, as well as techniques for representing equipment, sensors, and related

measurement data, documents, reports, images, and specifications. More importantly, early users can develop a library or services that allow us to implement IBM and non-IBM best of breed applications is critical to our effort. Many of our early efforts involve the implementation of critical modelling and analytics from IBM Research to the industry. The goals are as follows:

- Provide an immediate, optimal path from research, to early adopters, to business as usual.
- Provide rapid integration framework connections for visualization capabilities. Most projects require many levels of visualization, from advance animation to business intelligence. Key to our efforts is the ability to meet business needs with the assets in the IBM portfolio: Cognos®, Ilog, WebSphere Application Server, Web 2.0
- Provide rapid integration to optimization and analytics software tools. From Ilog to APCS, we must quickly respond to business issues with assets from our technology portfolio

# Abbreviations and acronyms

| | |
|---|---|
| **API** | Application programming interface |
| **APS** | Advanced Planning and Scheduling |
| **CCTS** | Core Component Technical Specification |
| **CIM** | Common Information Model |
| **CM&D** | Condition monitoring and diagnostics |
| **CMMS** | Computerized Maintenance Management System |
| **CRM** | Customer relationship management |
| **DMS** | Distribution Managements Systems |
| **EMS** | Energy Management Systems |
| **GID** | Generic interface definition |
| **IBM** | International Business Machines Corporation |
| **ITSO** | International Technical Support Organization |
| **KPI** | Key performance indicators |
| **LIMS** | Laboratory Information Management System |
| **LP** | Liquid propane |
| **OSA-CBM** | Open Systems Architecture for Condition-Based Maintenance |
| **OSA-EAI** | Open Systems Architecture for Enterprise Application Integration |
| **SCADA** | Supervisory Control And Data Acquisition |
| **SOA** | Service-oriented architecture |
| **UN/CEFACT** | United Nations Centre for Trade Facilitation and Electronic |
| **XSD** | XML Schema language |

# Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

## Online resources

These Web sites are also relevant as further information sources:

- Mimosa

  http://www.mimosa.org

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