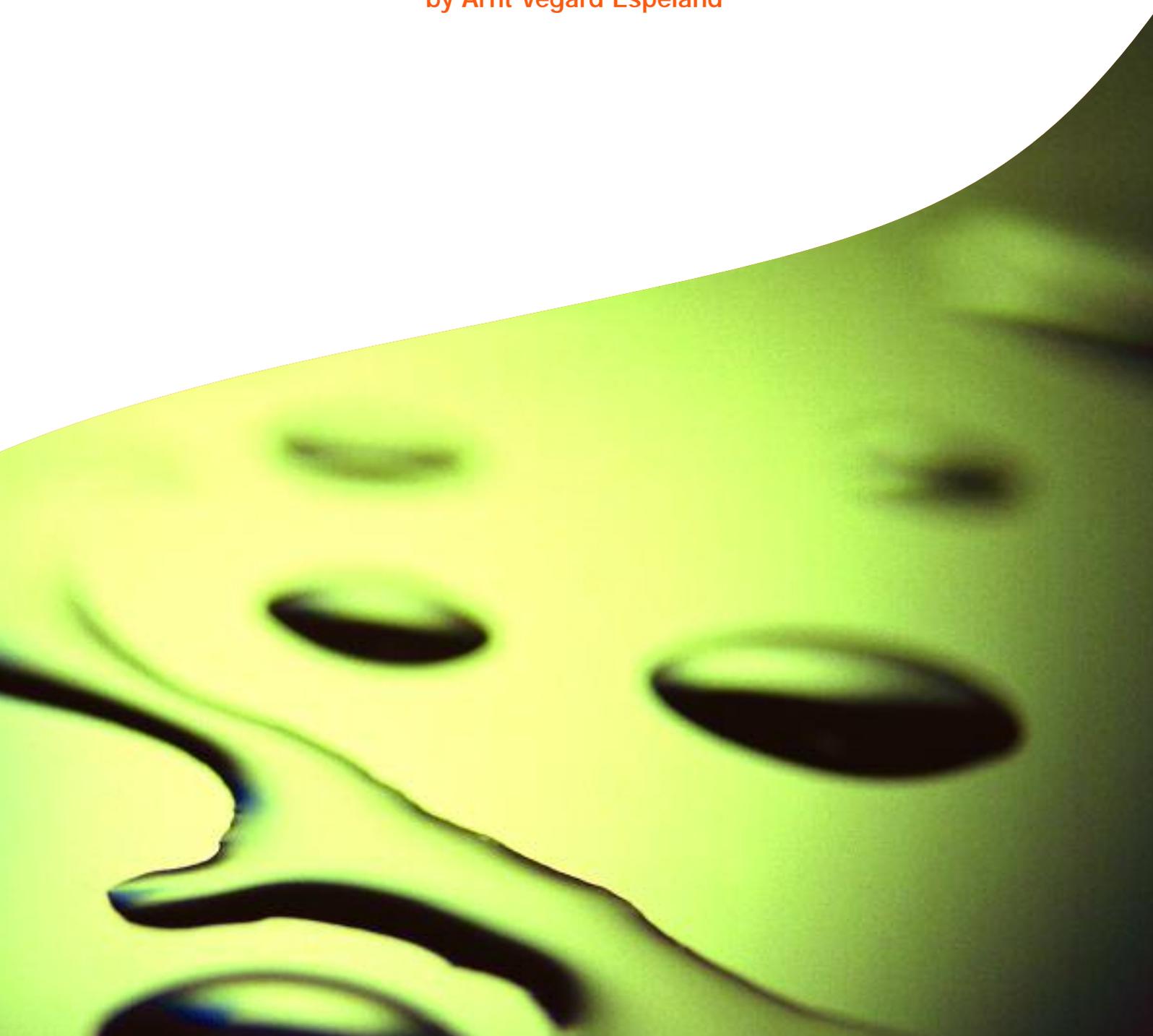


# Service Oriented Architecture for Smart Oil and Gas Operations

by Arnt Vegard Espeland



**The overarching vision of Smart Operations (SOP) is to improve efficiency through better onshore/offshore communication, multi-disciplinary collaboration decision making and improved work process. A Petoro study, performed by Capgemini, concludes that a successful SOP program must include four themes; technology, people, process and implementation.**

Our experience to date indicates that a robust IT architecture is a critical success factor for realizing the benefits of Smart Operations. This paper will establish some key architectural principles for Smart Operations and based on these principle we will compare a Service Oriented Architecture (SOA) versus a traditional architecture approach.

### **Architectural principles**

Smart Operations is about improved efficiency through improved collaborative working practices enabled by new ways of applying technology; this vision implies fundamental changes in business processes. Existing processes will be reengineered, some existing processes will become outdated and some new processes will be created.

It is also important to recognize the strategic nature of Smart Operations; even when initial goals are achieved, there will be room for continued improvement in the future. As such, the business must be flexible and agile with respect to ever changing work processes. IT is a tool box that supports the business. Obvious, this tool box must consist of elements capable of supporting the changes in the business processes.

Changing work processes and enabling multi-disciplinary collaboration will require seamless data flow across applications, application integration and collaboration between applications. Additionally, new technologies will be developed and combined with the new and emerging applications.

Bear in mind that Smart Operations is not an enterprise-internal initiative only. Multidisciplinary collaboration and improved new work flows rely heavily on external service providers. Hence, the data flow and application integration cross enterprise boundaries must be addressed.

Clearly, in order to meet the requirements of flexible work processes, seamless data flow, cross application collaboration and agility with respect to new technology, the IT architecture must at least conform to the following principles:

- Flexibility with respect to changes in the business, future technology, combining functions into new ones, splitting functions into new ones and replacing one function with another.
- Ability to handle real time data.
- Seamless data flow across work processes, applications and across enterprise boundaries.
- Ownership and security of data.

### **Traditional architecture**

The traditional design approach is founded on the business model of large inflexible business units and monolithic functions. For the business, this business model has resulted in big investments, large long running projects and big applications, i.e. ERP.

The applied IT architecture is based on tightly coupled processes and systems. The benefits of this approach are outnumbered by its drawbacks:

- Tightly coupled processes and systems which lead to stovepipes.
- Its point to point interfacing structure has led to unmanageable, inflexible and expensive spaghetti of information systems.
- Enormous complexity of IT landscape

Having the architectural requirements of Smart Operations in mind, it is obvious that the traditional architecture is a dead end. The monolithic nature of traditionally architecture is advocating the opposite of the Smart Operations needed flexibility and agility. The complexity and cost of combining traditionally organized applications into new one supporting ever changing processes quickly becomes unmanageable.

To illustrate the limitations of traditional architecture, we look at the maintenance process in the E&P industry. Maintenance actions are identified through the process steps “Condition Monitoring” and “Maintenance Plan” and trigger the creation of work orders in the “Work order planning” process step. A work order may result in some procurement and inventory updates, which are process steps in the E&P resource planning process. In parallel to the E&P processes, 3rd party supplier company does have a support and sales process that supports the E&P company through selling services (i.e. technical support) and parts.

The traditional supporting IT will be organized as illustrated in figure 1.

As we can see from the figure, the processes are implemented as three systems. A change in the process requires changes in the supporting IT system. Furthermore, the integration between the IT systems is achieved through point-to-point integration. This integration is normally handcrafted and specialized for each case. If other suppliers are to be integrated, new integration modules must be build. Likewise, any changes in one of the E&P IT system can potential have major impact on the integration with the other systems.

**Service oriented architecture**

The latest view of the IT industry is that services and service oriented architecture, SOA, will help reduce the spaghetti index, reduce complexity, lowering cost of change and decrease time to market.

In terms of the maintenance process example, a services organization of the supporting IT system could be like figure 2.

This organization indicates a looser coupling of processes and IT systems; one process is no longer implemented as one monolithic IT system. Changing a process has thus less impact on the supporting IT system. Because each service have standardized its interface, services can be replaced by other services as long as the new service provide the same interface. The standardized interfaces also simplify integration between applications.

Another obvious benefit of a service orientation is reuse of services and increased flexibility. Taking the “Monitoring Service” as an example; for some equipment, the E&P Company will do the monitoring and for another one the E&P Company will outsource the monitoring to a supplier. That is, both the E&P Company and the supplier company can provide the “Monitoring” service. This flexibility can provide cost and performance optimization.

Figure 1

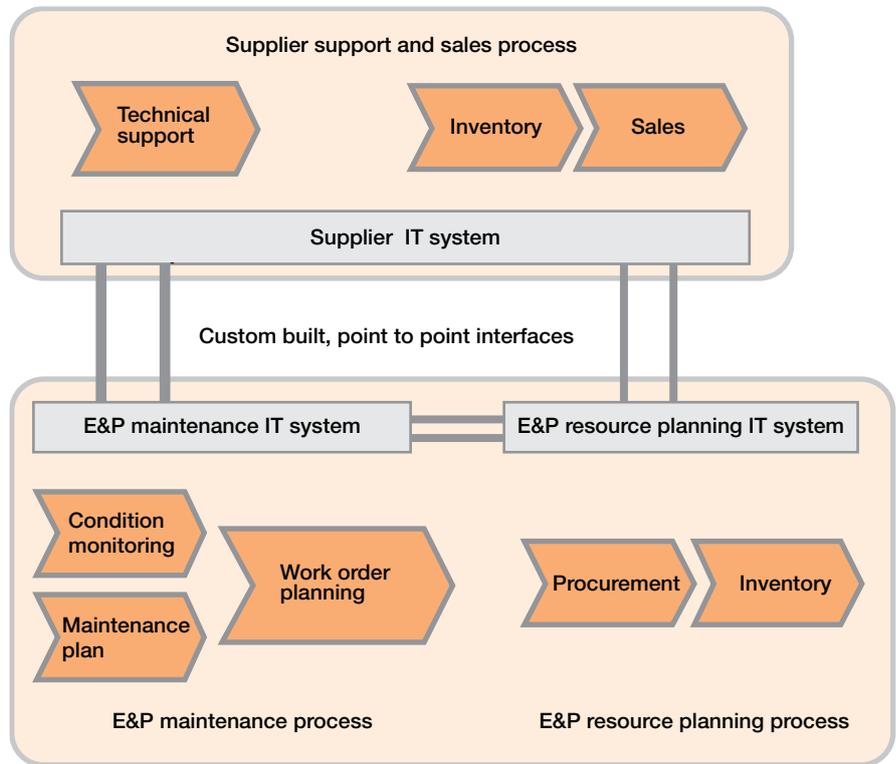
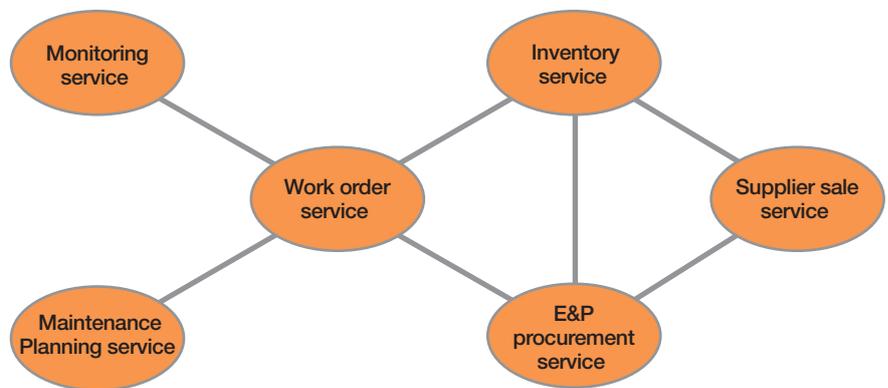


Figure 2



Capgemini firmly believes that to avoid building a new legacy of services spaghetti, consistency and coherence must be brought to the services offered. As a means to achieve this, Capgemini have defined seven principles for SOA:

**Service principle 1: Value.**

Any service should provide value to the customer. Services provided by IT need to provide value that can be measured and assessed qualitatively.

**Service principle 2: Identity.**

Services need to be clearly identifiable. If a service can not be identified it can not be described.

**Service principle 3: Function.**

The function of each service needs to be clearly described. The function description serves two purposes. The consumer needs to know exactly what the service will provide. In the event of a failure to deliver, the provider needs to have good process for handling these exceptions.

**Service principle 4: Trust.**

The consumer needs to be able to trust the function and quality of service defined by the provider.

**Service principle 5: Shared.**

Services should be shared or used again and again. If this is not the case then it is difficult to return the investment of the developed service.

**Service principle 6: Interface.**

Each service needs well-defined interfaces, including pre- and post-conditions. Otherwise the consumer will not know how to request it.

**Service principle 7: Quality.**

A service need to provide information regarding its speed, accuracy, security, cost, scalability etc.

**SOA principles vs. Smart Operations architectural principles**

How does the SOA principles map to the Smart Operations architectural principles? The three first principles; value, identity and function, are all generally applicable. These principles help the organization identifying what key processes will be in place across the enterprise. Each process can be decomposed into process tasks, aka *functions*, which do serve a purpose, i.e. adds *value*.

By defining the set of functions at the right level of granularity, the organization will be able to compose any work process. Hence, the function set supports the flexibility needed to become the base fundament of both existing and future work processes.

The principle of trust and quality are both obvious principles, but must not be ignored. The service value is highly dependent on the quality of service delivered. Therefore, the service must manage the customer's expectation through providing information regarding its speed, accuracy, security, cost, scalability etc. Furthermore, the customer must trust the function and quality of the service defined by the provider. If not the case, then the service will not be used and without being used there is no rationale for the service existence.

The multi-disciplinary collaboration of Smart Operations requires flexibility with respect to changes in work processes, seamless data flow and seamless integration of applications. These requirements are addressed by all seven principles and in particular the *shared* and *interface*. By shared, one service can be used again and again by several groups of professionals both within an enterprise and external 3rd parties.

The key for such sharing is the well-defined *interface* which describes the pre- and post-conditions of the service.

In SOP context, information and data becomes as valuable as assets and facilities. Consequently the information needs to be suitably protected and security must be build into the architecture. The architects must carefully consider the *quality* of each service with respect to information security; right data and service to the right person. A typical scenario is illustrated in figure 3.

Service A has two data elements and is used by two operator companies. Due to some ownership regulations on the service data, Operator 2 should have access to one data element only. Operator 1, on the other hand, should have access to both data elements. This requires some security constraint and is illustrated in the figure by giving Operator 2 accesses to a subset of Service A.

ISO/IEC 17799 provides best practice recommendation on information security management, and can be a great tool for helping setting the right level of security.

Real-time data is important in drilling and operation. In the figure 4, Service A could be some monitoring service and Service B could be a drilling service. The clock icon on the connector between Service A and B is symbolizing real-time data. The requirement of real-time data must be handled by Service B's service contract. Notice that this requirement is addressed by the SOA principles *quality* (i.e. the speed, accuracy and reliability), *interface* and *trust*.

Ease of connectivity to 3rd parties into Operators networks is an issue when dealing with shared services and real-time data cross enterprise boundaries. It can be addressed by carefully applying the SOA principles, in particular the principles of *interface*, *function* and *quality*. Through the SOA

principles, the services will be fully detailed. To further improve resource sharing and smoother implementation of new initiatives, the organization should adhere to standards where appropriate. Standards like POSC WITSMML and ISO 15926 (which Capgemini is supporting) will provide benefits when implementing new cross enterprise initiatives as well as helping realize internal benefits faster.

**The Dynamics of the Business Transformation**

An SOE requires more than just implementing the right technology infrastructure and architecture, although those are essential elements of an SOE. It is truly a transformational journey that requires a company to change the way in which it operates the business.

All E&P companies can benefit from becoming a Service-Oriented Enterprise. However, the way in which different businesses engage the market and the benefits they derive will vary depending on the maturity of the enterprise and the industry:

- 1. New player/mature industry (top left quadrant, Figure 5):** In the case of a new player in a mature industry, the SOE approach allows a business to do what it does, but cheaper and more effectively. By building an SOE platform from scratch, and leveraging alliances and “virtuality” via the Web, these types of companies can break through the existing process paradigms of their industry.
- 2. Established player/mature industry (bottom left quadrant):** In contrast, an established player in a mature industry can take a more evolutionary SOE approach—gradually replacing processes to achieve a cost and scale advantage. In this case, a business would select sub-processes in specific lines of business and geographies for SOE migration, and extend and integrate those on a “proof-of-return” basis.

Figure 3

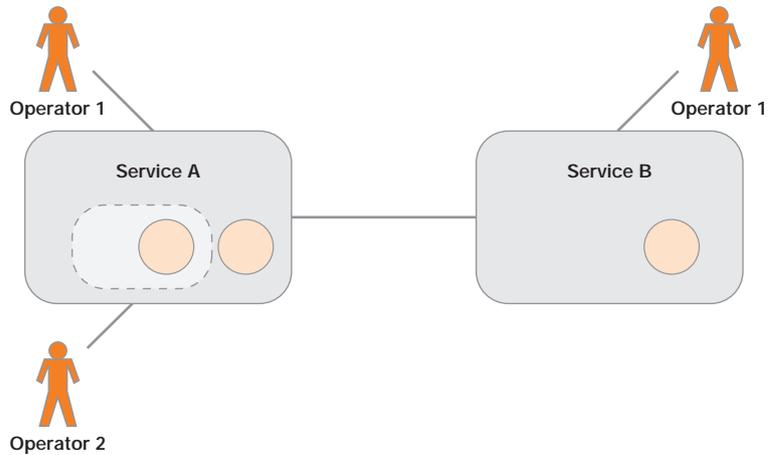
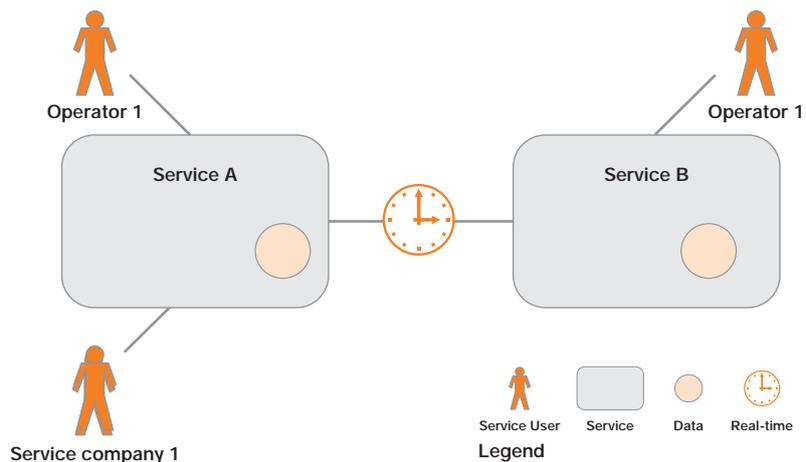


Figure 4



- 3. New player/emerging industry (top right quadrant):** For a new player in an emerging industry SOE offers the potential to innovate faster than the competition. An SOE helps the company stay closer to its customers in order to change as they change, based on a fully service-oriented process, people and IT platform. In other words, the business becomes totally adaptive.
- 4. Established player/emerging industry (bottom right quadrant):** And in the case of an established player entering an emerging industry SOE provides the ability to release the “new” from the legacies of the “old.” A company can configure new lines of business for massive start-up on “pure” SOE platforms, interface with legacy systems and push change toward the center.

Figure 5



Moving to a service-oriented approach also requires that companies make a considerable shift in how they think about ownership: who owns the technology, who owns the data, who owns the process. Ownership issues have become increasingly obscured in today’s environment. Sometimes a company owns the process, sometimes its customers own the process, and sometimes, as when the process exists on the Internet and therefore outside a company’s four walls, it may be unclear who really own the process.

**How Capgemini Can Help**

Capgemini combines significant transformational capabilities with leadership in architecture and open standards and extensive industry experience to help E&P companies become Service-Oriented Enterprises. Capgemini is respected for technology thought leadership and pioneering activities in areas such as Collaborative Working and Adaptive Enterprise, critical elements of a Service-Oriented Enterprise. Our world-class consulting practice specializes in designing and navigating the transformational journey.

**True transformational capabilities**

Capgemini takes a holistic approach to solving complex E&P business problems, driving continual improvements and operational efficiencies from business processes to underlying systems. We are a recognized global leader in transformation consulting, particularly large-scale, enterprise wide transformation. Approximately 65% of our consulting work deals with transformational issues, and we have sustained transformational relationships of more than 10 years with many flagship clients.

**Strong network of technology partners**

Capgemini is working with an ecosystem of technology vendors to shape the industry direction on SOE. Collaboration is the key to meeting the SOE challenge and to developing a changed understanding, culture and approach that redefines the enterprise as truly being “open for business.” A successful SOE knows how to run its business collaboratively in order to get the right knowledge and input from all parties, resulting in the optimum output in any situation. At Capgemini we are working together with market movers—including SAP, Intel, HP, Cisco Systems, Microsoft, Sun Microsystems, Oracle/Siebel and IBM—as well as innovative niche players like Dexterra, Agentis, Cordys and Business Objects to develop and implement SOE and SOA solutions.

**Acknowledged as a leader in architecture**

Capgemini’s leadership in architecture stems from 11 years of developing and enriching our Integrated Architecture Framework (IAF), which links low-level project implementation to high-level business strategy. Our architects are cross-certified to the ITACs global standard. Our community of certified architects, engineers and delivery managers numbers more than 12,300 who are trained in architecture implementation.

Capgemini was positioned by Forrester as a leader among IT services firms in Service-Oriented Architecture capabilities.<sup>1</sup> Capgemini received a "very strong" rating in "systematic approach to architecture," "SOA integration into portfolio," "project execution capabilities" and "evidence of work completed," as well as a "strong" rating in "emphasis on conceptual context" and "strength in SOA-specific offerings." In addition, IDC positioned Capgemini as a "Market Maker" in its Leadership Grid for SOA Professional Services.<sup>2</sup>

### Commitment to open standards

We understand the importance of using standards to conduct business. Imagine where the Web would be if Web servers and browsers didn't follow the standards. Our commitment to open standards is demonstrated through various activities. We have been a significant contributor to open source and work with standards organizations such as the Open Group to develop implementation standards for Service-Oriented Architecture and Service-Oriented Infrastructure. The Open Group is a vendor-neutral and technology-neutral consortium, whose vision of Boundary less Information Flow™ will enable access to integrated information, within and among enterprises, based on open standards and global interoperability. Capgemini is a platinum board member of the Open Group and was elected Vice Chair of the Open Group's Architecture Forum.

### Deep industry experience

Capgemini is a recognized player in the E&P industry and has successfully assisted many clients in transforming their IT and business process capabilities and operations. With a long-term, proven track record, we understand E&P and how to apply that experience to enable profitable growth. Capgemini currently works with the world's leading E&P companies, helping them optimize business operations, streamline expenses and generate profitable revenue growth.

### Summary

Smart Operations is by nature founded in small flexible attributed processes and cross disciplinary collaborative work processes. It is supported by new technology and new ways of applying technology.

To support Smart Operations the organization must establish a solid IT architecture. Compared to the traditional architecture, Service Oriented Architecture can reach its goals because it helps:

- reduce the spaghetti index
- reduce complexity
- lowering cost of change
- decrease time to market
- loose coupling of process and systems
- standardized interfaces

Service Oriented Architecture is founded in the principles: value, identity, function, trust, shared, interface and quality.

1: "Identifying Service Providers' SOA Value," Andrew Parker, Forrester, February 2006.

2: "Worldwide SOA Professional Services Vendor Analysis," Doc #33694, IDC, August 2005.



### About Capgemini and the Collaborative Business Experience

Capgemini, one of the world's foremost providers of Consulting, Technology and Outsourcing services, has a unique way of working with its clients, called the Collaborative Business Experience.

Backed by over three decades of industry and service experience, the Collaborative Business Experience is designed to help our clients achieve better, faster, more sustainable results through seamless access to our network of world-leading technology partners and collaboration-focused methods and tools.

Through commitment to mutual success and the achievement of tangible value, we help businesses implement growth

strategies, leverage technology, and thrive through the power of collaboration. Capgemini employs approximately 61,000 people worldwide and reported 2005 global revenues of 6,954 million euros.

With 1 billion euros revenue in 2005 and 8,000+ dedicated consultants engaged in Energy, Utilities and Chemicals projects across Europe, North America and Asia Pacific, Capgemini's Energy, Utilities & Chemicals Global Sector serves the business consulting and information technology needs of many of the world's largest players of this industry.

More information about our services, offices and research is available at [www.capgemini.com/energy](http://www.capgemini.com/energy).

For more information please contact:

**Arnt Vegard Espeland**

+47 24 12 7236

[arnt-vegard.espeland@capgemini.com](mailto:arnt-vegard.espeland@capgemini.com)

**Patrick Quinlan**

+1 403 444 5628

[patrick.quinlan@capgemini.com](mailto:patrick.quinlan@capgemini.com)

