**Executive Summary**

Unlike digitally savvy banking and retail industries, oil and natural gas businesses are latecomers to digitization. With large capital investments in complex industrial operations, firms in latecomer industries are seeking ways to cut costs and become responsive to market demands. Executives in oil and natural gas companies are facing unprecedented pressure to cut costs due to market turbulence and need advice on how to undertake digitization: organizational changes needed; who should lead the digitization effort; and the role of the chief information officer (CIO) in executing a digital strategy.

We address these issues by drawing on the experience of Encana Oil & Gas (USA) Inc. High fixed costs and declining gas prices required Encana to synchronize production with volatile demand for natural gas. To gain supply chain visibility, Encana’s CIO and business leaders jointly targeted operational processes to embed digital technologies to capture, integrate and deliver information, established new Information Systems (IS) governance policies and redesigned the IS organizational structure. Together, these actions strengthened Encana’s agility to respond to price and demand volatility. In doing so, Encana has become a frontrunner in a latecomer industry.

**DIGITIZATION IN LATECOMER FIRMS**

Digitization has changed the way firms operate in many industries. Financial services underwent digital transformation in the 1990s, followed by retail and entertainment, and, more recently, the healthcare industry. Yet some industries, such as oil and natural gas, waste management and construction, have been slow to adopt digital technologies. We refer to these as latecomer industries. Although firms in latecomer industries have been automating operations and have digitized some administrative processes, such efforts have generally been local and segmented. In the healthcare industry, for example, localized automation occurred in laboratory, radiology and pharmacy services through best-of-breed information systems that, until recently, were not integrated. Once automation in these services was complete, it was possible for healthcare organizations to integrate various parts of their business and offer digital services such as online appointment scheduling by patients, remote access to patient health records and real-time emergency room wait times available via a website.

Latecomer industries include firms with specialized, complex industrial machinery involving large capital investments. These characteristics act as barriers to entry for other firms, which, when combined with cyclical product demand (e.g., commodities), create inertia in undertaking digital transformation—especially when firms are enjoying high profits. However, increasing market turbulence resulting from competition for resources, and stringent regulations, require senior managers to carefully evaluate digitization opportunities to control costs and to become more flexible.

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1 Omar El Sawy, Elena Karahanna and Varun Grover are the accepting senior editors for this article.
Latecomer industry firms embarking on digitization face opportunities, as well as challenges. They can learn from best practices of firms in industries already digitized, but they must also choose which processes to digitize and how to successfully execute technology investments. Given that IT touches nearly all segments of the enterprise, business leaders of latecomer firms look to their CIOs to participate in making digitization choices and to orchestrate technology as well as people, operational processes and policies to impact the firm’s top and bottom lines.

To orchestrate digitization efforts, CIOs in latecomer industries must expand their “toolsmith” role of supporting back-office operations to providing business solutions. Recent research has highlighted the challenges CIOs face in fulfilling the dual expectations of exploring new demand-side opportunities and exploiting supply-side IT resources. These roles address two primary organizational imperatives. First, rapidly changing market conditions demand that organizations quickly assemble their resources—IT and others—to respond with agility. Second, increased competition exerts pressure to reduce operational costs and demands organizational efficiency. These dual demands are as great in the natural gas industry as in any other latecomer industry.

In this article we describe how business and IS leaders at Encana Oil & Gas (USA) Inc., a natural gas firm, responded to the challenges of market volatility driven by a dramatic drop in price and demand for natural gas. (The research we conducted at Encana is described in the Appendix.) We discuss the role of Encana’s CIO and IS function in orchestrating the firm’s organizational resources to exploit integration and digitization in a targeted supply chain process that synchronized drilling operations at the wellhead with market demand. Rather than undertake a comprehensive transformation, the CIO and business leaders carefully identified business processes that increased supply chain visibility and lowered exploration, drilling and delivery costs. They created new policies and redesigned the IS organizational structure to enhance Encana’s agility in responding to market volatility. The article concludes with lessons for CIOs and CEOs in latecomer industries learned from the Encana case.

ENCANA BACKGROUND

History and Corporate Structure

Encana Corporation, the parent company of Encana Oil & Gas (USA) Inc., had gross assets of approximately U.S. $34 billion and gross revenues from sales (net of royalties) of approximately $8.9 billion as of December 31, 2010. Encana, the subsidiary that is the subject of this case study, has about 4,200 employees and a substantial number of contracted staff. It operates gas fields in Canada and the U.S. and is recognized as an innovative mid-size natural gas producer. Its 2010 natural gas production was over 3,300 Millions of Cubic Feet Equivalent (MMcfe) per day. Figure 1 shows the locations of Encana’s gas fields across North America.

Encana entered the U.S. energy sector in 2000 as Alberta Energy Company Oil & Gas (USA) Inc. The company, created through the acquisition of McMurry Oil Company and other private interests, rapidly expanded with the acquisition of Ballard Petroleum in 2001 and Tom Brown Inc. in 2004. Encana Corporation has two operating divisions, the U.S. and Canada Divisions, and several business units (BUs) within each division.

Encana Corporation’s goal is to be the lowest-cost, highest-growth senior natural gas producer in North America.

Business Environment

Technological advances and large capital investments by natural gas firms have resulted in lower exploration costs, reducing, for example, drilling time of a shale gas well by as much as 35 percent. This improved efficiency has increased supply and put downward pressure on gas prices, requiring gas producers to cut costs or curtail production. The new sources of shale gas now coming on stream mean that market

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2 Other authors have identified a CIO role of ‘IT Mechanic’ that we believe is similar to the toolsmith role. See Preston, D. S., Leidner, D. E. and Chen, D. “CIO Leadership Profiles: Implications of Matching CIO Authority and Leadership Capability on IT Impact,” MIS Quarterly Executive (7:2), 2008, pp. 57-69.

3 Chen, D. Q., Preston, D. S. and Xia, W. D. “Antecedents and Effects of CIO Supply-Side and Demand-Side Leadership: A Staged Maturity Model,” Journal of Management Information Systems (27:1), 2010, pp. 231-272. This paper discusses how CIOs are increasingly expected to play both supply-side and demand-side leadership roles in deploying IT.


Digital Transformation in Latecomer Industries: CIO and CEO Leadership Lessons from Encana Oil & Gas (USA) Inc.

Given these market conditions, it becomes imperative that Encana produces optimal quantities of gas. Too much would force Encana to sell gas at a discounted price; too little would result in supply disruption to customers. As a consequence, gas customers—utility companies, brokers and industrial buyers—are concerned about the uncertainty from potential disruption in supplies should drilling become unprofitable for gas producers.

To reduce uncertainty, gas producers and customers enter into contracts based on fixed prices, floating index-based rates or an option involving a combination of fixed price and floating index. While such transaction structures provide some certainty for gas customers, they require gas producers to closely monitor the terms of each contract vis-à-vis production costs and to make prompt adjustments.

Organizational Goals For Digitization

Natural gas companies like Encana are reluctant to invest in digitization while market conditions are so uncertain. As in other latecomer industries, the natural gas supply chain involves large capital expenditures in equipment and several complex processes—exploration, extraction, production, transport, storage, distribution and marketing. Digital transformation in the natural gas industry requires substantial IT investments as well as expertise to integrate various supply chain processes—a commitment for which...
natural gas firms are not yet equipped. Therefore, natural gas producers must carefully evaluate their business goals and allocate organizational resources prior to committing to investments in digitization.

To address these challenges and market conditions, Encana’s business and IS leaders set two organizational goals for digitization:

1. Respond effectively to price volatility; and
2. Reduce production costs by seeking unconventional sources of natural gas.

Driven by these goals, Encana has aggressively staked claims—known as “plays” in the oil and natural gas industry—to extract natural gas in areas that account for nearly 25 percent of the U.S. reserves, which are estimated to last for more than 100 years. From a digitization perspective, these goals translated into integrating the supply chain from “wellhead to Wall Street” so the firm could regulate production by automating and integrating the exploration, drilling and delivery processes.

**CIO ASSIGNED BY THE CEO TO ORCHESTRATE DIGITIZATION**

Prior to 1990, Encana’s IS function was organized to deliver reliable and efficient core computing services such as networking, telecommunications, servers, desktops and e-mail. The CIO’s role was that of a toolsmith, characterized by an absence of business leadership and low decision-making authority to engage in or influence strategic decisions.

In the 1990s, Encana’s senior business and IS leaders began discussing emerging technologies and how IT could help position the business for growth. Senior business executives, though complementary about the CIO’s ability to deliver a reliable and cost-effective IT environment, cautioned him that the IS function must not constrain Encana’s business flexibility. Strong fiscal management of Encana’s business model required the IS function to be agile and capable of quickly scaling IT systems to meet business demands. This quickly became the CIO’s mantra and a clarion call for the IS organization to better understand business needs and to assess how IT could improve operational, managerial and strategic business processes.

There were two main questions that needed to be addressed: how would the CIO and business leaders translate this vision into lower production costs and responsiveness to price volatility?; and who would lead this effort? While gas engineers understand drilling and gas delivery, they are not familiar with IT capabilities. Conversely, IT professionals had little understanding of what occurs at the wellhead.

As Encana envisioned IT’s role in fostering growth, the natural gas industry as a whole was enjoying high profits due to record high gas prices. As such, cost reduction or agility was not a high priority for the firms and the CIO’s toolsmith role served quite well. Yet, Encana’s executives understood that increasing sources of shale gas in North America would inevitably lead to greater price volatility, requiring it to become efficient in selecting and acquiring gas fields, in gas exploration and drilling, and in delivery, while staying synchronized with fluctuating prices and market demand.

As Encana’s business strategy emphasized low-cost and high-availability gas production it was clear that the effort would involve the entire organization. The CIO and IS function were essential to this effort because IT touches every part of the organization. Encana’s CEO therefore assigned the CIO to orchestrate the digitization effort to reduce costs and develop capabilities to deal with market volatility. The CIO leveraged learning from the engagement framework previously deployed in Encana’s Canadian operations, and took on a “Mr. Holland

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9 Holland, D. “Your IT department is not ready,” Digital Energy Journal (30), April 2011, pp. 14-16. This paper explores the application of Digital Oil Field (DOF) systems and concludes that the upstream technical side is ill-equipped and inappropriately staffed for companies to take advantage of digital technology’s potential.

10 There are four types of unconventional gas sources: deep-basin, low permeability, dispersed and tight, and shale. They are difficult to explore and require specialized drilling equipment and expertise. For more information, see Eresman, R. “Future is Unconventional,” World Energy (7-4), 2004, pp. 58-60.


12 Originally, the CIO sometimes interacted with Executive Vice Presidents rather than the CEO.

13 Preston, D. S., Leidner, D. E. and Chen, D., op. cit., 2008. This article discusses characteristics of CIO profiles and differentiates between CIOs’ strategic and tactical leadership and decision making.

14 Preston, D. S. and Karahanna, E. “How to Develop a Shared Vision: The Key to IS Strategic Alignment,” MIS Quarterly Executive (8:1), 2009, pp. 1-8. This article discusses the mechanisms for developing a shared vision between the CIO and the top management team. These mechanisms are Star, Executive, Confidante, Educator and Underperformer.

15 Fonstad, N. O. and Robertson, D. “Transforming a Company, Project by Project: The IT Engagement Model,” MIS Quarterly Executive (5:1), 2006, pp. 1-14. This article proposes that a successful approach addresses two fundamental goals: alignment between IT and the rest of the business and coordination across multiple organizational levels. Encana also operated across multiple levels and adopted the IT engagement model approach.
role”\(^{16}\) to orchestrate technology, governance and processes to create a “digital opus” that would make Encana a frontrunner in a latecomer industry.\(^{17}\)

**BUILDING THE DIGITIZATION INFRASTRUCTURE**

Most of the well-known examples of digitization involve firms that have converted physical products into digitally deliverable products. Examples include e-books and downloadable music, or, in the case of physical products, information about delivery processes such as package tracking (e.g., UPS, FedEx) or troubleshooting support (e.g., HP printers). As Encana’s product cannot be digitized, the firm needed to digitize production information by embedding IT into wellhead devices and other equipment, integrating supply chain processes and disseminating near real-time information for decision making.

Figure 2 shows the four phases of Encana’s “digital oilfield” investment. **Phase I** (Wellhead Automation) commenced in 2002 and involved the digitization of key upstream supply chain processes with Internet-based financial and operational systems. These included electronic invoicing and field ticket transactions (to record time, volume and/or type of product or service, and pickup and/or drop-off information) with its suppliers and vendors to accelerate invoicing and reduce transaction costs. Digital integration of back-office operations with suppliers’ processes provided Encana managers with insights of what drives operational costs and strengthened supplier relationships.

Similarly, digitization of internal business processes required integrating the Supervisory Control and Data Acquisition (SCADA) systems\(^{18}\) used to manage gas wells and production operations with corporate decision support systems. SCADA systems were initially deployed in the field for operational efficiency with little or no integration with corporate IT systems. The emergence of embedded Internet-based IP networks now enable integrated signaling hardware and controllers to feed into Encana’s communications infrastructure.

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\(^{16}\) Refers to the lead character music teacher in the movie *Mr. Holland’s Opus* (1995), who “… sharing his contagious passion for music with his students becomes his new definition of success.” See http://www.imdb.com/title/tt0113862/.

\(^{17}\) Preston, D. S., Leidner, D. E. and Chen, D., op cit., 2008. This article defines the IT orchestrator CIO as one with strategic knowledge, interpersonal skills, reporting to the CEO or top management, and with a strategic IT vision. Our definition of the orchestrator CIO is broader and includes coordination of non-IT resources.

\(^{18}\) SCADA systems include valves, motors, and sensors that when integrated with software can monitor and control a plant or equipment. Their applications are in telecoms, water and waste control, energy, oil and gas refining, and transportation.
network and thus provide greater supply chain visibility and control.

Integration of SCADA systems with the IS network set the stage for the CIO and IS management team to play a defining role in orchestrating other organizational resources to address Encana’s digitization goals. Large amounts of field data could now be mined, delivered and applied by executive leadership and decision makers in various business groups such as Land, Drilling and Completions, Operations and Production Engineering, Production Accounting, Gas Marketing and Strategic Planning.

Recognizing that wellhead digitization involves more than simply connecting various disparate systems, the CIO and the executive leadership team sponsored the Production Volume Management (PVM) system—Phase II of the digitization effort—with a capital investment of $20 million. Tim Blackwood, Encana’s Vice-President, Finance, summarized the impetus for PVM and the expected results from digitization as:

“... we spend considerable time investigating the source for factual information and manipulating data to meet specific needs. Inconsistent processes and multiple, duplicate tools throughout the division further contribute to risk and lost productivity. The ultimate goal of PVM is to provide the business with high-quality, timely and reliable production data. This will enhance the quality of our decisions, support our future growth and lay the foundation of our future success.”

A schematic of the PVM system is shown in Figure 3. PVM optimized the upstream supply chain for effective cost management. It also introduced innovative technologies to digitize business processes such as field data capture, daily production reporting, production accounting, royalties management and plant accounting, all of which enabled greater visibility into the supply chain.

In Phase III—Land & Revenue Accounting system—data from operations was combined with contracts and accruals of land royalties to monitor the profitability of each gas play. As shown in Figure 4, data captured from drilling, production, maintenance and other systems, including upstream supplier invoices, provided decision makers with a data trail of business
operations. This “visualization” provided deeper insights into the cost structures of Encana’s capital investments in production and reservoir management, thus enabling managers to become more efficient by adjusting not only the production at the gas wells, but also in managing drilling and maintenance schedules. Figure 4 also depicts how the CIO’s orchestrator role encompasses his toolsmith role.

As shown in Figure 4, business intelligence tools were used in Phase III to identify patterns from integrated cross-functional data combined with external scientific and geological data to produce near real time actionable knowledge to fine-tune Encana’s strategic planning. With a capital investment of $12 million, the Land and Revenue Management system integrated information about key assets for exploration and drilling. Together, Phases II and III thus targeted the harnessing of real time data (e.g., SCADA) and historical data (e.g., leasing and drilling costs) that would significantly advance managerial decision making and contract performance.

The orchestration of business resources led to “brick-by-brick” digitization of processes, resulting in applications such as Digital Oil Platform (DOP) and Electronic Lease Purchase Report (eLPR), both of which are described in the box below. These applications enabled Encana to exercise greater cost control and agility in securing land leases while also strengthening relationships with contractors and service providers. In the drilling sector, rapport with service providers is an intangible asset that is essential to meet exploration and delivery deadlines and is highly valued among natural gas companies. Capabilities to manage suppliers and control costs are considered essential to becoming a world-class energy producer.19

Phase IV—Third-Party Collaboration—(2011-2013) seeks to add more “bricks” to Encana’s digitization through integration with the systems of third parties such as industrial customers, utility companies and gas distributors.

19 Laurens, C. and van der Molen, O. “This is the time to deliver on upstream operational excellence,” McKinsey Quarterly, Winter 2010, pp. 26-32. The authors contend that world-class oil and gas producers have superior supplier management and cost control capabilities.
ORCHESTRATING ORGANIZATIONAL RESOURCES FOR DIGITIZATION

Orchestrating organizational resources to digitize processes requires both supply-side and demand-side leadership. As in an orchestra, although several different notes play concurrently, one hears each note relative to the lowest sounding pitch—the bass note. IT is akin to the bass note that connects various other organizational functions in order to execute the overall business strategy. An IT function that is out of tune with the rest of the organization will certainly stand out for all the wrong reasons.

Business strategy is implemented through organizational design and control processes that are consistent with the values (and mission) of the organization.20 Firms in latecomer industries typically have large investments in mechanical equipment, and their organizational strategy requires synchronized redesign of business and operational processes, IS and corporate governance, incentives and learning mechanisms. Encana’s CIO orchestrator role thus required crafting an organizational strategy that integrated exploration and drilling assets with administrative processes (as described above).

We describe below how Encana’s digitization strategy capitalized on visibility into the supply chain to control costs and respond quickly to market demands. Combined with applications, such as DOP and eLPR, the PVM system provided efficiency as well as agility. Agility was further accelerated through business intelligence generated from cross-process analysis of business operations (Figure 4). With such intelligence, Encana could anticipate business conditions, pre-empt operational risks, and seize new business opportunities by better understanding the markets it served. For instance, gas prices are based primarily on the prevailing index prices for natural gas in the region in which it is sold. Since large energy consumers such as electricity companies can substitute fuels for electric generation, gas prices are also impacted by prices of competing fuels (e.g., coal and oil) as well as regional energy demand and supply. Business intelligence generated from indices and prices of competing

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fuels informed decision makers so they could adjust production to remain synchronized with demand.

As a first step toward developing the organizational strategy, Encana’s leaders revised IS and business governance and established IS guiding principles for acquiring IT, information availability and responsibility for demonstrating value from IT investments. The guiding principles would serve as a blueprint for Encana’s pursuit of achieving operational excellence and organizational goals. Figure 5 depicts the way in which Encana’s CIO orchestrated organizational resources as the firm digitized its operations and processes.

**Establishing IS Guiding Principles**

Encana’s senior management and the CIO jointly established the 10 IS guiding principles set out in Table 1 and objectively determined the IS function’s role. First, they identified the core IS competencies that were critical to the business and must remain within the enterprise. The objective was to establish internal IT service levels required to sustain business applications and preserve vital data for cost control and business agility. For all other IT functions, Encana’s leaders decided to retain planning, vendor management and firm-specific skill sets while actively seeking to outsource the tactical and technical operations. Encana adopted Gartner’s IS Lite staffing model and modified it to drive better IS-business synergies.

**Restructuring the IS Organization**

Each of Encana’s two divisions has several Business Units (BUs). Each BU is serviced by various support groups such as Business Services, Drillings & Completions, Environment, Health and Safety, and IT Solutions (referred to here as IS). The IS organizational structure mirrors that of the business with an IS leadership team at the corporate level, an IS team at the division level, and IS groups at the BU level. A key responsibility of the IS leadership team is to advocate BU needs at the division and corporate level.

To support the guiding principles, the CIO restructured the IS organization to a highly decentralized governance model where IS professionals worked alongside BU managers. This close relationship protected BU interests and ensured reliable and local solutions to support BU operations. Commodity functions such as telecoms, networking...
and hardware acquisition were centralized at the corporate and division levels so the BUs could benefit from economies of scale in contracting and purchasing IT services.

The decision rights for the size and structure of BU IS groups were assigned to BU business managers. This meant that BU managers determined IS service levels according to their business priorities and allocated the IS budget accordingly. The BUs were responsible for directing how divisional IS teams should focus their services—for instance, by application support or by BU function such as account management, field support or business systems analysis. This governance structure encouraged IS staff to learn the business and participate in providing practical and innovative solutions. This learning and innovation was a critical component of Encana’s agility to respond to new gas plays, land leases and gas supplies contracts. Better understanding of the business also enabled IS professionals to seek opportunities for efficiencies within IS.

Business Unit IS groups retained the link to corporate IS through a reporting relationship that enabled them to have access to best practices and process standards as well as provide input to contract terms with IT vendors and service providers. The highly decentralized governance model enabled corporate IS to concentrate on IT platform development, and supporting corporate business functions such as compliance, regulatory and strategic alliances. In summary, BU IS groups focused on how best to support the operations while corporate IS supported global business needs emerging from the BU groups.

### Overcoming Resistance to Outsourcing

Consistent with the guiding principles, the CIO distinguished between efficiency-creating IS and strategy-enabling IS, with the aim of outsourcing or contracting out much of the efficiency-creating IS and retaining strategy-enabling IS. In the past, efficiency-creating IS was developed, implemented and maintained within Encana, and some IS professionals were resistant to the idea of this type of IS being outsourced.

<table>
<thead>
<tr>
<th>Table 1: Encana’s 10 IS Guiding Principles</th>
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<tbody>
<tr>
<td><strong>Acquisition of IT/IS</strong></td>
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<tr>
<td>1. IT/IS investments must be sponsored and driven by the business, be cost-effective and deployed first in the highest payback areas.</td>
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<tr>
<td>2. IT/IS infrastructure technology selection should be based on market-leading, mainstream investments, avoiding “swimming upstream.”</td>
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<tr>
<td>3. Encana will “buy off-the-shelf” IT/IS solutions wherever possible. Building applications from scratch should be a last resort and must have the full backing of the business leader.</td>
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<tr>
<td>4. Deploying consistent, integrated enterprise systems will enhance BU autonomy and flexibility; thus rigidity and standards at one level will enable flexibility and autonomy at another.</td>
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<tr>
<td><strong>Information Availability</strong></td>
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<td>5. Information will be captured and maintained by people closest to the source.</td>
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<td>6. Information will be presented in the form that is most useful to business decision making.</td>
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<tr>
<td>7. Information will be made available, with appropriate security, anywhere/anytime for others in the organization to reference or subscribe to, avoiding the “Why wasn’t I informed?” question.</td>
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<tr>
<td><strong>Responsibility for Business Value</strong></td>
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<tr>
<td>8. Getting value from IT/IS investments is a shared responsibility between business and IS leaders. Business process efficiency is a critical component of achieving value from IT/IS investments.</td>
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<tr>
<td>9. Recognize that people, not technology, are the primary factor in realizing value.</td>
</tr>
<tr>
<td>10. Benchmark the costs and effectiveness of IT/IS investment against peers in the industry; always factor in affordability.</td>
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</tbody>
</table>
Despite the documented benefits of outsourcing, IS professionals are known to fear that outsourcing could cause them to be made redundant.\(^\text{22}\) The “hero syndrome”\(^\text{23}\) (the situation where the IT organization feels it can be more responsive than vendors to business needs) is also a factor in resisting outsourcing.

The aim of outsourcing efficiency-creating IS created a dilemma for Encana—how can efficiency-creating IS be outsourced when efficiency is one of the two primary business demands? The CIO argued that IS outsourcing was consistent with IS guiding principle No. 3 (buy off-the-shelf solutions wherever possible) as well as with the demand to lower business costs. Outsourcing frees up resources for use on strategic IS planning that can help Encana become more responsive to market demands.

The CIO emphasized that the IS function must focus its digitization effort on helping BUs. This could be achieved by providing, for example, integrated systems to analyze rock formations that can enable Encana to quickly lease high quality gas sources, and business intelligence applications that can build economic models for drilling when faced with price and demand volatility.

Encana’s CIO’s decision to contract or outsource IS technical functions raised another question—how can IS staff be motivated to learn the natural gas business? IS professionals want to remain current with emerging IT because it offers greater career prospects. As part of implementing the IS governance structure, Encana’s CIO established various career paths and provided resources to help technical IS professionals transition to business and leadership roles. For example, a program for new hires rotates employees for two years through various BUs to learn about business operations.

To foster business and leadership skills, Encana offered on-site courses, such as Six Sigma and lean principles, and on-demand digital online seminars in cross-functional business areas. An annual conference offers opportunities to share best practices and to network with other BUs. Availability of these resources emphasizes Encana’s commitment to the 10 IS guiding principles while also demonstrating the value the firm places on human resources and its employees’ intellectual capital.

### Focusing on Operational Excellence by Redesigning Processes

Experts in the energy industry have encouraged oil and natural gas companies to take advantage of the economic slow down and decline in demand to drive operational excellence.\(^\text{24}\) As Encana’s digitization goals were geared toward cost control and agility, in line with IS guiding principle No. 1, business leaders entrusted the CIO to lead process redesign in operational areas such as exploration, drilling and transport. Information generated from redesigned operational processes would be presented to engineers and decision makers to facilitate learning and deeper understanding for greater control.

The CIO and executive leaders recognized that, to achieve operational excellence, Encana must digitize “molecule” technologies (i.e., drilling and production) and “bit” technologies (i.e., business intelligence, pricing and demand data) and reconfigure key business processes. They recognized that the greater the convergence of molecule and bit technologies, the more strategic will be the IS function. Molecule technologies are very capital intensive so initiatives closer to the wellhead were a high priority for process design. Furthermore, redesigning wellhead processes yielded greater opportunities for cost control. By contrast, Encana did not undertake redesign of office productivity processes. Though essential for business, IT systems for administrative processes were contracted out if they were not core to the business.

In Phase I, Encana redesigned workflow processes using digital portals to streamline equipment maintenance, reduce unscheduled downtimes and maximize production. Similarly, in Phase II, the DOP application streamlined the contracting, order and delivery, invoicing and payments processes to enable redesigned supply chain processes. In line with guiding principle No. 7 (anywhere/anytime information availability), the SCADA systems for supporting field operations, and analysis and reporting delivered real-time data to Encana’s network, which facilitated contract analysis and the production of key performance indicators. BU managers could now track deviations from expected production and take actions to synchronize production with market

\(^{22}\) In “How Cloud Computing Will Impact the CIO Role” (http://cloudcaboodle.com/blog/article/how-cloud-computing-will-impact-the-cio-role/), Brian McCarthy, CEO of Cloud Caboodle, argues that the resistance to outsourcing has an emotional component emerging from the fears of unemployment. He quotes Forrester vice president Ted Schadler “… cloud computing poses a direct threat to ‘blue collar’ IT, such as admins and others who simply maintain IT infrastructure.”


\(^{24}\) Laurens, C. and van der Molen, O., op. cit., 2010. This paper presents evidence from firms’ database and consulting experience that indicates firms with operational excellence can expand the value of their production asset base by as much as 30%.
demand. Integrated production and managerial-tracking processes enabled automated regulatory and environmental reporting, allowing managers to concentrate on the business mission. Finally, in Phase III, managers linked key business drivers with the digitization strategy to take advantage of redesigned drilling and measurement processes so they could better manage land and revenue.

Encana is now gearing up for third-party collaboration processes (Phase IV) to connect downstream partners—distributors, brokers, utility companies and industrial customers—with its internal systems. In line with IS guiding principle No. 6 (information presented in the most useful form), the goal is to provide decision makers with data that provides a comprehensive picture of events and processes. Encana will therefore be able to share its response to market volatility with partners and help them control their costs. In the long run, greater collaboration among partners will lower everyone’s costs and will benefit gas consumers.

Initiating an Organizational Learning Program

Process digitization creates vast amounts of data. For example, oil and gas wells produce as many as 25,000 data points per second. How can Encana make sense of this vast data resource? How can the CIO fulfill the goal of Encana’s finance VP of using this data to enhance the quality of decisions? What knowledge can be extracted to improve efficiency, exercise greater operational control and support future growth? In addressing these questions, Encana, like others in the energy industry, is facing a loss of “tribal” knowledge, resulting from gains in drilling technologies and employee attrition due to retirements.25 After wellhead data had been integrated with the PVM system, the CIO initiated a knowledge management program to capture extant expertise, generate business intelligence and deliver timely information to decision makers.

Encana’s commitment to people and their knowledge is consistent with IS guiding principle No. 9. During the economic slowdown of 2009, the CIO organized internal conferences where experienced operations and IS professionals offered training to newer employees. Cross-BU IS training offered learning from best practices in IT deployment, troubleshooting field problems and leveraging information to maximize land asset returns.

The IS learning enhanced the skills necessary for improved information flow to and from field assets such as the SCADA systems, and resulted in the development of tools, such as hierarchical dashboards and graphic visualization of work processes (as shown earlier in Figure 4) for interpreting drilling and reservoir data.

Similarly, corporate IS developed a standards catalog for BUs to reference when acquiring new technologies. Exemptions from established standards required making a business case and approval from the BU executive vice president. Records of exceptions formed the basis for refinements in data and technology standards.

DIGITIZATION OUTCOMES AT ENCANA

Although firms in the natural gas industry are gradually adopting digital oil platform (DOP) technologies, Encana is a frontrunner in a latecomer industry. It has taken the lead in digitizing molecule-based operations and integrating them with bit-based technologies to control costs and respond to price and market demand volatility. Business intelligence gained from integrating internal learning with external data has resulted in a managerial capability to project market prices for the next three days with greater than 98 percent accuracy. The PVM system has enabled Encana to adjust drilling and production processes to match the demand and price forecast. Encana has orchestrated its technology, people and process resources through embedded digitization, IS governance and process excellence to synchronize its supply with market demand.

Peter Keen has expressed concern that strategic business conversation between the CIO and CxOs has dried up, relegating the IS function to an operations focus.26 Despite this setback, Keen argued for the CIO’s centrality and influence in the organization, and stated that influence is not determined by the size of the IS function. The IS function at Encana is now more operations focused but has greater influence. This influence was earned through a digitization strategy that transformed a critical business process


26 In an interview with MIS Quarterly Executive, Peter Keen discusses the evolving relationship between the CIO and CxOs and how IS academics can contribute to expanding the CIO’s role in converting inventions into innovations. See Keen, P. G. W. and El Sawy, I.A. “Engaging in CIO-CxO ‘Conversations that Matter’: An interview with Peter Keen,” MIS Quarterly Executive (9:1), 2010, pp. 61-64.
rather than through a grand architecture to transform the organization.

Even though Encana’s CIO does not report to the CEO, he serves as a trusted advisor and is called on to participate in formulating business strategy. As implied by IS guiding principle No. 8, justification of IT/IS is no longer the CIO’s responsibility; it now resides jointly with IS and BU leaders. If an IS project does not result in the expected payoff, BU executives and IS executives jointly reexamine the assumptions of the business case leading up to the IS investment to identify the reasons why the business case was inaccurate and then use the learning to inform future IS decisions.

In Table 2 we summarize the CIO toolsmith and orchestrator roles, performance metrics and learning focus we identified from the Encana case study. We believe that these roles apply generally in other latecomer industry firms. However, it should be noted that, as shown earlier in Figure 4, the orchestrator role can encompass the toolsmith role. It thus includes the “business technologist” role of a CIO who understands the business and orchestrates technology and business resources to accomplish business goals.

CHALLENGES AND LESSONS LEARNED

The success of Encana’s digitization initiatives was not without challenges. Outsourcing non-core IT makes Encana vulnerable to a diminished technical skills base and higher coordination cost. Greater process digitization is likely to create a skills gap between pre-digitization employees who possess valuable experience but are unfamiliar with digital processes and recently hired technologists and engineers who possess technical skills but do not yet have insights into business operations. Similarly, a large number of on-site technical contract workers or service providers may cause conflict between two cultures—those who understand technology and those who understand the business.

The highly decentralized IS structure, while providing proximity to the BUs, exposes Encana to potential conflict between BU and corporate leadership. Aligning IS with one BU’s needs can cause IS managers to “go native” and make myopic decisions that are in the interest of the BU rather than the organization as a whole. Such conflict risks the proliferation of technologies that can lead to “shadow IS” infrastructures in BUs. Further, given that BU size and revenue determines the level of BU IS resources, a highly decentralized structure can create a culture of IS “haves” and “have-nots,” making it difficult for BUs with smaller IS budgets to implement innovative ideas.

The Encana case study yields several lessons for CIOs and CEOs of organizations in latecomer industries.
(summarized in Table 3). Although some lessons are applicable to firms in industries where digitization is already the norm, latecomer firms have unique challenges resulting from the extensive investment in industrial equipment that must be digitized because it is critical to the business. This situation contrasts sharply with, for example, the banking industry, where digitized customer-facing processes such as online bill payments and loan applications still run on mainframe-era technologies in the back office.

**CIO Lessons**

1. **Don’t Focus on Position in the Organization Chart.** CIOs in latecomer firms should not focus on a “seat at the table” or concerns about their position in the corporate organizational chart. Latecomer firms have historically used IT as a workhorse for accounting, warehousing and marketing tasks, not to shape strategy. With scarce experience of the role of IS in enabling competitive advantage, CIOs in latecomer firms must earn their position in the organization chart by demonstrating that IS makes a difference in how to run the business and how it can impact the top line or the bottom line. Encana’s CIO (and IS managers) earned the trust of business leaders by deploying IS applications that provided critical supply chain visibility and accurate three-day price forecasts. The next two lessons provide further insights into how they built this trust.

2. **Embed Digital Technologies First in Operational Processes.** CIOs in latecomer firms should first embed digitization in operational processes. Industrial-era devices dominate grassroots processes in latecomer industries. Priority must therefore be given to integrating the operational processes necessary to cut costs and to eventually build digital applications. For instance, digital applications to track adverse drug events in the healthcare industry were possible after patient record data was integrated with previously digitized laboratory and pharmacy operations. In the natural gas industry, digitization embedded at the wellhead through SCADA systems was given a high priority because it provides visibility into the supply chain.

3. **Seek High Revenue Opportunities or a Business “Pain Point.”** Latecomer CIOs must earn the trust of business leaders by focusing on high revenue opportunities or “pain points” in the execution of business strategy, rather than respond to a “squeaky wheel” or imitate competitor actions. There are many processes to modernize in latecomer firms; instead of a “big bang” transformation of the firm, the CIO should take a restrained approach and seek to digitize processes that remove pain points or provide business opportunities. For Encana, the opportunity lay in the pursuit of unconventional sources of natural gas and the pain point was the uncertainty of gas prices. The CIO of a latecomer firm should confer with business leaders because opportunities and pain points will likely be different even among firms in the same industry.

4. **Establish IS Guiding Principles.** The CIO must take the lead to establish IS guiding principles, which should address questions such as: Who will be responsible for making the business case for digitization investments? What role will the IS function play in selecting IT? Unlike digitized firms in other industries that have well established policies developed over many years, latecomer industry firms have limited experience of business executives working collaboratively with the IS function. Instead of ad hoc digitization, latecomer firm CIOs should encourage business and IS leaders to jointly establish guiding IS principles designed to reduce potential conflict. Since each firm has competencies distinct from its competitors, the guiding principles must take into account the firm’s IS proficiency, readiness and need for proprietary IT. Encana pioneered exploration
technologies for shale gas discovery and drilling devices for rugged terrain, so the guiding principles reflected the authority of the business while the IS function supported business strategy.

5. Run a Tight IS Ship. The CIO of a latecomer firm earns business credibility by running a lean IS operation. He or she must relentlessly seek efficient delivery of IT services whether in-house or outsourced, or a combination. Latecomer industry CIOs usually inherit large technical IS groups and antiquated computing infrastructures. As they transition into the orchestrator or strategic leader roles they will need wider skill sets than their predecessors. For the CIO of a latecomer firm, a strategic and commercial orientation, external customer focus and market knowledge are far more important than in the past, to ensure that the IS function is bringing competitive value to the organization. Encana’s CIO’s thoughtful sourcing of IT services earned him and the IS function credibility and has enabled IS leaders to influence the business while promoting digital literacy among business leaders.

**CEO Lessons**

1. Take Ownership of IS Implementation. CEOs should take ownership of the implementation of new systems by driving necessary organizational changes in governance, reporting structure and realignment of incentives. Traditionally, IS implementation responsibilities fell on the CIO. Encana enshrined the joint role of business and IS leaders in IS guiding principle No. 8 (Table 1) to ensure that business leaders take ownership of IS implementation.

Latecomer industry firms have large asset bases that must be modernized. Digital integration of these assets will require managing change that will affect people, processes and operational technology. Without visible leadership from the CEO, few digitization efforts will succeed in managing change. Encana’s CEO and BU leaders took ownership and led the effort to implement the PVM, DOP and eLPR systems. Indeed, in all cases, the need for these systems emerged from business leaders.

2. Digitization Success Requires a Close CEO-CIO Working Relationship. Regardless of the position of the CIO on the organization chart, digitization success in a latecomer industry firm will be easier if the CEO and CIO work together to select the processes in which to embed into IS. They must prioritize digitization goals—cost reduction, increased process visibility and control, revenue growth or organizational learning. CEO-CIO agreement is also essential to establish agreed metrics of success. Encana’s CEO and CIO agreed that forecasting gas prices was critical to control costs and revenue growth. The agreed upon success metric in this area was the accuracy of three-day gas price forecasts. CEOs in latecomer firms should not view their CIOs simply as technology toolsmiths. As IT is the “bass note” that connects all other constituencies, CEOs should view CIOs as orchestrators of business goals through digital transformation.

3. Good Times and Bad Times: “This Too Shall Pass.”

Many latecomer industries go through business cycles driven by factors such as regulation, consolidation and technological innovation. In the natural gas industry, technology for lateral drilling gave access to large deposits of shale gas that has changed the economics of the business. But CEOs of latecomer firms must not let the good times dampen the need for greater efficiency through digitization. Just as importantly, though, they must not discontinue digital transformation efforts during economic slowdowns or hard times for the industry. Encana’s experience indicates that it is easier during slower times to put knowledgeable people to work on digitization projects simply because they are available. Latecomer industry leaders should not succumb to the argument “the industry did not have computers for a century, and we did fine.”

**CONCLUDING COMMENTS**

The Encana case describes a latecomer industry firm with limited experience and capabilities in digital technologies under pressure to cut costs, and an organizationally-savvy CIO who orchestrated selective digital transformation by integrating supply chain processes from “wellhead to Wall Street.” In a role that expanded from toolsmith to orchestrator, the CIO embedded IT in operational processes while aggressively outsourcing non-core IT functions. Going forward, CIOs can close the expectation gap between the IS function and the business by addressing three factors:

1. Focusing on the IT fundamentals of cost, reliability and infrastructure development;

28 A proverb suggesting that all conditions, good or bad, are transitory.

29 Louie Ehrlich, President, Chevron Information Technology Company, and CIO, Chevron Corporation, proposes that to overcome the gap between the IS function’s capabilities and the expectations of the business, IS must evolve from a service provider to a true partner. (See http://www.ciodashboard.com/leadership/closing-expectation-gap-business-stakeholders/)
2. Demonstrating the CIO’s and IS function’s knowledge of the business and their capabilities to address business needs; and
3. Influencing those business leaders who are IT-savvy.

By orchestrating the digitization of Encana’s supply chain, the CIO has closed the gap through addressing IT fundamentals and has demonstrated understanding of the business. Influencing Encana’s IT-savvy business leaders is an on-going journey.

APPENDIX: RESEARCH METHODOLOGY

The authors gathered data for the Encana Oil & Gas (USA) Inc. case study through several qualitative methods to learn about how an organization in a latecomer industry can benefit from digitization of key processes and services and the challenges faced. Multiple in-depth unstructured interviews and discussions with key IS and business leaders were conducted over a two-year period (2009-2010).

In addition, Encana provided access to all relevant current and archival information about its methodology and approach to digitization. This information included presentations, meeting minutes, field notes, technical documentation and other official documents (e.g., memos, appointment diaries, correspondence), and press clippings. Encana has been applying its approach to digitization and IS-business integration for nearly a decade.

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