PERFORMANCE INNOVATIONS

This is Hatch 2015

applying emerging
technologies

the evolution of
urbanization

environmental
& community success

redefining
project delivery

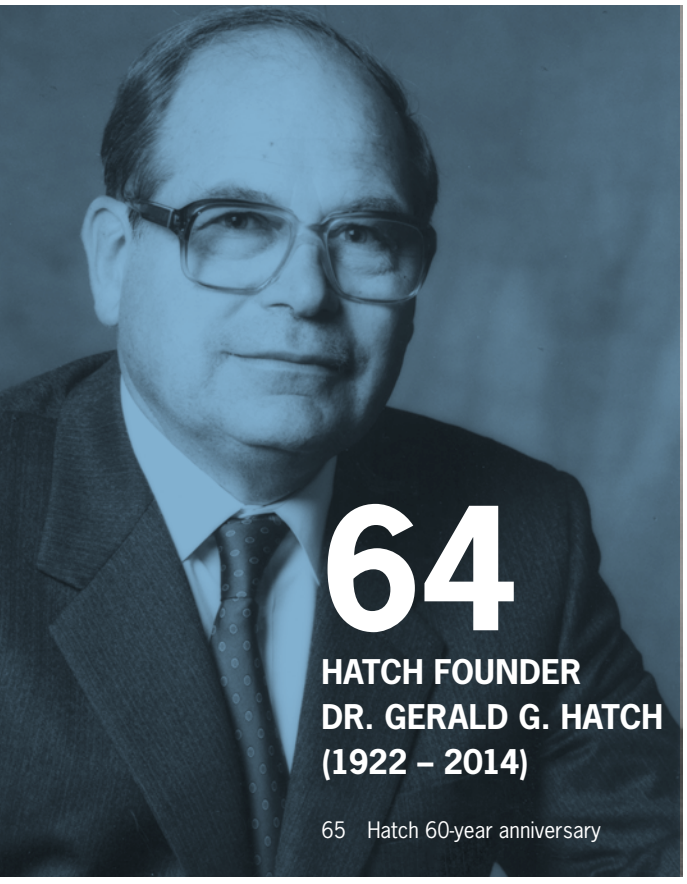
improving facility
performance

Safety • Quality • Sustainability • Innovation

1955–2015

HATCH

contents



COVER

Rio Tinto Alcan's award-winning AP60 aluminum smelter in Québec, Canada

Rio Tinto Alcan's proprietary AP60 smelting technology is the most productive and efficient aluminum reduction method in the world, with a capacity of 60,000 tonnes and the ability to produce 40% more aluminum per cell than the previous generation of AP technology.

In October, the Project Management Institute honored RTA and Hatch with the global 2014 Project of the Year Award for the AP60 project. **(See story on p. 6)**

“Our goal is to be our clients’ most valued partner. Our people are highly motivated to work on difficult challenges, and we share a sense of responsibility in how our work enables our clients’ businesses to grow.”

PERFORMANCE INNOVATIONS

Continually changing market and economic conditions around the world demand an equally dynamic approach for delivering professional services to our clients. At Hatch, we go to great lengths to understand these forces and refine our service and technology mix to match our clients' evolving needs.

Through our work in developing nations, we see an escalating demand for natural-resource management, energy, infrastructure, water, and food. In more mature markets, we see the urgent need to improve productivity, reduce costs, and accelerate the time-to-market to meet stakeholder expectations. For our clients, the challenge is to accomplish these goals under tight capital constraints.

We understand the increasing need to do more with less and to constantly look for ways to drive stakeholder value. In our own business, we do it by investing in quality people and being highly engaged in every aspect of our clients' businesses, from planning and design to operational performance. Many of our clients have restructured their organizations to succeed in these volatile times, and we're pleased to have helped them improve their performance through process modifications, technological advances, and new problem-solving techniques.

For 60 years, we've approached business by nurturing a culture of innovative problem-solving and striving to be our clients' most valued partner. Our people are highly motivated to work on difficult challenges, and we share a sense of responsibility in how our work enables our clients' businesses to grow. Through this commitment, we continue to build a record of successful assignments.

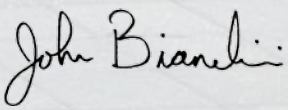
Our teams tackle every new problem by looking at it from different angles and collaborating across our expertise base. We apply our strong fundamental knowledge, employ our proven techniques, and develop new approaches and breakthrough technologies to solve our clients' toughest business challenges.

We've collected a number of stories from the past year that help illustrate our approach and how it has driven performance improvements in a wide range of industries and projects. In every case, our clients faced unique challenges, and we worked closely with them to evaluate the possibilities and deliver practical solutions.

We're also pleased to feature industry insights from five members of our senior leadership team. They cover a lot of territory—from the initial creative sparks of innovation all the way to project delivery and continuous improvement. Their subjects are all intrinsic to the challenges faced every day by our clients and their industries overall. Efficiency is certainly a common theme, but the articles dig much deeper into specific areas, and I'm sure you'll find them interesting and incubators for further dialogue.

Another highlight in this edition is a special feature on the 2014 Project of the Year Award from the Project Management Institute for our work on Rio Tinto Alcan's (RTA) AP60 project. It's extremely rewarding to see our client and colleagues receive such high industry recognition for this truly innovative project. AP60 is the first plant of its kind in the world and will produce 40% more aluminum per cell than the previous generation of AP technology. The project also attained a new safety record, re-setting the industry benchmark for future projects.

We hope that this collection of project stories and ideas will inspire your teams in their pursuit of innovative solutions—they certainly continue to inspire our 10,000 employees around the world. We're eager to share these perspectives with you and enthusiastic about creating many more new possibilities together in the future.



John Bianchini
Chief Executive Officer

2014 PMI PROJECT OF THE YEAR

IN DEPTH

The project was completed within budget and one month ahead of schedule. It was the first major project to successfully implement RTA's new HSEQ management systems, and it received a third-party auditor's commendation for exceptional HSE leadership.

With 1,600 on-site personnel at its peak and a lost-time injuries rate of just 0.27 for 5 million hours—99% better than typical Québec construction industry performance—this project exemplifies the unified culture of commitment for which we and our clients continually strive.

AP60

In October, Hatch's AP60 project for Rio Tinto Alcan (RTA) was named 2014 Project of the Year by the Project Management Institute (PMI). The global competition is designed to honor organizations and individuals whose passion, talent, and expertise make the greatest contributions to the project-management profession. The Project of the Year Award recognizes a completed project that demonstrates exemplary application of project management principles and techniques.

AP60 Phase 1 is the first of its kind and the most technologically advanced aluminum smelter in the world. The greenfield plant in Jonquière, Québec, was designed to demonstrate RTA's new proprietary AP60 smelting technology at industrial scale. It has an installed capacity of 60,000 tonnes and the ability to produce 40% more aluminum per cell than the previous generation of AP technology.

Hatch has been involved in the project since the initial development phase. For the latest phase, we worked with a joint venture partner to provide project management, engineering, procurement, construction management, pre-commissioning, and commissioning services.

Our exhaustive value-improvement exercise resulted in capital expenditure savings of about $280 million. Other key achievements included full project completion within budget and ahead of schedule, as well as a new industry standard for safety performance.

RTA project director Michel Charron said "Project management—it's all about how good you are at detailing a plan, presenting a plan, executing the plan, and delivering the result. And that's what the team did so well. They were the best."

The award was presented at PMI's Professional Awards Gala in Phoenix, Arizona, USA, on October 25, 2014.

“Project management—it’s all about how good you are… They were the best.”

Michel Charron | Rio Tinto Alcan

Rio Tinto Alcan

BUILDING COMPETITIVE ADVANTAGE

APPLYING EMERGING TECHNOLOGIES

By Nils Voermann
Global Managing Director, Technologies

The purpose of new technology is to do things better, more safely and more efficiently. Ironically, that road is paved with much difficulty and risk. And, although every company wants to be more innovative and more productive, they naturally need rewards to outweigh the risks.

True innovation is about the idea and its implementation—the first is no good without the second. For big industrial applications, implementation is where you make or break a project. That's why Hatch puts equal emphasis on both those areas—creation and implementation of new technology. A lot of our progress comes from looking at current methods and understanding what makes the difference between success and failure.

“The creative part of innovation is key. It’s very much about an individual’s unique curiosity, talent, and inspiration—and the multiplicative effect of bringing people together in a collaborative environment.”

Continued

Generating new ideas

Innovation is hard; that's precisely why succeeding at it provides durable competitive advantage. It's very much about unique experience, curiosity, talent, inspiration and, often, perseverance.

So how do you improve the quality of the ideas generated within your organization? Well, at Hatch, we do a lot of things to promote creativity and collaboration. I think variety is key here. We're open to a great idea from any source, so we reach out for them in many different ways. When it comes to new university grads, we recruit from the top 10% in academic standing. Once on our team, no matter how long they've been here, they're encouraged to spend time on wild and crazy ideas. We have a regular forum where our people can bring their ideas forward, and there's enthusiasm for it because we have a budget to commercialize and develop our best ideas.

We've also been expanding and strengthening our external relationships. Decades ago, it was Hatch and our clients alone. But in recent years, we've been increasingly proactive in seeking new ideas in broader collaboration with others. We're involved in Enertech venture capital funds, always looking for and evaluating exciting, new possibilities in the global technology space. We fund scholarships and research programs at universities around the world. Hatch's Smart Predictive Line Controller technology started with an idea from a University of Toronto professor.

We hold more than a hundred patent families across multiple industries. We host special symposia in many areas to share and develop knowledge in collaboration with our customers, suppliers, academics, and other partners. Knowledge and technology transfer is often a key part of our project deliverables, in customized system designs and training for example.

Implementing technologies

Unlike ideas, the implementation of emerging technology is not at all ethereal. Our technology development work is phased with tollgates at each level where we decide whether or not to proceed with further development. Only the most impactful new technologies make it through this rigorous process. For the final step, commercial-scale implementation, we use our proven project procedures. Safety, quality, schedule, and cost are all tracked, analyzed, and improved as new information becomes available.

A variety of studies have been completed in this area in recent years, and our analyses in the metallurgical industries are consistent with the general findings. Success is measured by time between construction completion and full design production rate. However, delays and iteration are fairly prevalent when looking at the history of new technology projects; there's much room to improve how these types of projects are implemented.

Fortunately, the implementation of new technology is not merely a game of chance. The things we choose to do—or not do—have a strong influence on the probability of success.

Seven key factors of new-technology success

Testing and scale-up

These two factors are the most important. Not only does each new unit operation need to be tested, but the interactions between selected unit operations must also be thoroughly tested. The engineering firm that will design the commercial plant should be involved early so all test variables and acceptable ranges can be measured and agreed upon. After diligent modeling and simulation (calibrated with physical measurements), the scale-up factors from lab to pilot to demonstration to commercial scale will have critical business and engineering implications. A factor of 10:1 is clearly safer than 100:1, but large-scale testing is obviously more expensive. What scale-up at each stage will provide the information needed to move safely forward?

The number of new elements

The relationship is simple: the higher the number of new elements, the lower the probability of success. New elements can include feed stocks, process steps or unit operations, interactions between unit operations, different project location/environment, different team, additional or changed end product, etc. Some of these can be addressed by testing the entire integrated system, including building a pilot plant on the site of the prospective commercial scale plant.

IN FOCUS

When two passionate young engineers both list learning and problem-solving as hobbies, it only makes sense to team them up. Andrew and Maciej studied mechanical engineering together at the University of Toronto, where they each received multiple NSERC Research Awards. They joined Hatch in 2006 and were separately involved in the design, construction and commissioning of various furnace projects and solving many unique challenges along the way.

We re-united them in 2012, and they've since collaborated on new concepts for a wide range of energy and metals applications—including expansion of Hatch's proven technologies for aluminum smelting, copper flash, and blast furnaces.

Product Development Engineers
Andrew Shaw & Maciej Jastrzebski

Over-reliance on standard equipment
For equipment vendors, it makes the most sense to sell as many standardized products as possible; developing unique designs is not as profitable for them. Their business model is generally about providing a minimally acceptable fit for as wide a range of applications as possible—but that's very different from the best fit for a specific set of new conditions.

Lump-sum fixed-price contracts superficially reduce risk to the project owner but are typically inappropriate for first-of-a-kind technology projects. The contractor will carry a large contingency to cover its liability, thus increasing the price; but most of the risk invariably remains with the project owner. These contracts usually lead to squabbles over who is financially responsible for problems inevitably identified during plant ramp-up—time that would be better spent finding solutions. One day's interest saved on the capital employed to build the plant, or the revenue from one day earlier into production, is usually more important than calculating contractual liability to the last cent. It is crucial to fully understand where in the process standard equipment will perform best and where it won't. When and where is customization the wise investment?

Project phasing
The idea of tollgates is well established. But saying it and actually doing it are two different things. Projects that are properly phased have a better chance of success. Defined targets and objectives must be demonstrated at each stage before proceeding to the next. The hope that technical problems will be solved simply by increasing scale is a recipe for disappointment. The owner needs to be fully capable of making a go or no-go decision based on the knowledge developed along the way, rather than being carried forward by the project's momentum alone. When new questions are raised, don't be afraid to test for the answers and revise course before proceeding to subsequent and more expensive project phases. Although it may feel slow at the time, being methodical through the early stages can actually speed things up in the long run. After all, what's the point in being wrong, faster?

Champions & critics
For a new technology to become reality, somebody has to stick their neck out. We need committed technology champions over the often multi-year implementation duration. Passion is what drives ideas. But creators can sometimes be too close to their great new invention to see its potential flaws. So we also need dispassionate and unbiased third-party experts—in both the owner and engineering firm—to ask the hard questions. The most successful new technology implementations benefit from controlled tension between strong champions and critics.

Continued

Human and financial resources
The most successful projects retain key personnel over the development cycle and add specialists as required. Ramp-up curves are learning curves. Team commitment, knowledge, and learning are cumulative and unique for each project; the departure of key people can be highly detrimental.

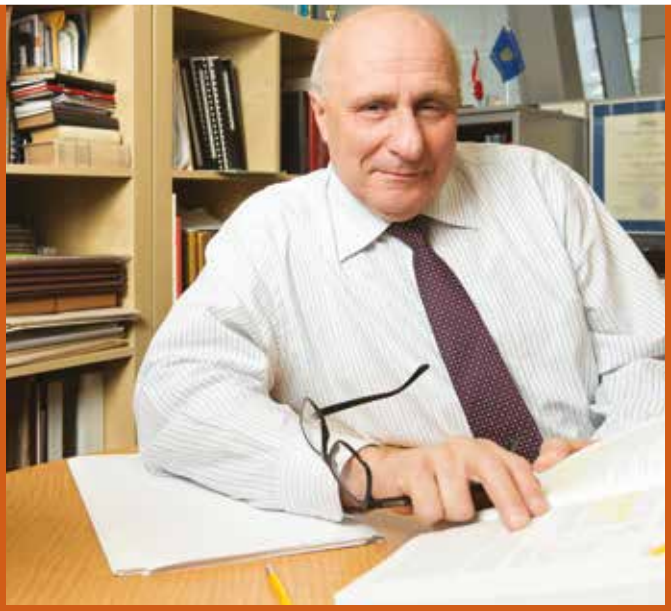
New technology plants will inevitably need some kind of modifications after start-up and during ramp-up. Adequate financial resources are, of course, imperative. So why are ramp-up costs so frequently underestimated? Contingencies assigned at the outset are often used up by mechanical completion. In reality, modifications during ramp-up can be 5–10% of the total capital cost of new technology plants.

Overall business case
The business case needs to be sufficiently robust to finance not only construction, but also the additional expenditure for the debottlenecking typically required after start-up to achieve design plant throughput.

Access to consistent raw materials is fundamental. Having an off-take agreement with a solid counterparty or end user is something the project financiers like to see. Speed is often important to clients who want to get a jump on their competitors. But it is important to realize that the finish line is not mechanical completion of the physical plant—it is achieving the full design production rate.

If this all sounds like a very complex matrix of philosophy and executional rigor, it should. Creating and implementing valuable innovation takes simultaneous commitment and investment on many fronts. It is indeed difficult. That's precisely why succeeding at it provides durable competitive advantage. ■

IN FOCUS



Having worked and consulted on iron and steel projects in every major steel-producing region, Dr. Yakov Gordon is a true global player—with over 100 publications to his credit. The Association for Iron & Steel Technologies (AIST) named Yakov the 2015 winner of its prestigious Howe Memorial Lecture Award for outstanding individual contributions to the science and practice of iron and steel metallurgy or metallography. The award was established in 1923 and has honored many famous industry icons through the years. Yakov will give the opening lecture at the May 2015 AISTECH conference in Cleveland, Ohio, where over 5,000 of the industry's finest will listen to his insights on the important role engineering consultants play in commercializing new technologies.

Dr. Gordon has over 40 years experience, and he's just as enthusiastic now as he was on day one. He's a globally recognized expert in ironmaking technology and the related process thermodynamics and kinetics. Generous with his time and knowledge, Yakov never says no and is an important mentor to young Hatch engineers.

Technical Director, Iron and Steel **Yakov Gordon**

THE WINDS OF CHANGE

Integrated wind-storage-diesel energy

Tugliq Energy & Glencore | Québec, Canada

Wind forecast models helped ensure safe and efficient erection of the nacelle and blades

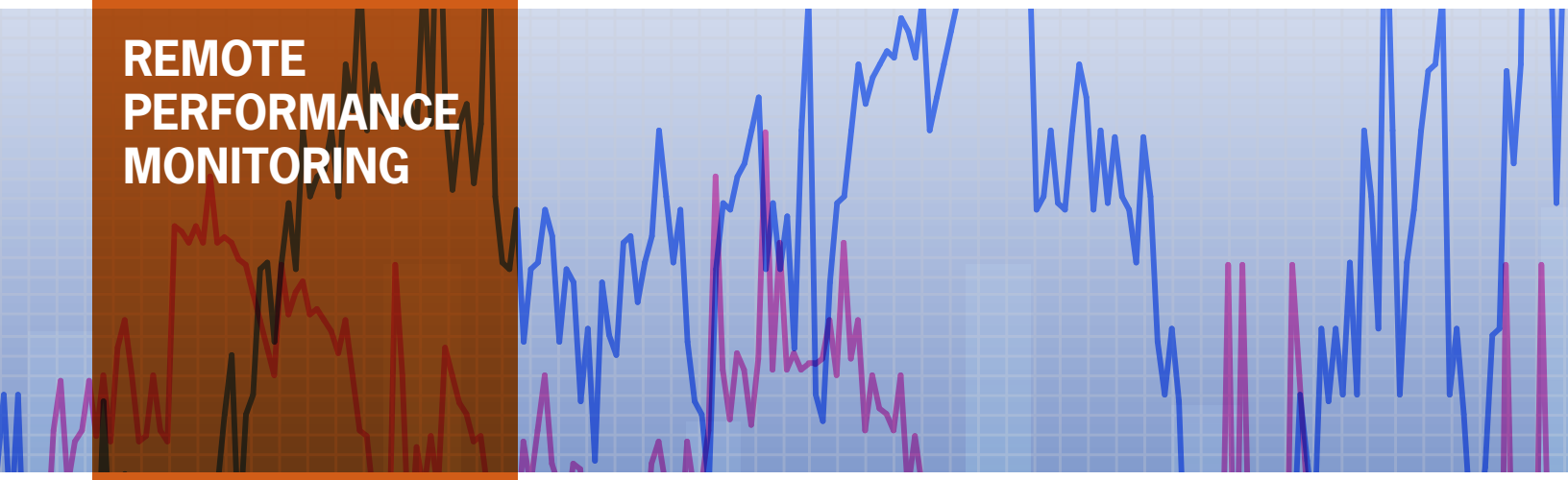
This five-year pilot project aims to significantly reduce the remote Raglan Mine's reliance on diesel and improve its emissions performance through alternative energy. Results may also pave the way for cleaner, more efficient energy supply at remote industrial sites in general.

There's a lot of wind variability and extremely low temperatures at the northern tip of Québec, so reliable energy storage is key to smoothing out energy supply fluctuations and maintaining grid power quality. The project is the first of its kind and will evaluate three distinct technologies: flywheel, lithium-ion battery, and hydrogen system. Our initial scoping study mandate was expanded to full system design including turbine generation, energy storage, and microgrid smart control technologies to achieve high wind-power penetration. Our work included planning and engineering of all development phases, complete wind energy production assessment, managing the implementation, and now providing post-commissioning support and energy optimization. Our four-month LIDAR wind measurement campaign played a crucial role in confirming wind speed at hub height. We also assisted with successful government funding applications to NRCAN and the Government of Québec, and provided key support to the long-term agreement between Tugliq and Glencore.

The engineering and construction was fast-tracked to be completed within the short Arctic summer construction window. This required tight integration of the Hatch team with the client and third-party suppliers. About 18,000 site-hours have been accumulated with zero lost-time injuries, thanks to impeccable management by Raglan Mine's own HSE team. The first kWh was produced on August 31, 2014, and remaining elements will be commissioned by second quarter this year.

Photo courtesy of Tugliq Energy

FLASH FURNACE LANCE



REMOTE PERFORMANCE MONITORING

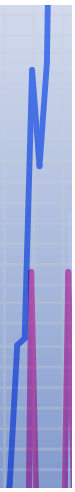
NSOLV BITUMEN EXTRACTION

NEW TECHNOLOGIES IN ACTION

Whether innovations are injected as small, focused parts of well-established processes, or as comprehensive new approaches, their impact on efficiency, productivity, and sustainability can be profound.

In the copper-smelting field, Hatch recently commercialized technologies that have redefined maximum operating efficiency benchmarks for flash furnaces. Through a program of ongoing research, development, and implementation, we examined the fundamental limitations within existing flash furnace operations; and early deployments of our equipment have produced significant step changes.

The biggest improvement involved Hatch's new patented concentrate burner technology, in particular, our new central burner lance design. In-plant testing on a full-scale copper flash smelting furnace demonstrated 10% higher furnace oxygen efficiency. This increased production and has the potential to reduce operating costs by as much as $15/tonne of copper produced (depending on energy costs). The improved combustion performance has also improved process stability.

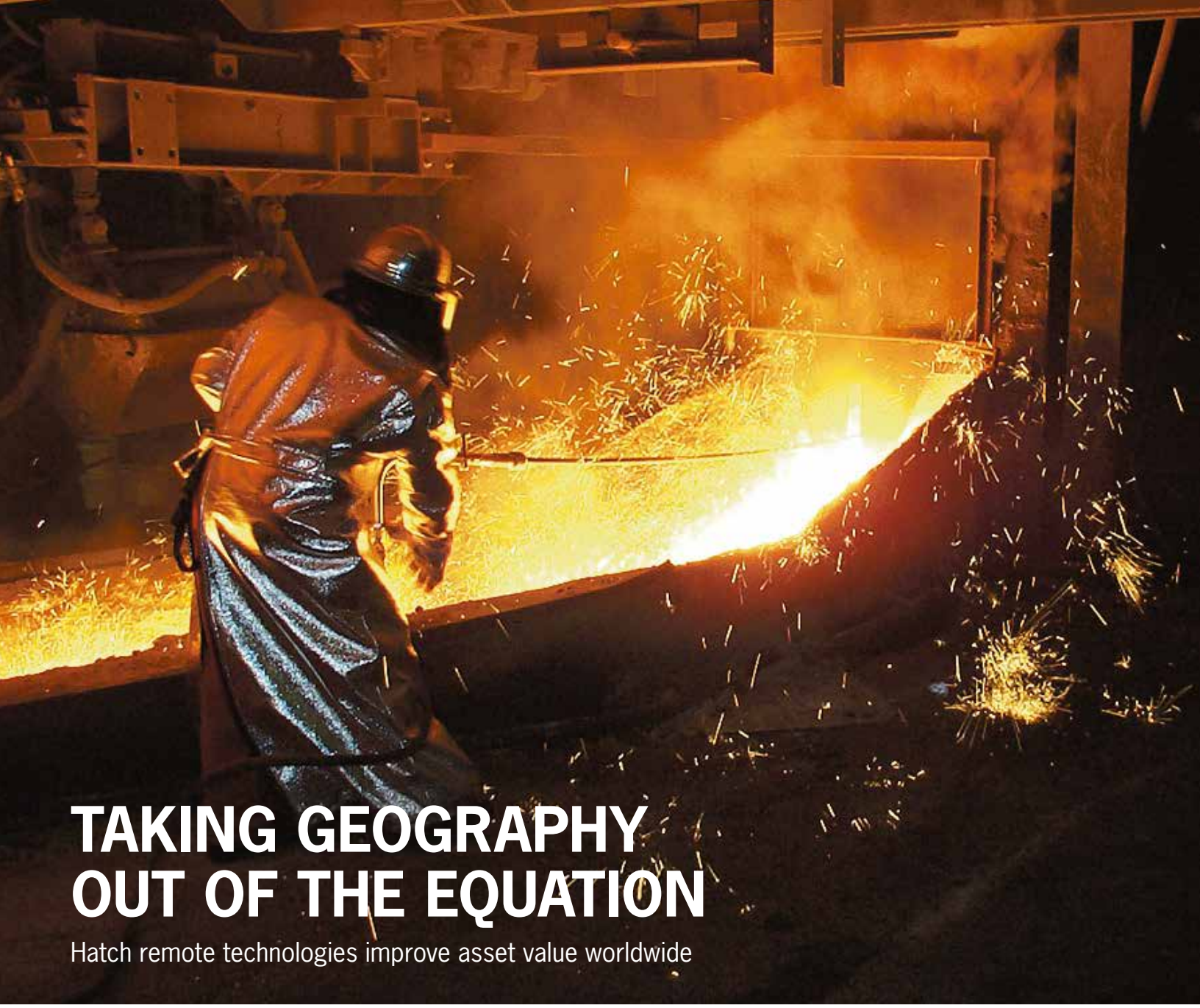


In a world that is data-rich but time-poor, compiling complex, multi-site data and getting it in front of key decision-makers can be a real challenge. Since traditional tools only raise alarms for outlying events or process upsets, you're essentially always dealing with problems from the past.

In contrast, Hatch designs remote monitoring systems that give decision-makers real-time information to identify emerging issues, evaluate different scenarios and avoid future problems. We start by aligning data management procedures across your facilities so trends and correlations can be accurately identified and measured against your operating objectives. This optimizes consistency, enables rapid cross-fertilization of findings between sites, and maximizes the impact of limited resources or centralized expertise. The big advantage here is that you can now go beyond remediation to actually improve future performance. To that end, in addition to supplying the systems, we also provide ongoing expert support for data analysis and proactive equipment tuning.

We pioneered remote performance monitoring for metal rolling installations and recently implemented a similar system for an integrated ore-to-metal ferronickel smelter. This area of technology will revolutionize asset productivity for all aspects of mining, metals, energy, and infrastructure operations.

With 30,000 barrels of oil produced as of February 2015 at its demonstration plant near Fort McMurray, Alberta, Nsolv Corporation is well on its way to proving that its Bitumen Extraction Solvent Technology (BEST) is the best-in-class solution for sustainable and continued oil sands development. Using zero process water and 75–80% less energy than the incumbent steam-assisted gravity drainage (SAGD) technology, the rigorously lab- and field-tested Nsolv process offers an unparalleled simplicity and 40% lower CAPEX than SAGD. Even with a low oil price, Nsolv improves netback by $10–20 per barrel compared with SAGD. Inherent in the process is a partial upgrading feature, producing a lighter, cleaner oil that requires less diluents for transport and enables 20% more pipeline capacity. With 80% lower GHG emissions than SAGD, Nsolv's oil is among the greenest in the world. Hatch is now providing engineering services as plans progress for the first commercial installation, with several sites under consideration worldwide. The Nsolv technology is available through licensing and equity partnerships.



TAKING GEOGRAPHY OUT OF THE EQUATION

Hatch remote technologies improve asset value worldwide

With reliable, high-speed internet communication, it is now possible to provide real-time support for a process plant or furnace control system without traveling to a remote site. In the same way that a surgeon can consult on an operation in another country, Hatch can collaborate in great detail with a furnace operator on the other side of the planet. Here are a few examples of our remote furnace monitoring projects.

SUDBURY INTEGRATED NICKEL OPERATIONS
Glencore | Ontario, Canada

Hatch's fiber-optic monitoring system has been installed to monitor furnace tapblocks at Sudbury Integrated Nickel Operations. We use a virtual private network to access and continue to support the development of the system as a tool to better understand tapblock condition. With data access and the development of detailed thermal models of the tapblocks, we've been able to assist Glencore in tapblock condition assessment as part of their ongoing efforts to improve the safety of the furnace operations.

MORTIMER & POLOKWANE SMELTERS
Anglo Platinum | South Africa

Hatch specialists in Mississauga, Canada, provide support for furnace control systems at two operations in South Africa. In addition to completing regular system modifications and software downloads, we also collect data from the archive systems. Data collected since 2011 from Polokwane's fiber-optic temperature monitoring system has been important in the ongoing development of a corrosion-resistant sensor for this furnace. The data has also been used to advance the understanding of conditions that can lead to tapblock failure, and to develop a radar system that measures the calcine banks in the furnace.

IN FOCUS

Daan has an Honors BEng in materials engineering and a BSc in chemistry from the University of Western Australia. He's been a process engineer for 11 years, with experience primarily in nickel laterite and sulfide smelters, and heavy involvement in every stage of project development—from scoping, prefeasibility, feasibility, basic and detail engineering phases through to commissioning and ramp-up. Raised in the small Australian mining town of Kalgoorlie, Daan had nearly lifelong exposure to one of Hatch's core business areas—and now he's widely considered a commissioning guru for the mining industry.

With a PhD in chemical engineering, it's safe to say that Richard has a keen interest in the subject. But he's equally curious about the fundamental workings of any machine or system, and enjoys building and dismantling things to understand how they function. His specialty is controlling those functions, specifically through multivariate statistical analysis, dynamic modeling, simulation, and optimization. Richard has extensive experience in the design and implementation of advanced control systems for smelting furnaces—including P&ID development, controller design, instrumentation, PLC programming, HMI development, and commissioning. He's even a math wiz outside the office—frequently found working to subtract digits from his next marathon time.

Commissioning Team Leader **Daan Sauter** and
Control Specialist **Richard MacRosty**

ONE SUCCESS LEADS TO ANOTHER

Upgrading two ferronickel electric furnaces

Anglo American | Barro Alto, Goiás, Brazil

Improving operational performance by upgrading two 81 MW ferronickel electric smelting furnaces

When Anglo American management heard about our success at similar facilities, they knew we had not only the text-book expertise for their furnace project, but also the proven ability to quickly adapt and keep a project flowing despite unusual challenges.

We are now upgrading two 81 MW ferronickel (FeNi) electric furnaces and ancillary equipment to improve performance and reduce operating risk at the Barro Alto smelter in Goiás, Brazil. We're providing engineering, procurement, and construction management services, in an integrated project team with Anglo American personnel and collaborators in Mississauga, Canada, and Belo Horizonte, Brazil. On-site personnel are primarily local Brazilian tradespeople and suppliers.

With decades of related experience, proven technologies, materials management implementation, construction planning expertise, and global resources, our furnace experts focused on efficiency to deliver planned upgrades in the shortest possible interval. We shut down the first furnace in October 2014, with first metal scheduled for the first half of 2015. The second furnace will then be shut down with a similar work schedule and first metal expected before the end of 2015.

The upgraded furnace binding system, integrated with the new refractory design, will promote long-term furnace integrity. An improved copper wall cooling system will increase operational flexibility, while a new air-cooling system will reduce refractory hydration risk.

THE FINAL COUNTDOWN

Moving towards completion at the world's largest aluminum project

Ma'aden | Ras Al Khair, Saudi Arabia

After five years and many impressive milestones, the Hatch Outotec JV (HOT) is getting set to wind down our commissioning work at Ma'aden Aluminium's new alumina refinery in Saudi Arabia. The critical next phase for the HOT team is operational support during ramp-up to nameplate production. The refinery is an integral part of the world's largest and most efficient vertically integrated aluminum facility, which is a joint venture between the Saudi Arabian Mining Company (Ma'aden) and lightweight metals leader Alcoa.

The aluminum complex includes four primary elements with initial capacities as follows: 4 million metric tonnes per year (mTPY) bauxite mine, 1.8 million mTPY alumina refinery, 740,000 mTPY aluminum smelter, and 380,000 mTPY rolling mill. The mill is one of the most technically advanced in the world and the first in the Middle East to produce food-grade can sheet, as well as sheet for automotive applications. For the refinery component, a team of Hatch experts assisted the cold, hot water, and process commissioning activities for the digestion, evaporation, and ancillary facilities.

Hatch's patented multi-cell jacketed pipe heater and tube digestion technologies are at the plant's core

SURGICAL PRECISION

New control technology improves mining dredge operating performance

TiZir | Senegal

TiZir's Grande Côte mineral sands project in Senegal uses a new control system developed by our Systems & Process Control team in Perth, Australia. The Hatch Virtual Spud technology (HVST) was designed to accurately maneuver Grande Côte's 1,200-tonne line dredge without a spud.

HVST enables barges to dig deeper and wider channels, and improves production by at least 10% by eliminating downtime for spud movements and increasing the mining area sevenfold per anchor setting. Smoother dredge operation results in far fewer scenarios where the plant is subjected to abnormal stresses and, therefore, provides longer capital life and better energy efficiency for the operation.

The HVST planning tools help optimize anchor-point positioning, which enables consistent availability of maneuvering force along the mine path while minimizing impact to the adjoining natural environment, increasing the mine's ability to coexist with other land users.

Much easier to operate than previous methods and providing highly accurate maneuverability (within 300 mm of required trajectory), the system manipulates four onboard electric winches attached to a set of shore-based anchors, with no need for an anchoring spud that's typical of such dredges.

The new Hatch technology received a Western Australian Excellence Award in the category of Control Systems, Networks, Information Processing, and Telecommunications.

HVST's planning tools and precision operating controls significantly improve dredge path to exploit the ore body

“The smart city concept isn’t a social ideal. It’s an economic imperative.”

THE EVOLUTION OF URBANIZATION

By Martin Doble
Global Managing Director, Infrastructure

Right now, urban centers account for about half of the world's population, and the UN estimates that those 3.6 billion city dwellers will be 5 billion before 2035. This is critical information for Hatch and all our customers because everything we do together is driven by urban demographics and economics. Steel builds cities. Hydro and natural gas fuel them. Highways access them. Ports supply them. People travel in them. They drive much of the world's quality of life.

Smart urbanization begins with the understanding that everything is connected. That applies to the people, infrastructure and resources within an urban center and extends to its surrounding regions. The entire value chain and community must be considered in order to optimize population movement, enable economic growth, and improve the sustainability of the resources required.

DESIGNING ECONOMIES

IN FOCUS

Nick has been honored with numerous awards in his 39 years as an engineer, and in March 2015, he received the American Society of Civil Engineers' prestigious Outstanding Projects and Leaders (OPAL) Lifetime Achievement award for management. Under his leadership, Hatch Mott MacDonald's profitability increased more than sixfold—primarily through internal growth. It now has over 2,700 employees in 76 offices across the US and Canada, and is ranked 31st in the 2014 *Engineering News-Record*'s Top 500 Design Firms.

HMM's trajectory is a direct result of Nick's emphasis on a strong culture of safety, professionalism, and ethical practice. He is highly involved in various professional associations, authors numerous technical papers, and is a sought-after speaker. Whether at a drafting table, project site, boardroom, or lectern, Nick is well-known for the tenacity, energy, and insight he brings to everything he does.

Hatch Mott MacDonald President & CEO **Nicholas DeNichilo**

Continued

Smart cities need smart money. That is to say, they need to make smarter decisions about where and when they invest, particularly for key enabling infrastructure. Unfortunately, those decisions are too often singular or isolated in nature. Budgets are compartmentalized, which makes it difficult to create solutions that adequately serve multiple users and multiple objectives.

Possible interrelationships aren't thoroughly sought out or considered. A recent report on infrastructure spending productivity reckons that there are about $400 billion in cost-saving opportunities in current projects and processes worldwide. With estimates of over $40 trillion in infrastructure spending between 2005 and 2030, there will either be a lot more bad spending decisions to come, or a lot of opportunity to improve.

A competitive landscape

A focus on shared capacity will be critical for improving infrastructure investment and development. One plan can benefit many stakeholders and help multiple investors achieve their objectives. A lot of Hatch's work increasingly involves that space between the public and private. We're seeing infrastructure capital coming from many different sources than it has in the past, and the resulting productivity growth is more widely distributed, too.

Cities and regions vie against each other for investment capital and industrial activity. They therefore need to define their competitive advantages. They must specialize and focus their own investments in order to attract the right talent and money to grow and build momentum. This is what's happening in South Africa right now—planning regional specialization.

Resource accessibility is crucial. As cities grow, there are increasing challenges around access to food and other goods. Making them readily and efficiently available enables individual participation and collective productivity.

Urban resource availability issues also put pressure on rural areas—farming communities worldwide are struggling to increase productivity and move their goods to market. The plans and investments that cities make in infrastructure reach far beyond city limits, so supply chain efficiency has to improve.

Hatch has found that many problems in complex supply chains can be solved or alleviated by relatively simple optimization strategies. For instance, we worked on a "smart ports" scheme recently that reduced operating costs and freed up significant resources simply by getting multiple ports to agree on standards so the same specifications can be used across the supply chain.

Enabling change

Technology will be the big enabler. Communications and control systems are improving rapidly, and there's huge potential for "big data." An overarching theme will be global mobility and connectivity for people and information. Some aspects will be quite practical while others will be extremely complex.

New ways must be found to improve transportation and accessibility while reducing fuel consumption and vehicle congestion—replacing combustion engines with electric engines won't eliminate rush-hour gridlock. Can scientists and entrepreneurs find ways for cities to generate their own energy? In Paris, for example, they're testing sidewalk electrodes that

Kristin is a PEng with a master's degree in engineering and public policy and over six years of specialization in water management and wastewater treatment for mining and mineral processing. Her experience ranges from studies and piloting, through to commissioning, training, and operational support for greenfield and redevelopment projects. She's equally capable of seeing the big picture for integrated planning and implementing the fine details needed to realize incremental improvements.

She's keenly interested in how environmental stewardship can improve quality of life, and takes every opportunity to learn about and work with people from other cultures—from her involvement in Engineers Without Borders to her current work mobilizing Hatch's new office in Lima, Peru. Kristin is also keen on the value of multidisciplinary solutions and strong teamwork, which is just as evident at the office as it is when she's on the ultimate frisbee field.

Water Process Engineer **Kristin Pouw**

flex under footstep pressure to create and release energy. Hatch has worked with the Williams Formula 1 Racing Team on its coil-spring energy storage technology to support energy efficiency in rail transit systems.

Obviously, human capital is a vital part of any smart city. Local education and research institutions need to help shape the workforce for a city's specialization. Strong economic sustainability goals must be incorporated into major infrastructure planning, through a combination of local supplier development and a framework of world-class technical and design expertise.

The bottom line is this: the "smart city" concept isn't a social ideal, it's an economic imperative. Cities around the world are collectively swelling at a rate of about seven million new residents per year. Every new infrastructure project will be either a bridge or a roadblock for their economies.

Success will come from strong leadership—people who know how to engage their communities and partner with business, social, and educational organizations within their communities. It will take imagination to fit the small and large elements together, to find common goals for public and private interests. And it will take commitment to avoid isolated, short-term transactional thinking in favor of truly long-term planning for shared resource efficiency and supply-chain competitiveness. ■

DEFINING SMART CITIES

Smart cities are places where economic and social progress is rife, with citizens who enjoy the fruits of this economic progress. They have a future that preserves the wealth of the earth and sustains a high quality of life. These are places that deliver life to the fullest, with opportunities for growth and exploration, room for thought and experimentation, and spaces for recreation and biodiversity.

- **Regional competitiveness**
- **Transport and integrated communications technology**
- **Quality of life**
- **Governance and management (citizen participation)**
- **Natural resource management**
- **Human and social capital**

CITY-WIDE SOLUTIONS

Strategic planning and operational design of metro transit system

eThekwini Transport Authority | Durban, South Africa

Metropolitan Durban is South Africa's third-largest city by population (3.5 million) and the largest by land area (2,297 km^2). Embracing local diversity, the municipal government aims to be Africa's most caring and liveable city by 2030. This vision focuses on safety, accessibility, efficiency, social cohesion, and sustainability in terms of livelihoods, economics, and the environment. Given the growing population and a forecasted 22% increase in rush-hour person traffic by 2020, public transit is a critical factor in achieving all aspects of that vision.

The ultimate objective is to redefine Durban's spatial structure and development trajectory beyond 2030 by implementing infrastructure with initially low CAPEX and OPEX investment—and enough flexibility to affordably evolve with future growth and changing needs.

The fully integrated approach cut expected expenditures by up to 46% across key system elements

The new Go!Durban transit system will comprise 90 km of rail rapid transit, 330 km of bus rapid transit, 2,200 km of road-based feeder services, 290 km of complementary rail services, 820 km of complementary bus services and a fleet of approximately 4,120 vehicles. They will gradually replace the existing system over the next 15 years. Hatch Goba has been involved with overall strategy development and detailed feasibility study for Phase 1, which will develop the network's first four corridors—one rail and three rapid-transit bus lines. These were selected to benefit the most users (about 65% of total public transit demand) in the shortest time frame, with optimal short-term investment. In 2013, we were also asked to undertake the detailed operational design for Phase 1.

Since 2010, our services have included: market research; user requirement specification development; network planning and mode selection; stakeholder engagement; service design; demand modeling and revenue estimation; infrastructure planning, preliminary design and costing; operating cost estimation; preparation of funding applications; and ongoing technical and advisory support until implementation.

With a fully integrated approach to planning through to detailed operational design, we've worked with our client to cut expected capital and operational expenditure by up to 46% across key system elements. With a solid understanding of the relationships between transportation, land use, and economics, our approach strives to achieve equity of access to opportunity, reduce impact of transportation on the environment, promote a liveable city, develop a spatial structure that rectifies historical imbalances, address the needs of public transit and private auto traffic, and make an overall positive impact on the city's economy. These goals are achieved through a collaborative effort between the eThekwini Transport Authority, City Planning, and Human Settlements units.

LIGHT RAIL FOR HEAVY TRAFFIC

Urban transit expansion with underground and surface elements

Metrolinx & Toronto Transit Commission | Toronto, Ontario, Canada

Twin tunnels with an internal diameter of 5.75 m are being bored in two contracts, 6.67 km long for the first and 3.25 km for the second

The Eglinton Crosstown light rail transit (LRT) is the largest transit expansion ever undertaken in Toronto. The route runs across Eglinton Avenue in densely populated midtown, connecting Etobicoke in the west with Scarborough in the east. The project consists of approximately 19 km of new LRT with 13 new underground stations and 10 ground-level stops. The underground section required nearly 10 km of twin-bored tunnels plus launch and extraction shafts for the tunnel-boring machines, cross passages, safety exits, and other related infrastructure.

Hatch Mott MacDonald (HMM) developed the project implementation plan, and performed preliminary and detailed designs of the twin-bored tunnels. The tunnels pass nearly 1,200 buildings, as well as buried and surface utilities. HMM performed a detailed assessment of tunneling effects on these structures, and developed a mitigation approach with comprehensive consideration of private-property issues, utilities treatment, and traffic management.

HMM also provided the reference concept design for a number of elements being procured as a large P3 project: LRT elevated guideways, at-grade sections, the vehicle maintenance and storage facility, and six of the total 13 underground stations. As part of a joint-venture team, HMM responsibilities also include program management, supplier qualifications and RFP specifications, and technical services for systems, geotechnical, and structures.

Design work began in 2009, and the current schedule expects passengers to be in transit in 2020.

The LRT system will have a fleet of over 200 Low Floor Flexity Light Rail Vehicles built by Bombardier.

854 BILLION GALLONS & COUNTING

18 years of water management services for US capital

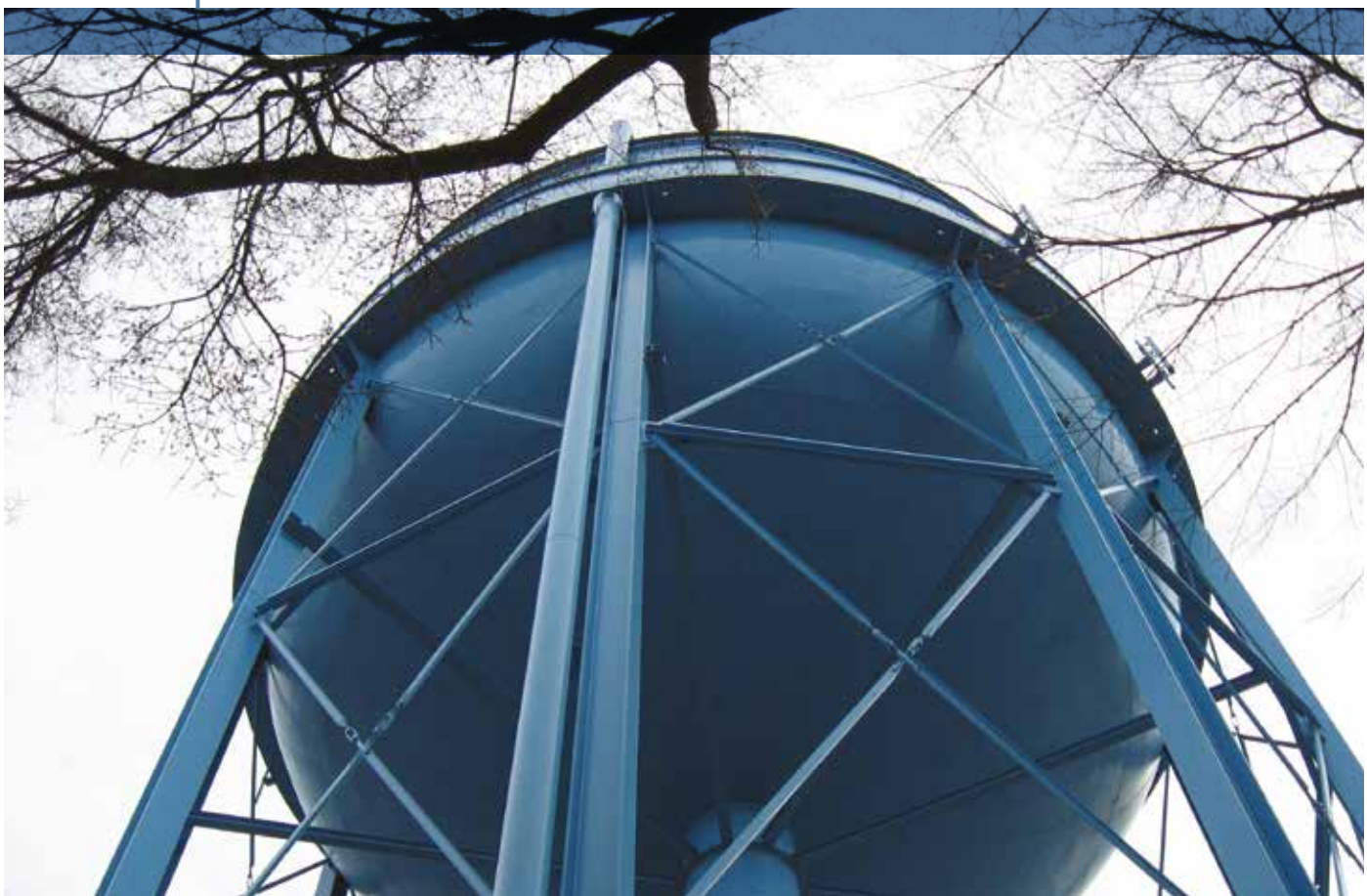
DC Water | Washington, DC, USA

DC Water provides about 130 million gallons per day of drinking water to 600,000 residents, 700,000 area employees, and 17.8 million annual visitors. The water system includes eight storage reservoirs and tanks, 36,000 valves, 9,000 hydrants and about 1,300 miles of mains. As in many east-coast American cities, the aging infrastructure needs ongoing monitoring, maintenance, and major renovation to keep up with modern demands.

From early hydraulic modeling to the latest diagnostics systems, data has always driven our work for DC Water

One of the first things Hatch Mott MacDonald did was to import an Esri geodatabase to create a hydraulic software model including all the pipes in the various pressure zones. That was back in 2001, and we've provided engineering and program management services ever since. We've done everything from repairing countless small-diameter valves to mitigating the effects of lead from old pipes and improving fire safety. Our design for the Fort Stanton Reservoir safeguarded drinking water supply while preserving the historic park's character and preventing erosion. In addition to working through remediation priorities, we continually expand system-management capabilities by integrating the latest proven technologies, most recently in big-data monitoring and diagnostics.

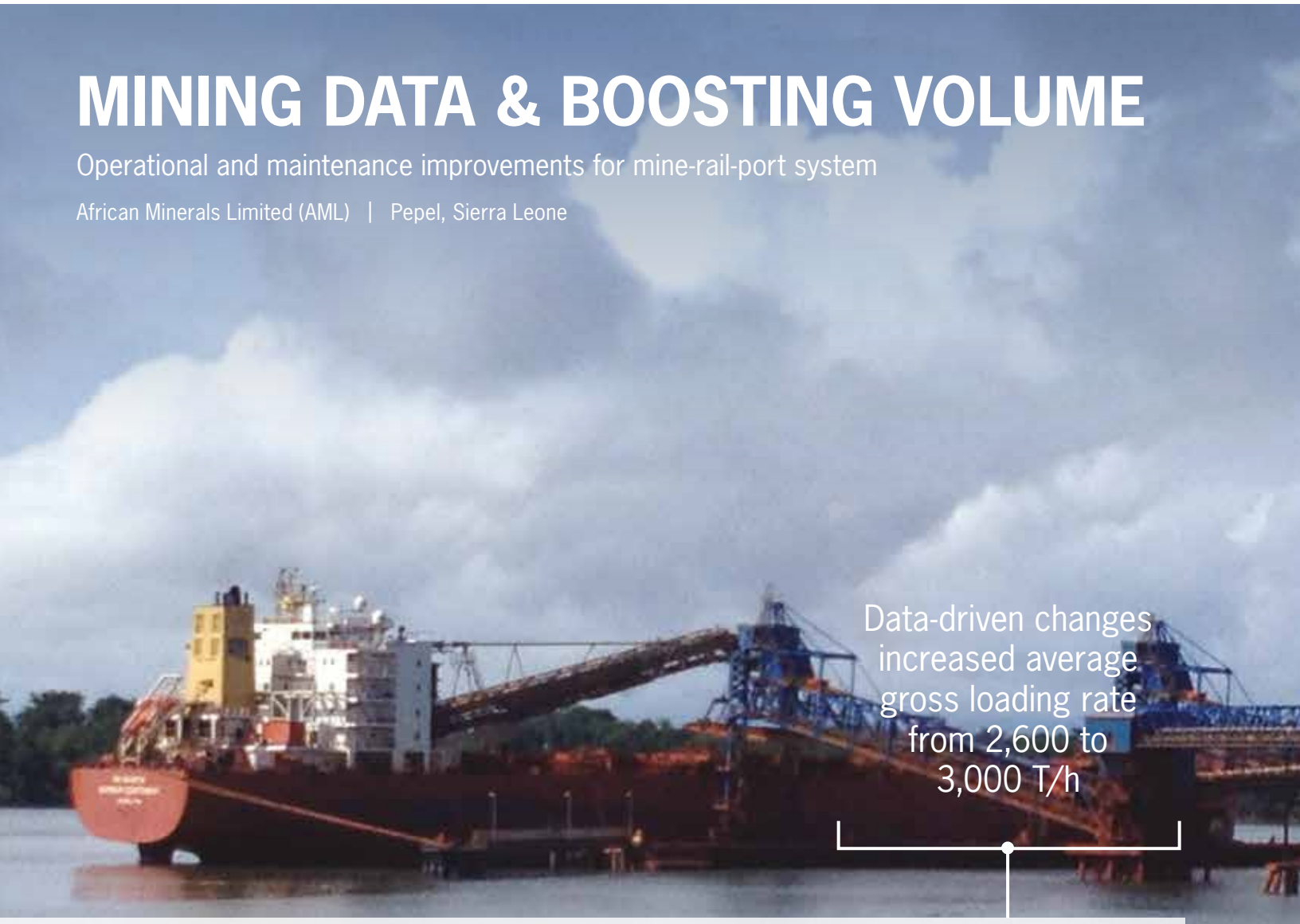
HMM's partnership with DC Water gets stronger every year. In January 2014, it was renewed for another five-year term to continue supporting the Capital Improvement Program with planning, design, and construction services, and operation of the transmission and distribution system. The new contract aligns with DC Water's vision of becoming a world-class water utility by introducing several new initiatives such as benchmarking with industry leaders, collaboration with other utilities around the world, and giving higher priority to innovations in pipe renewal technologies and carbon footprint reductions.



MINING DATA & BOOSTING VOLUME

Operational and maintenance improvements for mine-rail-port system

African Minerals Limited (AML) | Pepel, Sierra Leone



Data-driven changes increased average gross loading rate from 2,600 to 3,000 T/h

Iron ore is exported 200 km by rail from the Tonkolili mine to Pepel port where it is loaded onto transshipment vessels for delivery to Capesize ships 20 km offshore. After nearly two years in operation, export volumes were falling short of forecasts, and AML asked Hatch to evaluate its infrastructure and processes with the goal of increasing exports from 12 MTPA to 20 MTPA by 2015, utilizing primarily existing equipment.

We began by identifying critical points in the logistics chain and installing monitoring systems for weekly data capture and analysis—mapping the as-is situation, measuring against benchmark design rates, and identifying bottlenecks for improvement. We collected data from December 2012 onward and used extensive static analysis to improve the effectiveness of dynamic simulations. A number of improvements were prioritized, including train reconfiguration, stockyard optimization with a focus on consistency versus peak workload, setting more sustainable targets, improved planning for seasonal constraints, and corrections in a number of current operating practices.

In December 2013, we started to implement changes to operating and maintenance procedures, designing improvements for existing components, and specifying new equipment where needed. Within five months of the first changes, average gross loading rate had improved from 2,600 T/h to 3,000 T/h, and annualized shipped tonnage has since remained above 18 MTPA (with the exception of January 2014, when Capesize vessel availability was below normal). Further volume increases are expected when all remedial works are complete.

BORDER CROSSING

Developing local procurement capabilities in China

Few western engineering companies have much experience with China's materials and manufacturing suppliers for large-scale technology and infrastructure projects. In fact, Hatch is the first 100% foreign engineering company to receive several important licenses from the Chinese government, enabling us to independently deliver projects that include technology transfer and patented equipment supply.

While most aspects of engineering and manufacturing are quite similar between China and other countries, there can be subtle differences that have a significant impact on project progress.

Looking at the QSLIC calcium carbide project as an example, our Shanghai, Beijing, and Shenyang teams played key roles in bridging different capabilities and customs.

At the resource level, some equipment and materials we would typically use in projects are not available in China. Our sourcing and engineering teams worked together to identify optimal substitutions from Chinese standards and make necessary design adaptations.

Another big difference is the public open bidding process, which attracts a much wider range and higher volume of proposals than is customary with western projects. Our procurement teams therefore developed technical-clarification and prequalification processes to help identify the most suitable Chinese suppliers.

Hatch's Vendor Quality Surveillance team regularly visits vendor shops for inspections and process reviews

Where multiple vendors were involved, we adopted rigorous quality and IP management processes to ensure consistency and eliminate quality risks during fabrication of initial equipment as well as future spares inventories. These initiatives delivered the desired quality and achieved the client's objectives for low CAPEX. Local availability of qualified spare parts also optimizes OPEX and helps minimize downtime for maintenance and repairs.

In addition to QSLIC's Mg and CaC_2 projects, our recent experience in China includes the Jiangsu lithium carbonate plant, BlueScope steel coating facility, procurement and large module construction for the Koniambo nickel project in New Caledonia, as well as modules for oil and gas and metallurgical projects in Australia, Brazil, China, and elsewhere. These engineering and procurement successes, and our growing relationships with many Chinese vendors, show that different traditions can come together for great results, both locally and globally.

Hatch identified over 60 performance improvements to enable expansion plans

BIGGER & CLEANER

Operational performance improvements keep coal terminal expansion on target

Shenhua Huanghua Port Authority (HPA) | Huanghua, Hebei, China

Hatch formed a specialist study team to help HPA carry out a scope definition study of expansion Phases 1–4 to identify, evaluate, and prioritize potential improvement projects aimed at achieving industry best practices at the port. We focused on four key areas: equipment and operations, cleanliness, automation, and information systems. The team also made recommendations on safety and other general site-wide issues.

In addition to the primary objective of reducing spillage and dust generation in material handling and transfer areas, the cleanliness projects could reduce cleaning costs by 10–20%. Environmental improvements will also come from reduced run-off and improved collection facilities. Simulation modeling of the terminal is identifying stress points to improve bottlenecks and other limitations impacting throughput. Discrete element modeling of ore transfers, part of our detail design process, will minimize dust generation and spillage at transfer points. Improvements will be made to site-wide automation and control systems, as well as information systems to provide reliable and stable reporting.

The study identified over 60 projects to improve operating performance. Hatch was subsequently awarded implementation of the 15 top-priority projects, and we've been engaged to complete the concept study for the Phase 5 expansion.

VISION FOR FISSION

Due diligence for Canadian nuclear industry

Canadian Nuclear Association and Canadian Nuclear Safety Commission | Canada

Canada is a top-tier nuclear nation with more than 60 years of safe commercial program development and over 3,200 TWh of low-emission electricity produced by CANDU reactors. The industry is also credited for the creation of food and medical sterilization solutions as well as healthcare diagnostics technologies. Both the Canadian Nuclear Association (CNA) and the Canadian Nuclear Safety Commission (CNSC) recently turned to Hatch for help in evaluating the environmental and regulatory aspects of nuclear power generation.

For CNA, Hatch conducted a meta-analysis of various life cycle assessment (LCA) studies covering nuclear, wind, and natural gas combined-cycle power generation. Our study evaluated greenhouse gas and other air emissions throughout the nuclear power generation life cycle, including: fuel extraction, processing and use; waste management; power station construction; and decommissioning. The study was unique in its assembly of existing LCA literature into models that facilitate practical comparison of disparate technology options.

Over the past few years, there's been growing global interest in the development of small, modular reactors for niche power markets because of the technologies' deployment flexibility, lower capital investment, scalability, and enhanced safety. As the industry prepares to commercially develop and operate fleets of these micro nuclear reactors, Hatch supported CNSC with advice on how to ensure their safe operation in Canada. Our design and safety assessment covered seven innovative reactors and identified the potential regulatory and licensing considerations.

Our global experience includes execution of nuclear projects around the world for commercial CANDU and light water reactor operations, and advanced reactor technology developments

ENVIRONMENTAL & COMMUNITY SUCCESS

By Corinne Boone
Managing Director, Environmental Services

At Hatch, sustainability is at the core of how we conduct our business and deliver value to our clients. Optimization of economic, social, and environmental concerns leads to shared wins for business, the environment, and society. However, projects have traditionally struggled with optimizing social outcomes.

Increasingly, mining, energy, and infrastructure project proponents seek to identify and implement innovative approaches to sustainably engage for sustainability. The potential for project success is high when sustainability is actively integrated with the overall development, but low (and often a failure) when action is not taken or integrated. Companies now realize just how much is at stake.

SUSTAINABLE ENGAGEMENT FOR SUSTAINABILITY

“By 2025, sustainability conversations won’t be happening at the corporate level. The hard facts about “the soft side” of project development will be well understood and the work will be happening at the departmental level, just like engineering and procurement.”

Continued

When it comes to getting our collective minds around sustainability, how to develop a strategy, implement it and monitor the results—one of the biggest challenges is that it means different things to different people. Common definitions include: lasting, financially viable, environmental compliance, or just doing what is required. Others define it as the delicate balance or merging of environment, community/social, and financial/economic concerns. This latter definition is gaining acceptance as the path to achieving and maintaining successful businesses, relationships, and projects.

Although we sustainability practitioners sometimes cringe when we hear sustainability defined as "lasting," that term is actually quite relevant. If the right balance is not struck across environmental, economic, and social considerations, projects will not last—or be sustainable.

More and more projects around the world are being developed in remote locations that have very difficult environmental and socioeconomic challenges. Even though populations may be small and scattered, they have a keen awareness and strong voices. Information access and dissemination are now prevalent even in remote areas, and people around the world are tuned in to what happens far away. With social media and virtually unlimited access to global journalism, information, and opinions, stakeholder analysis has evolved to the point where remote communities are no longer isolated communities.

There is mounting evidence that companies lose shareholder value, experience huge value destruction, and suffer opportunity costs when they fail to explicitly integrate environmental and social considerations into business decisions early and throughout the life of a project. A body of literature has emerged on this topic. One 2014 report published by the Harvard Kennedy School* provides some analysis about the "costs of conflict"—estimating that real business costs associated with environmental and social risks can add up to millions of dollars.

One of the challenges is that companies often don't want to pay for environmental and social impact assessment and mitigation, or engage in full-blown stakeholder engagement activities, until they know for sure that the project will go ahead. However, although early investment can be financially challenging and may risk inflating expectations of a project, it is significantly better than having large amounts of investment stranded and/or projects suspended when they are under construction or even in operation.

Instead of viewing early assessment, sustainability, and engagement initiatives as hurdles or sunk costs, they should be seen as parts of the process that improve a project's chances of proceeding—and achieving long-lasting economic and social development. Everyone knows that a design change can impact procurement cost and schedule, and that scheduling depends on financing. There are similar interrelationships—and opportunities—with sustainability work. So, it has to be integrated with all the other aspects of project development (engineering, financing, scheduling, procurement, etc.). Companies that invest early in the "softer" side of project planning and development work understand these interrelationships and are in better shape to navigate the challenges.

An explicit approach is required that integrates sustainability considerations on the same level as financial and other risk considerations. This involves an understanding of the social and physical environment around projects, the communities in which projects are located, the project needs—and effective integration of this information to develop strategies that will help obtain and maintain the project's "social license to operate." The potential for success is high and much is at stake. It can take years to achieve social license to operate and just minutes to lose it.

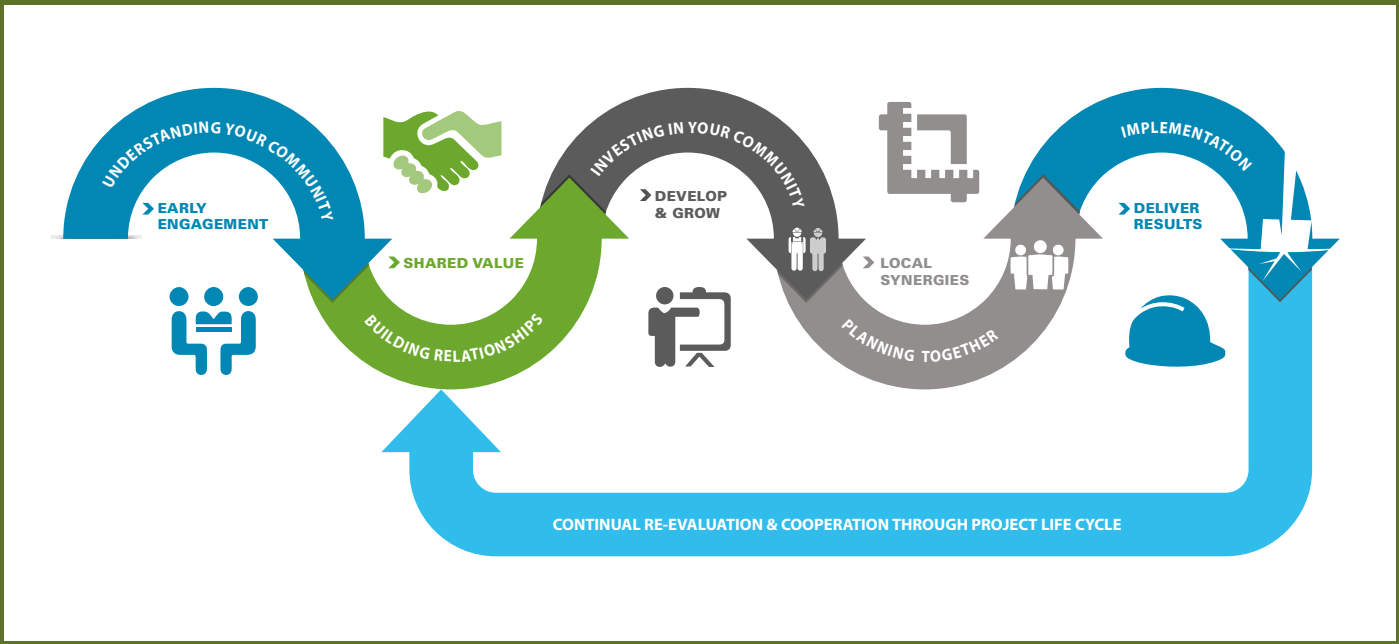
Ongoing and engaging sustainability is the baseline for future success in the mining, energy, infrastructure, or any other development sector—public or private. Successful businesses in the future will be those that integrate full life cycle considerations into their activities. Businesses that adopt the sustainability approach will leave a positive legacy for the communities in which they operate. This will also facilitate lasting trust and commitment between project proponents and stakeholders.

Hatch continuously strives to develop strategic yet practical and implementable approaches for identifying benefits of early and ongoing integration of sustainability considerations into projects. In our consulting role, we are in a unique position to develop concepts into reality, and this is no different in our approach to sustainability.

By 2025, sustainability conversations won't be happening at the corporate level. The hard facts about "the soft side" of project development will be well understood and the work will be happening at the departmental level, just like engineering and procurement. In fact, sustainability considerations will be integrated, measured, managed, and continuously improved and adapted to meet changing circumstances, just like all other aspects of running a successful project.

*Davis, Rachel and Daniel M. Franks. 2014. "Costs of Company-Community Conflict in the Extractive Sector." Corporate Social Responsibility Initiative Report No. 66. Cambridge, MA: Harvard Kennedy School.

EARLY & CONTINUOUS ENGAGEMENT NEEDED



Understanding your stakeholders

Early engagement is critical to understand stakeholders' perspectives and to project success—showing genuine initiative will go a long way towards being taken seriously and building credibility.

Building relationships

Sponsorship and commitment from the senior executive level are essential but often underestimated at the outset of projects. Promote transparent, consistent, and ongoing communication with all stakeholders. Develop a strategy together with common goals and objectives. Project teams must be ever-present and accessible. Trust and credibility have to be earned.

Investing in your community

You're moving into a new town. You don't want to be the bad neighbor. There are things you can do to assist communities that may not have a direct ROI in accounting terms, but that will create and protect value for both the project and communities. Look for local suppliers and consider helping to create new ones. There are people next door who could develop small businesses to service your site throughout its operating years. Help them to do it. The social dividends are often enormous.

Planning together

Work with local and regional governments and all key stakeholders and groups to support the creation of a master plan that supports the community—infrastructure, power, water, and other economic activities and services. Identify synergies and spinoffs. Take a broader approach than you have in the past—look for positive cumulative impacts from a long-term regional perspective.

Implementing the project

Ensure that everything you do in engineering, construction, and procurement is aligned with the agreed goals and plans for the community and environment. Understand and deliver on your promises about local employment and business opportunities and synergies. Maintain relationships, investment, and open dialogue so you keep earning trust and improving your reputation.

Then, *re-evaluate, re-engage, re-balance, and continuously improve.* ■

ASSESSING POTENTIAL

Sustainable local development for mine expansion study

Tasiast Mauritanie Limited SA (TMLSA) | Mauritania

TMLSA studied a potential expansion of its Tasiast gold mine that would have involved constructing a new process facility to increase production to 38,000 t/d. With a key project goal to maximize in-country resources, the feasibility study that Hatch completed in 2014 included local labor and supplier development programs.

The study investigated ways to increase local participation in higher-value contracts than typically allowed with this type of project

Workforce training components were designed specifically for potential opportunities at Tasiast. The Hatch Environmental Services Group worked with TMLSA to canvass the local workforce and establish partnerships with local recruitment agencies to ensure each location's unique needs were addressed. Supplier-focused elements would have included entrepreneurial and business training as well as a contracting strategy structured to enable more participation by local suppliers for a variety of services including concrete supply, transportation and logistics, design, and construction of auxiliary buildings.

Hatch's approach to project sustainability ranged from initial community relations and social license through to technical improvements to minimize project footprint and maximize local content, all according to latest international standards and best practices. In addition to the project-specific training and supplier development, we worked with TMLSA on parts of its community investment program, such as providing support to an orphanage in Nouadhibou.

Initial program results were excellent, with the key success being a fully integrated team approach by Hatch and TMLSA personnel.

CATCHING THE SUN

25 MW solar project in extreme cold climate

Rainy River First Nations | Ontario, Canada

Rainy River is a new 210-acre, utility-scale solar project in northwestern Ontario. It comprises three smaller developments (Dave Rampel and Morley sites at 10 MW each and the 5 MW Vanzwolf site) and uses photovoltaic (PV) panels to produce 25 MW (38 MW DC) of power. Hatch had a broad scope of responsibility including detailed design basis (site layout, yield optimization), noise study documentation, regulatory applications and permit alignment, energy output assessment, and system modeling.

As full-time, on-site Owner's Engineer, our services also included supervising the EPC contractor and subcontractors, reviewing all engineering deliverables, overseeing environmental monitoring and compliance, and coordinating with Hydro One for grid connection through a 25 km, dedicated 44 kV feeder. Saulteaux Consulting & Engineering, a 100% Aboriginal-owned company in Fort Frances, Ontario, provided site support.

Temperatures are below -40 °C for much of the year, so the greatest challenges for this project related to the unusually deep frost. With 13,000 helical piles involved, the design had to be robust enough to withstand potential frost heave while still allowing cost-effective and timely installation. Our solution to these issues included customized inverter housings and the longest piling foundations ever used in Ontario. Hatch was on the project since June 2013; construction started in May 2014, and the facility was put into service in February 2015.

The Rainy River project comprises three smaller developments, each with separate feed-in-tariff contracts and renewable energy approvals

Image courtesy of Shell

PLANNING FOR PEOPLE

Social impact assessment for floating LNG project

Browse Joint Venture | Western Australia

The proposed Woodside-operated commercialization of gas and condensate fields in the Browse Basin (425 km from Broome), could involve up to three FLNG vessels and numerous onshore sites.

Hatch is undertaking a comprehensive social impact assessment (SIA) of onshore activities, a stakeholder engagement process, development of social design criteria for concurrent basis of design (BOD) and front-end engineering and design (FEED) phases, and a draft Social Impact Management Plan with practicable options and measureable key performance indicators (KPIs).

Having recently completed a similar assignment for Shell's Prelude project, our Environmental Services Group is the only Australian consultancy with proven experience in this unique area.

Hatch has prepared comprehensive SIAs for two projects using Shell FLNG technology

IN FOCUS

Catalina has a BEng in environmental engineering and an MSc in environmental science. She was such a great addition to the Hatch team during her internship, that we had a job offer waiting for her on graduation day. She may be young, but she has a wealth of experience already (including environmental analysis, waste management, mine closure planning and costing, onsite inspections, corrective actions, emissions studies) and can develop detailed plans with practical implementation in mind.

She spends time at our Santiago and Mississauga offices and works on many Hatch projects around North and South America. Catalina is the real deal when it comes to environmental efficiency and sustainability. She's an avid hiker and camper, and she even harvests organic tomatoes, peppers and strawberries—from where else but the micro garden she built inside her apartment.

Environmental Analyst **Catalina González**

PRACTICING WHAT WE PREACH

Hatch's own sustainability initiatives

Sustainability has always been part of the Hatch approach. It's a core principle that guides our delivery of value to clients as well as our internal drive to be a socially responsible company. We invest in community activities focused on science education and specialty training for youth and Aboriginal groups. We also continually measure and improve the environmental performance of our operations, both at our offices and at project sites. Here are a few highlights from 2014.

Environmental metrics

The Hatch Global Environmental Metrics program has been in place since 2011 to give us a better understanding of our operational performance in terms of greenhouse gas (GHG) emissions, energy and water use, and paper consumption. Guided by in-house experts and using International Standards Organization (ISO) methods for emissions accounting and life cycle assessment, the approach ensures that measurements are accurate and effective in driving meaningful change.

We recently established a performance baseline of activities over the last three years to evaluate trends and set bottom-up performance targets for continuous improvement. Topline annual metrics per employee show 4 tonnes of carbon dioxide equivalent (tCO_2e) emissions, 11 m^3 of freshwater use, and 20 kg of paper consumption associated with Hatch activities.

Higher education

In 2014, we donated $3 million to educational programs and research, and funded scholarships. Examples include our annual Gerry Hatch scholarships (since 1990); scholarships for the University of Toronto's Institute for Sustainable Energy; Aboriginal and Indigenous scholarships in Canada at Queen's, McMaster, University of Toronto, and University of British Columbia, and in Australia at Curtin University and University of Western Australia; scholarships at the Universidad de Chile; and bursaries at the University of the Witwatersrand in South Africa.

New for 2015 is a scholarship for Aboriginal students entering the engineering program at Lakehead University in Thunder Bay, Ontario, as well as a mentorship program to reach many youth from remote Ontario communities who go to Thunder Bay for high school. Thirty mentors from Lakehead University are expected to participate, along with local Hatch Mott MacDonald staff and past Aboriginal scholarship winners working at Hatch who will help judge the spring science fair.

First Nations training programs in Ontario

We continue our commitment to support training initiatives for First Nations communities and develop local capacity around the extractive industries. In August 2014, Hatch partnered for the second year in a row with the Chiefs of Ontario to conduct a workshop about mining development processes for the Wahnapitae First Nation, north of Sudbury.

Held at Wahnapitae's LEED-certified Centre of Excellence, the workshop was inspired by participant feedback from a training session for the Constance Lake First Nation in 2013, for which Hatch employees gave several lectures. Many of those

A lot of people might call carpooling a hassle. But Luke Westfall puts it in the hobby column along with cycling and urban infrastructure. He's a PEng with a master's degree in mechanical and materials engineering and eight years of experience specializing in climate change, life cycle assessment and measurement, monitoring and reporting systems for environmental performance metrics. He also keeps Hatch on track by managing the performance indicators that measure our global carbon footprint.

Luke's worked on projects across a wide range of industries, including power generation, metals, oil and gas—and he's our go-to for all things GHG. In fact, one of his GHG inventories was instrumental in securing a $10 million grant to pilot the innovative Nsolv bitumen extraction technology. He's very serious about improving the relationship between industry and the environment, and he has a lot of fun doing it.

Senior Environmental Services Consultant **Luke Westfall**

participants were involved again in this second iteration, along with new participants from Matawa and Mushkegowuk, illustrating the importance of understanding mining and environment in these communities. Sessions focused on the mining life cycle, company-community interaction, and the potential impacts and benefits of projects. Presentations and discussions were led by personnel from Hatch and other industry partners, and three local mines hosted tours as part of the workshop.

PAR certification for our Canadian offices

Hatch recently achieved the first level of Progressive Aboriginal Relations (PAR) certification from the Canadian Council for Aboriginal Business. The program was introduced 13 years ago, is juried by Aboriginal business people, and remains the premier Canadian corporate social responsibility program with an emphasis on Aboriginal relations. Our qualification was subject to an independent, third-party verification of reports outlining activities across Canada that reflect our commitment to meaningful, long-term engagement with Aboriginal communities in and around our projects.

Promoting engineering education in northern British Columbia

This program was jointly established in 2013 by Hatch and Hatch Mott MacDonald (HMM) to encourage local economic participation and growth by motivating youth to consider careers in engineering and sciences. Hatch and HMM engineers and social scientists have presented to over 850 students from grades 8–12 in Prince Rupert, Terrace, Kitimat, Port Simpson, Haida Gwaii, and Dease Lake. Other components of this initiative include the annual scholarship for 2nd or 3rd year students in the University of British Columbia's School of Engineering (giving preference to Aboriginal and Northern BC students), and sponsorship of the Northwest Science Fair Extravaganza, BC LNG Youth Conference, and the Minerva Foundation of BC's Combining Our Strength™ program.

Hatch Environmental Management Systems & ISO 14001 certification

The Hatch Environmental Management System (HEMS) is our core framework for systematically implementing sustainability initiatives and ensuring continual improvement of environmental performance. HEMS was certified to be ISO 14001:2004 compliant in December 2013, along with Hatch's project-delivery services and four offices in the Greater Toronto Area (GTA).

Throughout 2014, HEMS has improved the environmental performance of our GTA offices, including financial savings and management of compliance requirements and environmental issues. We've also integrated ISO 14001 requirements in our Project LifeCycle Process to provide consistent, transparent, and easily transferable management and assessment of environmental and social impacts, as well as sustainability services. This gives our clients greater certainty in tracking, managing, and improving their compliance and environmental performance on projects—improving control and reducing risks.

“Underpinning it all is a commitment to getting the basics right and planning ahead in detail—not just for individual projects, but for improvements in the broader sense.”

COMBATING COMPLEXITY

REDEFINING PROJECT DELIVERY

By Robert Francki
Global Managing Director, Project Delivery

Capital projects are facing more remote locations, longer logistics chains, more significant and complex support infrastructure, more rigorous regulatory conditions, more difficult access to financing, more demanding local communities and, in the case of resource projects, lower ore grades—all combining to make projects more complex. This has driven many major providers of engineering, procurement, construction, commissioning, and project management (collectively EPC or EPCM) services to focus predominantly on project management and administration. While Hatch equally continued to build project and construction management capabilities and capacity, we also importantly maintained strong engineering skills and kept investing in specialist technical skills.

This combination of technical and delivery strengths was a direction set by our founder and, as one considers the challenges of the current project environment, makes more sense than ever.

Most will recognize that, beyond the ability to organize the delivery of a new project or the improvement of an existing facility, strong subject-matter expertise is required in the technology, facility type, or infrastructure category for the result to effectively meet its business objectives.

As project complexity continues to increase, there are a few key ideas that I see making the most impact on a project's success throughout its full life.

Continued

Subject-matter expertise

A team with strong specialized knowledge and experience will be stronger than one with general experience. Generalists will drive the project according to top-level KPIs but won't necessarily recognize all the technical issues that affect those KPIs. Fast and cheap isn't useful if the facility does not operate as required or is costly to maintain. That's why we ensure that the core teams on our projects have the appropriate technical background for the job at hand. This is a big part of why Hatch projects start up and ramp up so effectively.

Procurement: the earlier, the better

It is best to start considering procurement strategies at the study stage. Understanding equipment and materials availability will make a big difference to the design team. The goal is to push cost down without undermining performance. As the project evolves, design and procurement plans must iterate together so vendor information is available when required and resources are available at the expected costs and lead times. This requires close cooperation between design and procurement teams as opposed to an over-the-wall procurement approach.

Our Global Procurement Intelligence (GPI) system takes early sourcing strategies to a whole new level. It's an interactive registry that helps us qualify suppliers and fabricators and stay up to date with changes in their capabilities. At any given time, we can draw on GPI to help with sourcing and engineering decisions. Given the international nature of our work, and the growing importance of global sourcing in general, it's beneficial for suppliers to be qualified in the system.

More early planning means less waiting later

In an ideal world, the most cost-certain way to approach any project would be to complete 100% of the engineering before going into construction. In reality, there are business pressures driving shorter project schedules, and construction is initiated partway through the design cycle. So you have to strike a balance. For large projects, construction usually overlaps engineering by about 1.5 years. Naturally, with more overlap, the likelihood increases of changes during construction and start-up. By carefully assessing project complexity, identifying main risks, and increasing pre-execution planning, a much better balance can be struck between design completeness and schedule advancement.

Nothing exists in a vacuum

The power of modern database software enables project teams to draw on previous engineering solutions as well as useful designs from other fields. Cross-fertilization of expertise is a great way to achieve the best result—particularly in study and design phases, but also throughout execution.

When it comes to cross-fertilization, top of mind in industry now are things like knowledge management systems, reusable design, modularized design and construction, the road to BIM (Building Information Modeling) 7D design, and mobile apps to increase the effectiveness and efficiency of field teams. Site deployment is another specialty that's only really been recognized in recent years. It's such a simple concept, but historically difficult to do well because it was typically wrapped up in the responsibilities of the project construction team. Hatch has separated it, and the results are inspiring.

Underpinning it all is a commitment to getting the basics right and planning ahead in detail, not just for individual projects, but for improvements in the broader sense. That's why Hatch continually invests in developing technologies, specializations, and implementation techniques even though there may be no immediate revenue stream. We're comfortable taking these forward because we have the technical knowledge base to support them, we believe in enabling innovation and expertise to improve, and we see excellence in the basics as our guard against increasing project complexity. ■

GLOBAL PROCUREMENT INTELLIGENCE

In Hatch's experience, efficient procurement strategies significantly reduce both cost and schedule risk. Our innovative GPI system reduces both cost and schedule risk by quantifying and qualifying the effects of sourcing equipment and materials from different countries. It also allows supplier and contractor performance monitoring through the entire project life cycle. The powerful GPI database consolidates a wide range of information on regional sourcing options, contractor performance, and supplier capabilities—including cost, quality, materials availability, substitution possibilities, existing facility capabilities, expansion plans, and more. With GPI, procurement planning and contractor evaluation can easily begin at the scoping (FEL1) study phase, which becomes significantly more important as project remoteness and size increase.

The system offers tremendous insight into procurement markets that present much schedule and cost-saving potential for major projects, but where our clients haven't yet had much sourcing experience. GPI provides essential information on the regional, tax, commercial, and technological differences that can have implications for engineering and construction planning. Most importantly, GPI is monitored and managed by Hatch procurement specialists. We qualify vendors, validate quality assurance inspection and testing, and confirm accuracy as supplier capabilities change. We also provide comprehensive support for tendering, expediting, contract administration, and reporting. This combination of GPI tools and expertise gives our clients the confidence needed for their most important sourcing decisions.

SPECIALIZED ENGINEERING SERVICES

When it comes to project delivery, Hatch continually evolves its body of knowledge and capabilities with the same philosophy and perspective that we have for engineering design. We work closely with our clients to fully understand the operating challenge they face. Integrated teams of domain experts ensure that proposed solutions take the whole project into consideration—from FEL1, design and construction through commissioning, ramp-up, and operations. Traditional tools and processes are systematically combined with innovative new technologies to reduce risk and maximize productivity. We invest to research, develop and rigorously test optimization strategies that efficiently and cost-effectively solve even the most complex issues—keeping our clients on track for operational success. The following are some of our latest advances that are shaping the project-delivery landscape.

BUILDING INFORMATION MODELING

The BIM process integrates supplier, engineering, procurement and construction information in an enriched 3D digital model to improve decision-making through all project phases, optimize time and safety, and reduce costs. Its foundation comprises intelligent data physical components (location, dimensions, material properties, design codes, etc.), with dynamic interrelationships so that a change to one object can automatically determine changes to associated objects. BIM has evolved to include more dynamic dimensions such as schedule and progress, labor and material costs, energy and carbon footprint, and facility life cycle management. The latest 7D capabilities enable enrichments such as virtual operator training, maintenance planning, and configuration management.

Hatch has used BIM for over a decade and earned industry recognition and numerous project awards. We are now expanding BIM's value with geo-referencing capabilities to improve project scoping, environmental impact studies and regulatory compliance, materials evaluations, and construction planning tailored to the characteristics of each unique project location.

MODULARIZATION & FRONT-END IMPLEMENTATION PLANNING

Local skilled labor availability, long environmental permitting processes, extreme environments, design and executional limitations, procurement of long lead-time equipment, and high indirect construction costs are key challenges for any project—and they create even more financial and scheduling pressures for remote projects. An effective modularization strategy can ensure the highest safety standards and optimize labor sourcing and integrated scheduling, while reducing risk and costs. However, a modular strategy must be executed in a very different way from typical large-scale singular developments.

Hatch's M&FEIP group approaches modularization as an overall delivery strategy affecting every facet of execution. Our global procurement capabilities and unparalleled knowledge base ensure the best use of expertise, equipment, materials, and manufacturing yards around the world. The key advantage is parallel work fronts, allowing for a faster overall build. We also provide alternative logistics solutions to enable efficient transportation anywhere in the world. Our recent work for QSLIC in China and Tasiast in Mauritania are great examples of successful modularization.

OPERATION & ACCOMMODATION SITE IMPLEMENTATION SERVICES

Hatch's Site Deployment team has partnered with First Pac West Properties to offer OASIS—Operation & Accommodation Site Implementation Services—and provide an unprecedented level of quality in site mobilization and sustainment. Our team has ex-military professionals with extensive experience in extreme environments and complex terrains, who collaborate with our engineering and construction experts to deliver exceptional detail and a seamless transition from design to in-field execution.

The Solace System can be scaled up for construction and scaled down and refurbished for ongoing operations. The structures have a 20–65% smaller physical footprint than other systems and a much smaller carbon footprint thanks to energy efficiency and the ability to repurpose component parts, which reduces landfill contributions and is eligible for carbon credits. When the project is complete, the structure can be easily converted to a school, health clinic or other facility to benefit the local community. The end-to-end OASIS approach can significantly reduce and defer capital expenditures, minimize schedule risk, and drive down operating costs—all while increasing productivity and improving the viability of even the most challenging sites.

Innovative Solace System site accommodations

STEPPING UP DOWNSTREAM

New 195 MW run-of-river hydroelectric power plant

AltaGas | British Columbia, Canada

Forrest Kerr is a new, 195 MW hydroelectric facility, owned and operated by AltaGas and located in the traditional territory of the Tahltan First Nation in northwestern BC. The run-of-river design captures the immense energy produced by the natural flow and elevation drop of the Iskut River.

Hatch completed a number of feasibility and cost studies over several years to help define the optimal size and layout. In 2009, we delivered the final project feasibility study, including resolution of several technical issues and comprehensive capital and operating cost estimates.

The Forrest Kerr Hydroelectric Facility has nine Francis turbines with an annual capacity of 980 GWh. Final commissioning and testing was completed in October 2014

In 2011, after the project had been under way for about eight months with another engineering firm, we were asked to assume responsibility for the final design, procurement, and construction services. We quickly assembled a highly experienced design team and successfully managed the transition with underground excavations already under way. With significant modifications required to the headworks and underground powerhouse during this period, we conducted weekly design updates with the construction team and managed the changes with minimal lost time and rework in the field.

AltaGas managed the various construction contracts, while we provided resident engineering support services. Hatch delivered detailed construction drawings and specifications for the underground works contracts, general civil works, balance-of-plant electrical and mechanical works, and switchyard. We also provided drawings and specifications for a number of EPC contracts including the major mechanical equipment and the 37 km transmission line. One of the most interesting technical challenges involved the strict flow ramping requirements that were imposed to limit the water level fluctuations in fish-bearing areas downstream of the power plant. Together with AltaGas and Andritz Hydro, we developed an innovative configuration that allowed flow bypass through the nine generating units while running at over-speed. This avoided the need to construct a costly additional underground flow bypass and energy dissipation system.

Another challenge involved the high levels of bedload and suspended sediment carried in the river. Innovative sediment collection and flushing capabilities were built into the project to reduce sediment ingress to the power tunnel in order to limit turbine runner wear. Before moving ahead, the design and performance of these facilities were confirmed through extensive numerical studies and physical hydraulic modeling.

Despite all the challenges, the project was finished on time and on budget. AltaGas received a Project Excellence Award from Clean Energy BC. The Forrest Kerr Hydroelectric Facility is an important step in British Columbia's goal to achieve energy self-sufficiency by 2016, by providing clean, renewable energy to help meet Canada's commitment to reduce greenhouse gas emissions.

PREPARING FOR TAKE-OFF

Advanced engineering and manufacturing facilities

Airbus Americas | Mobile, Alabama, USA

In April 2013, following a year of evaluating alternative sites, Airbus broke ground for its new A320 airliner Final Assembly Plant in Mobile, Alabama—making it the first new manufacturer of large commercial aircraft in the US in over 40 years.

Hatch Mott MacDonald was part of the program management team with services consisting of consultant selection and procurement as well as design and incremental construction oversight for the final assembly line building, service and logistics centers, transshipment hangar, main gate building, underground passages, three aircraft hangars, delivery center, utilities, and adjoining infrastructure. Other services included the enabling works design, removal of existing substructures, grading and site preparation, and design of a 1.6 km long, 213 cm diameter concrete outfall to discharge into Mobile Bay—for which the rigorous USACE Nationwide Permit 12 was received in just 13 days.

> The new site includes nearly 17 acres of buildings with a designed capacity to deliver up to four planes per month with possible upgrading to double output

Designs were complete in July 2014 and construction is under way. Production start-up is expected in 2015 with first aircraft delivery in early 2016.

LESS H_2O MORE P_2O_5

Expanding a major phosphoric acid plant

Simplot Phosphates | Rock Springs, Wyoming, USA

This facility is a major producer of granular mono-ammonium phosphate fertilizer, super phosphoric acid, and related phosphate products. Lower quality phosphate rock feed and filter-scaling issues had been limiting plant performance, primarily due to excessive downtime for filter washing. Our phosphate engineering team's long history with the Rock Springs facility includes the original design and construction in the 1980s and a major debottlenecking project in 1999. With excellent knowledge of this uniquely designed plant, we hit the ground running for this expansion project in April 2011.

Expansion project has increased P_2O_5 production by 15%

The core of our solution was reconfiguration of the cooling water systems to eliminate a process cooling tower and reuse of hot process water from the phosphoric acid process, which required precise prediction of the cooling pond surface area. We designed and engineered a number of other new facility components, including a rock slurry storage tank and filter feed tank, reactor vacuum system, #11 RPA table filter, phosphoric acid evaporator with fluosilicic acid recovery, 44% acid clarifier/storage tank; and we reconfigured the plant electrical systems.

Commissioning and start-up were completed on schedule in June 2014. The filter wash cycles have been extended from two to seven days, and staggering the wash cycles of the filters and evaporators has enabled continuous plant operation—for a 15% increase in P_2O_5 production. The site team worked 581,600 hours with just one medical aid incident, which is a significant accomplishment given the hazardous chemical environment.

IMPROVING FACILITY PERFORMANCE

By Jeanne Els
Managing Director, Operational Performance

Economies of scale used to be a powerful differentiator, particularly in mining and metals. If an operation was big enough, it could do anything. But now, with commodity prices down, lower-quality reserves, and margins tighter than ever, large organizations are struggling with productivity that, in many cases, is even lower than it was before the last supercycle.

All organizations have gone through periods of severe cost-cutting, but nobody's really been able to address the core issue of productivity. There is significant latent capacity to be unlocked in the supply chain. The reality now is that scale is inhibiting improvement. I'll be discussing the problem from a mining perspective, but there are a lot of similarities in infrastructure and energy.

BETTER IS THE NEW BIGGER

“Static silo KPIs don’t consider the whole value chain. Higher-level, integrated dynamic decision systems are needed.”

Continued

What happened to performance?

We've just come through a decade or so of massive supply-chain development. Consider, for example, that you have several mines feeding a rail line that supplies one port to export different products to multiple markets. The complexity is incredible, and it has created operational silos in unexpected places.

There are three interrelated issues at play. First, when it comes to individual facilities and their managers, it's impossible to make the decisions that would have the most positive business impact. Think of the managers at the mines or the concentrators or the port—most of what's going on in the supply chain is outside their individual knowledge or control.

Compounding this is the issue of overall retention and availability of knowledge, specifically due to high employee turnover. This is partially because of an aging workforce but also because companies had to bring in a very large number of people during the capacity growth cycle. Knowledge transfer simply couldn't keep up with asset expansion.

Finally, there's the availability of information needed to improve supply chain decision-making and expertise development. Big data is a buzz word here, but the focus needs to be on quality, not quantity. There's already plenty of data out there, and it's easy enough to get more. The problem in most cases is having the right information at the right time to efficiently and confidently make the right business decision.

How can it be improved?

The "silo" decision-making processes have to be replaced with an approach that considers and affects the whole supply-chain. Decision-making must be informed by the existing business context, deep organizational knowledge, and the right data in the right format.

One of the areas on which Hatch focuses is improved organizational knowledge capture and innovative solutions to apply it to decision-making. Operations simulation is an invaluable tool here. The next step is an online decision support tool that informs across the supply chain.

The macro environment is always changing. Dynamic factors must be incorporated into decision-making processes. Consider my earlier example of several mines feeding one port. How does the mine deal with a situation where you need to prioritize throughput over quality, and decide to load a train in response to a customer's unexpected deadline? What are the day-to-day decisions made to avoid inventory build-up of an unwanted grade, etc?

Right now, the truth is that most big organizations don't have much of a calculated response to these external dynamic factors, let alone the complex interactions that are in the supply chains by design. If operating decisions continue to be directed by static KPIs, real headway is pretty much out of the question. Big organizations have to give their decision-makers new tools to take those dynamic factors into consideration and act on them in meaningful ways. This will inject the agility needed to unlock significant latent capacity and once again set these operations apart. ■

OPERATIONAL PERFORMANCE AT HATCH

We've developed three distinct service streams: designing projects, building them, and supporting our clients in improving their operations. We refer to the third service stream as Operational Performance (OP)—and it can make significant improvements during ramp-up of new facilities or through initiatives at ongoing operations. Our efforts are focused on improving the client's business, whether through cost, productivity or process improvements.

The Hatch approach is quite unique because it is based on a broad base of expertise. Many other engineering companies have either narrowed their focus to a very specific technical discipline or adapted a general project management approach and then subcontract for specialties as needed. We've kept investing in multiple areas of specialization in order to drive innovations in technologies as well as the processes needed to deliver our projects and improve performance.

Our OP specialists have years of experience in asset management and operations. We look at a client's entire operation—process, equipment, maintenance practices. We also deliver on-site engineering and operations support in alliance relationships or integrated teams. When delivering this work, our OP teams draw on the cross-section of other industry-specific expertise we have in-house. This approach has been the key to solving some of the toughest problems our clients have ever faced.

EXCAVATING EFFICIENCY

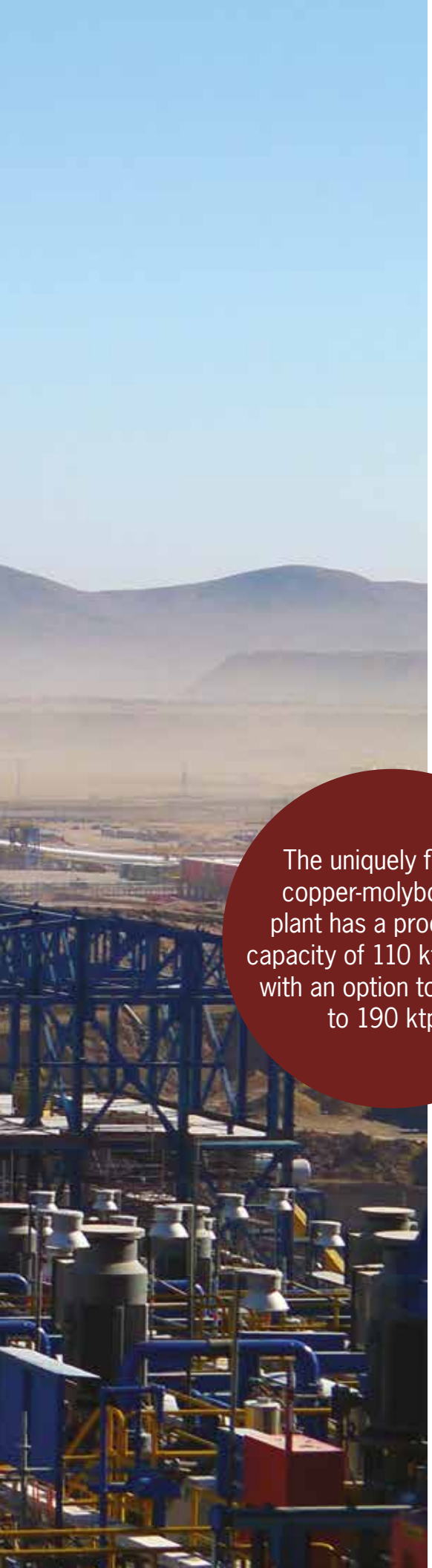
Dynamic simulation tool for underground fleet optimization

With its open-pit operations coming to an end, continued viability of a gold mine in Western Australia will require a significant increase in haulage from its underground operations. Although additional equipment can increase throughput, our primary objective was to see what could be achieved through efficiency improvements without adding anything new. Hatch and its partners developed a dynamic simulation model and performed a 16-week study to identify and fix logistical constraints standing in the way of the five-year capacity goal.

The study started with a full definition of the current mine design, including haulage routes and stockpiles. The model was linked to the mine's planning software to factor in scheduling, decision rules and constraints governing the sequencing of capital development, production development, and stoping tasks. We looked at various fleet configuration options and capabilities of jumbos, boggers, and haul trucks—right down to the fine details of vehicle movement through the mine (e.g., truck passing rules and priorities). Other factors included detailed logistics around truck and bogger allocation; operational parameters such as shift changes, fleet maintenance, and blasting; and exploration processes and activities.

One of the most important outcomes was demonstrating that jumbo operation was the main bottleneck, not the trucks as originally believed. We also identified opportunities to improve the prioritization of stoping and production activities. The biggest technical challenge was "teaching" the model the complex rules and interdependencies of this specific operation. All this knowledge is now captured in the dynamic model, a valuable tool to enable the client to challenge its traditional operating and planning practices. We are also using it to look at a long-term strategy targeting a 50% production increase through underground mine expansion options.

Hatch's dynamic model ran 1,000 simulations, enabling evaluation of numerous productivity improvements and strategic expansion options within just two months



METTLE FOR METALS

Efficient molybdenum and copper plant start-up

KGHM and Sumitomo | Region II, Chile

The uniquely flexible copper-molybdenum plant has a processing capacity of 110 ktpd of ore with an option to expand to 190 ktpd

Hatch is experienced with combined copper–molybdenum projects, but what made Sierra Gorda unusual even for us, was its extremely high initial moly feed grade—about 900 parts per million (ppm) versus the industry average of 100 to 200 ppm. Additionally, the technology we used has never been applied to moly concentrators before.

The high grade in itself wasn't an issue, since we could simply design a larger plant to handle that. The challenge was how to deal with the significant grade change expected in the fifth year. Continuing to use the same large plant equipment to process much lower quantities of moly for another 30 years would be highly inefficient in terms of mineral recovery, maintenance, and power consumption. We addressed this with a design that is both robust and flexible. The plant was designed so only minor piping modifications will be needed after five years to convert the plant from a high to low molybdenum feed grade.

Unlike regular flotation cells and columns, the moly technology we used was pressurized and sealed to collect, filter, and safely vent dangerous H_2S gas. Significant design adaptations were required to ensure that these cells and columns worked with the supporting equipment. The feasibility study and detailed design required fast-tracking so that the moly plant would be ready at the same time as the rest of the concentrator facility.

The Hatch Operational Performance team supported the very steep pre-commissioning and ramp-up of the process plant. Our success in the first 30 days was rewarded with another eight-month contract for operational readiness and commissioning execution support work for the copper–molybdenum concentrator.

The focus on efficiency paid off. First copper concentrate was produced as planned in 2014.

Construction of the Keeyask generating station began in July 2014, and first power is planned for 2019

70 YEARS IN MANITOBA

Sustaining operations and new hydro project designs

Manitoba Hydro | Manitoba, Canada

Our first project for Manitoba Hydro was the design of a hydroelectric station on the Winnipeg River system nearly 70 years ago, and we've worked together continuously since then on all kinds of large and small projects to sustain its operations throughout the province. We've helped design most of the northern developments including Pine Falls, Kelsey, Grand Rapids, Kettle, Long Spruce, Limestone, Wuskwatim, and Laurie River generating stations. We've also provided detailed designs for rehabilitation and retrofit projects for a number of stations and structures on the Nelson, Saskatchewan, Churchill, and Burntwood river systems. These all include various innovations to enable long-term performance despite the unique foundation and climatic conditions in northern Manitoba. Other services through the years have included dam safety assessments, public safety guideline preparation studies, and environmental monitoring.

Our latest major project is the Keeyask generating station about 180 km northeast of Thompson. The facility is being developed as a partnership between the Tataskweyak Cree Nation, War Lake First Nation, York Factory First Nation, Fox Lake Cree Nation, and Manitoba Hydro.

We've actually been involved in the Keeyask development through all FEL study phases for 25 years. We're now providing engineering services for final design of all structures and associated systems, including a seven-unit powerhouse and service bay complex, spillway, cofferdams and channels, three earthfill dams, two dykes, and transition structures. Planning studies received an Award of Excellence in April 2014 from the Association of Consulting Engineering Companies–Manitoba. With a 695 MW capacity, Keeyask will produce an average 4,400 GWh per year and increase Manitoba Hydro's total available capacity to approximately 5,900 MW.

REINING RIVERS

High efficiency for complex hydro operations and market conditions

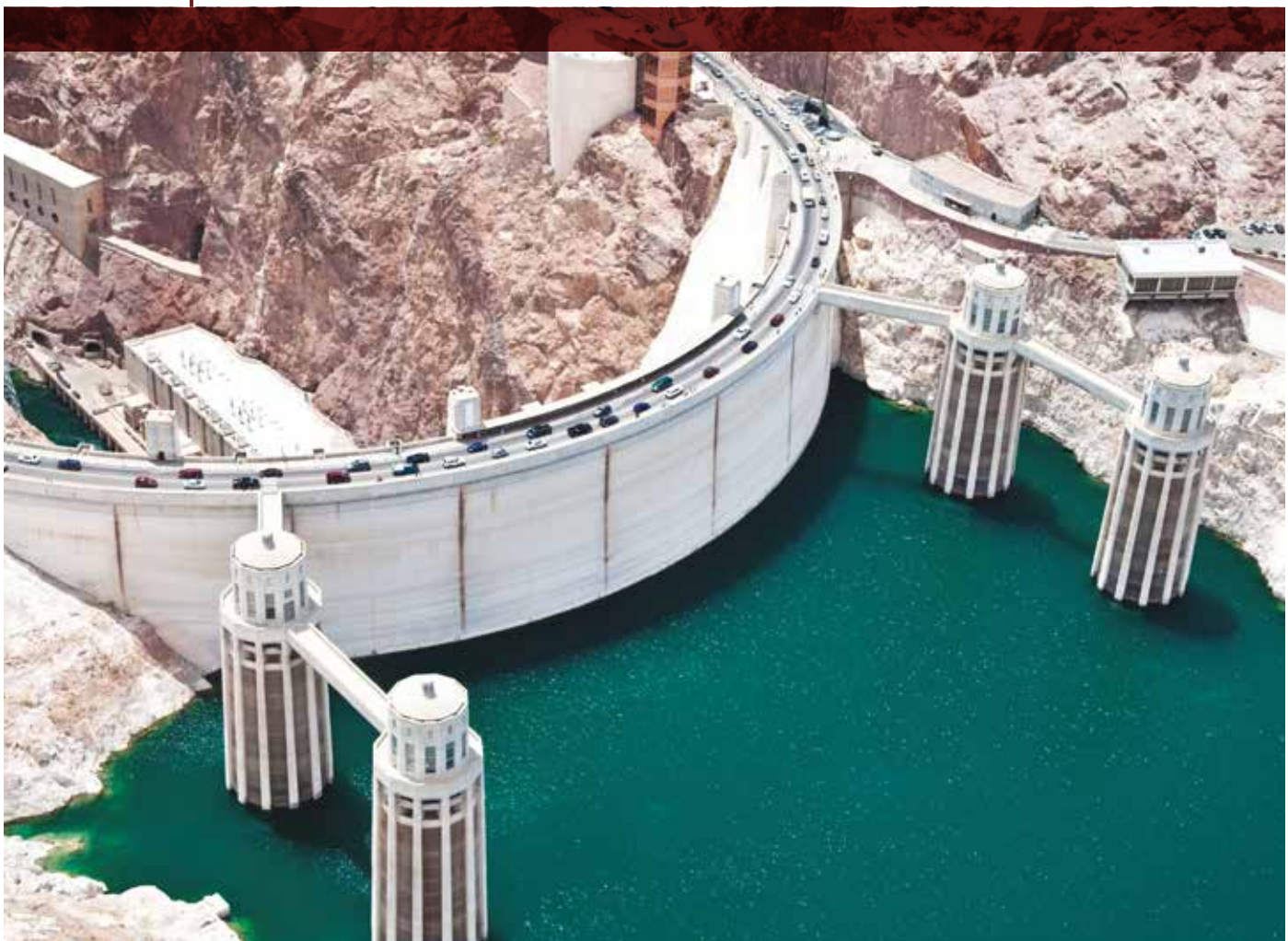
Southern California Edison (SCE) | California, USA

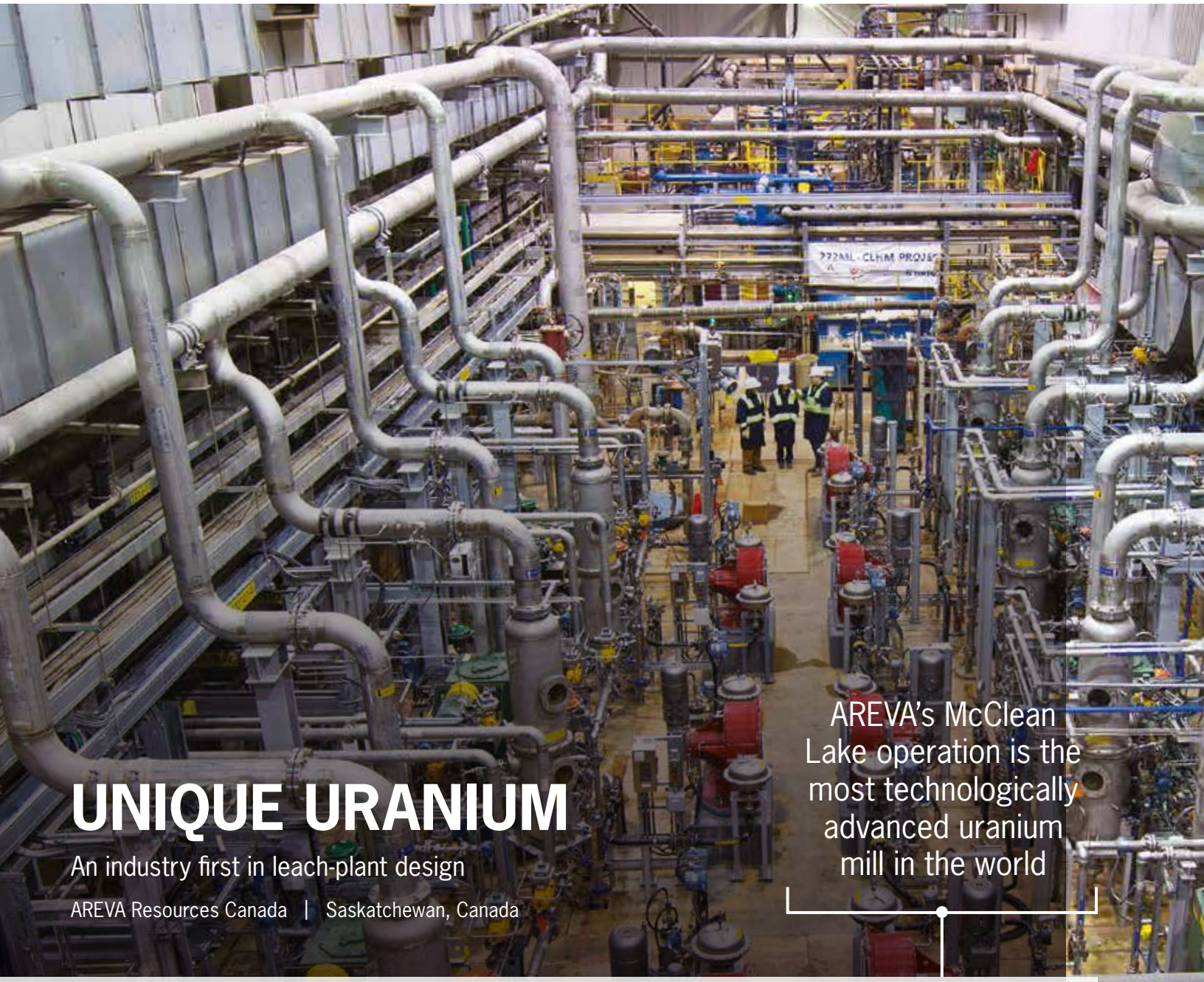
SCE is a major electric utility company serving more than 14 million people in a 50,000-square-mile area of central, coastal, and southern California. In 2007, Hatch implemented LT *Vista* and ST *Vista*, the long- and short-term scheduling modules of our *Vista* Decision Support System (*Vista* DSS™) to manage SCE's operations on the Hoover Dam and Big Creek river systems.

Since then, we've enhanced our system to include new modeling functionality tailored to the complex California market, and new algorithms and user interfaces. It now has the unique capability for joint optimization between energy and ancillary services—it is believed that no other existing models can perform such tasks to the same level of detail—optimizing the schedule for significant economic benefits.

The various *Vista* DSS modules have functioned consistently for the last seven years and helped SCE improve revenue from operations. In addition to the tools developed, we've provided ongoing operational support services to assist SCE's planners make the best use of the tool.

Southern California Edison uses Hatch's *Vista* DSS™ to schedule 25% of the energy generated by the famous Hoover Dam in Nevada





UNIQUE URANIUM

An industry first in leach-plant design

AREVA Resources Canada | Saskatchewan, Canada

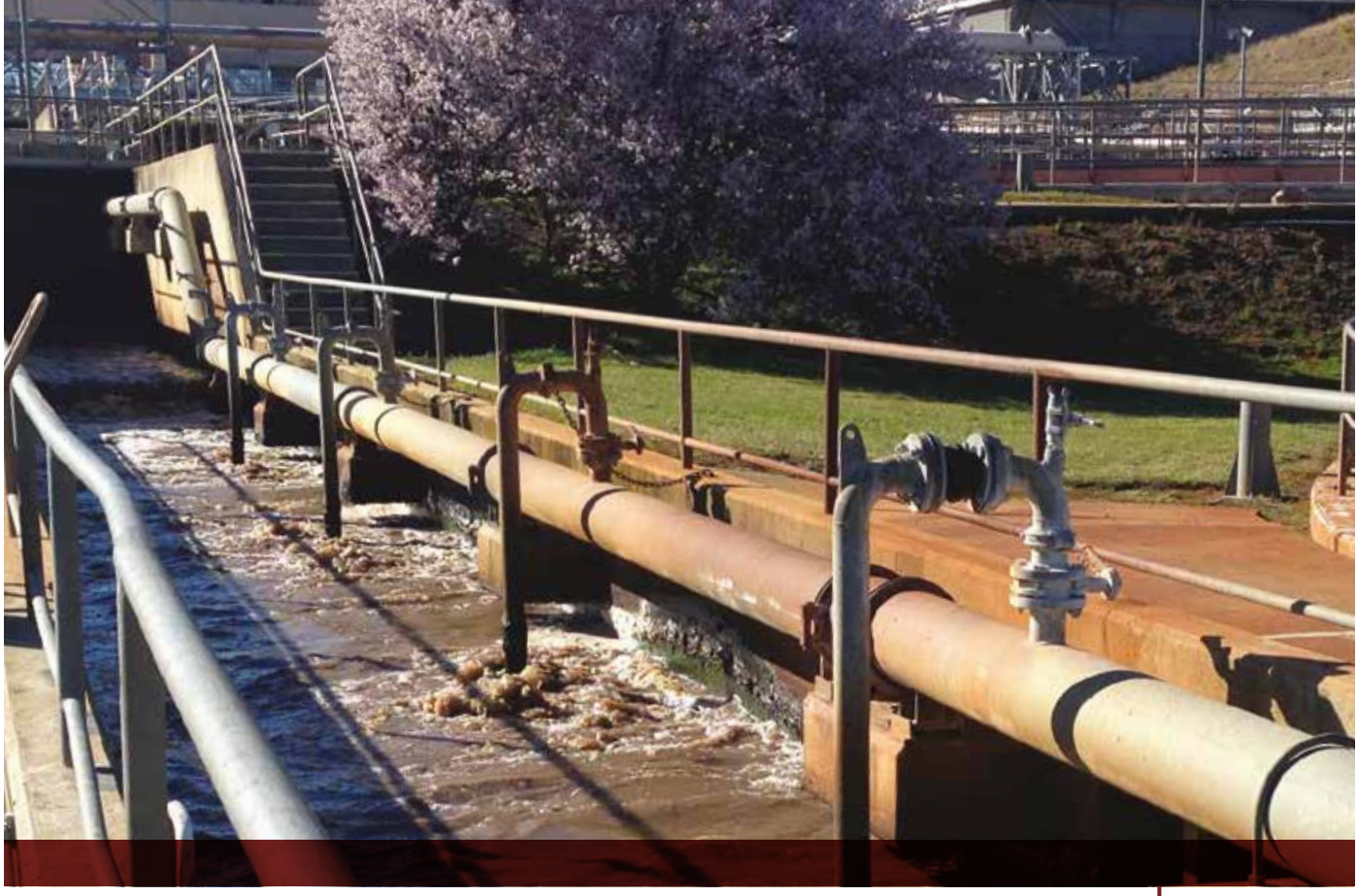
AREVA's McClean Lake operation is the most technologically advanced uranium mill in the world

The McClean Lake mill is AREVA's Canadian flagship uranium operation and has produced over 50 million pounds of uranium concentrate since 1999. The facility can process ore grades from less than 1% to 30% uranium, without dilution, making it the most technologically advanced uranium mill in the world.

Hatch's Autoclave Technology Group was retained in early 2013 to help modify the McClean Lake mill leach circuit for processing of the high-grade uranium ore from the nearby Cigar Lake mine. With extensive experience in leach-plant design and operations we provided a wide range of services aimed at safe and sustainable processing of Cigar Lake ore. These included process hazard analysis, lab-test support, CFD simulations, feasibility study, basic engineering, HAZOP, detailed engineering, expediting support, construction support, and pre-operations.

The modified circuit was successfully commissioned in September 2014 and first uranium concentrate was produced on October 8.

Photo courtesy of AREVA Resources Canada Inc.



FLOWING ACCORDING TO PLAN

Water and sewer asset management

ACTEW Water | Canberra, Australia

ACTEW, the water and sewerage authority for Australia's capital city, is required to submit expenditure and pricing proposals for regulatory approval. In preparing its 2014 submission, ACTEW wanted to develop a suite of Asset Management Plans (AMPs) to improve decision-making transparency, document asset life cycle activities and investments, and strengthen risk-based decision processes.

Hatch developed ISO 55000-compliant AMPs covering the entire asset portfolio. In order to capture, analyze, interpret, and document data on a vast array of assets within the very tight, 10-week time frame, we embedded a large team of technical specialists within ACTEW's staff and provided highly disciplined project management for the risk and criticality-based approach. A solid new technical platform is now in place, and close collaboration throughout the project enabled comprehensive knowledge transfer to ACTEW's employees for ongoing refinement of the AMPs.

> Our management tools cover a wide range of processes, including biological nutrient removal at this aeration channel

"It gets down to the credo... within an organization and, if you keep that culture, you're going to have a basic advantage wherever you go."

A LEGACY OF INNOVATION

Hatch founder Dr. Gerald G. Hatch (1922 – 2014)

Gerry Hatch is a legend in the Canadian metallurgical industry and will be remembered by friends and colleagues as a true visionary and an active mentor. Each and every day, he instilled a culture of innovation, diligence, collaboration, and client focus.

Gerry's influence and leadership transcended the company and affected the global scientific, business, and academic communities. He was recognized as an innovative engineer and an excellent businessman—exemplified by his many awards and honors including the Order of Canada, the Canadian Science and Engineering Hall of Fame, and the Canadian Mining Hall of Fame, to name just a few.

An avid promoter of strong, fundamental education followed by life-long learning in the field, he backed a number of science and engineering programs—including long-time technical and philanthropic support of the engineering and science institutions and faculties. His mentoring spirit is celebrated throughout the Hatch organization in the Gerald G. Hatch Scholarship, awarded annually around the world to students entering their first year of post-secondary education.

When it came to the engineering business, he had a unique and steadfast approach, saying "It gets down to the credo or climate that's created within an organization and, if you keep that culture, you're going to have a basic advantage wherever you go."

Built on his core values and enthusiasm for innovation, the company that bears his name has grown from six people in one office to over 10,000 people in 65 offices worldwide. The company owes its growth and success to the example that Gerry set and his commitment to differentiation, quality, and integrity—day in and day out. ■

60 YEARS OF SERVICE

This year, we celebrate Hatch's 60th year in business, with the roots of our acquisitions going back over 100 years. We are privileged to assist our clients in all aspects of their operations, solving some of the most challenging problems in the metals, energy, and infrastructure industries. Our experts work to quickly understand client issues, use innovative problem-solving techniques, and are committed to providing the best long-term solutions. We look forward to serving our customers for many more years to come.

www.hatch.ca

HATCH