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August/September 2017
Volume 58, No. 5

Cover: The new Iqaluit International airport opened in August. Photo courtesy Stantec.
See page 18

See page 34

features

departments

Next issue:
2017 Canadian Consulting Engineering Awards.

on topic

Industry Cycles

On a global scale the consulting engineering business continues to consolidate as large firms merge, grow market share, bolster their expertise, and gain operating efficiencies.

In the past few months, Montreal's SNC-Lavalin closed its acquisition of UK-based WS Atkins creating a $12 billion global firm, while in early August Jacobs Engineering Group of Dallas, Texas confirmed it is acquiring CH2M HILL Companies, together forming a $15 billion business.

For SNC-Lavalin, the move opens new world markets and strengthens its position in energy sectors including nuclear and renewables. Jacobs, a strong player in the transportation business, adds a top water design firm to the portfolio with the CH2M deal.

SNC-Lavalin has identified it wants to be among the top three firms in the global industry, an industry that is showing its maturity.

In an article from the Harvard Business Review (December 2002) entitled "The Consolidation Curve," researchers evaluated mergers around the globe and identified four stages of industry consolidation: opening; scale; focus; and finally balance & alliance.

The authors suggest that it takes on average 25 years for an industry to pass through all four stages.

In the 'opening' stage the combined market share of the largest three companies in an industry may fall from 30% to 10% as new competitors flood into the market. It's here where first movers recognize the need to build their footprint in order to protect their business.

Stage two, 'scale,' is all about buying up competitors and forming empires. It's here that companies hone their merger skills, retaining the best employees, building a scalable IT platform, and defining and focusing on core specialties while protecting their corporate cultures.

In the third stage, 'focus,' the top three industry players combined will tend to control between 35% to 70% market share. This is when the megadeals and large-scale consolidation happens.

It would appear this might be the stage of the global engineering services business today.

The final stage, 'balance and alliance,' is where the top three firms together will claim as much as 70% to 90% of their industry's market. It's here that firms defend their position and may begin spinning off new businesses into growth industries that are in the early stages of consolidation, thus beginning the cycle again.

Industries are constantly evolving, and consulting engineering practices large and small must change and adapt to the technologies and the needs of society.

While engineering, as a profession, is very mature, new business segments and opportunities continue to emerge. Whether your company's aspirations are global or regional, it's important to know where your firm sits on the consolidation continuum. Are you set for growth via merger or acquisition, or is your outfit content to be a regional market player? Either way the business cycles and megadeals will continue to roll.

Doug Picklyk

FOR PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE

CANADIAN CONSULTING engineer

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Canada

COMPANIES

Stantec's CEO Gomes retiring

After serving as president and CEO of Stantec for eight years—a period that saw nearly 50 acquisitions and topline growth of 229%—Bob Gomes will retire at the end of 2017, making way for Gord Johnston, the current executive vice president of Stantec's infrastructure business operating unit, who will take over the top job effective January 1, 2018.

Bob Gomes

Gord Johnston

Gomes joined the company in 1988 as an urban land project manager and held several leadership positions before being appointed president/CEO in 2009. The company's gross revenue has grown from $1.5 billion in Q1 2009 to $4.8 billion in Q1 2017. Gomes will remain a director on Stantec's board.

Johnston has more than 30 years of industry experience, including more than 20 with Stantec. A civil engineering grad from the University of Alberta, he served as the regional business leader for Stantec's water group in Western Canada before assuming the role of business leader for the company's water business line in 2010. In 2015, he was named as the executive vice president for the infrastructure business operating unit, and he has also been active in the firm's acquisition sourcing and integration efforts.

Jacobs acquiring CH2M

In another blockbuster merger in the global consulting engineering world, Jacobs Engineering Group Inc. of Dallas, TX is acquiring CH2M HILL Companies Ltd. of Denver, CO, in a cash and stock deal for approximately US$3.27 billion, including some US$416 million of CH2M net debt.

With existing revenues of US$10.7B, Jacobs says the new combined business will create a US$15B company. The news comes one month after the closing of Montreal's SNC-Lavalin acquisition of WS Atkins, which created a $12B global engineering firm.

With revenues of US$4.4B and 20,000 employees, CH2M has locations around the world, including 10 sites in Canada with offices in B.C. (Burnaby, Kamloops, Victoria), Alberta (Calgary, Edmonton), Manitoba (Winnipeg), Ontario (Kitchener, Ottawa, Toronto) and the Yukon (Whitehorse).

Steve Demetriou, Jacobs' Chairman and CEO

Jacobs employs over 54,000 people and operates in more than 25 countries, with Canadian locations in Vancouver, Calgary, Edmonton, Pickering and Toronto.

Jacobs is a global leader in the transportation sector (highways, rail, aviation and ports), while CH2M has been recognized as the top water design firm in the world

"By increasing our industry reach and adding to our already extensive skills, this transaction enhances our value to our clients and bolsters Jacobs' position as a premier consulting, design, engineering, construction, and operations and maintenance technical services firm," said Steve Demetriou, Jacobs' Chairman and CEO. " Together, we will bring more solutions to our clients."

"We are delighted about the prospects of combining CH2M with Jacobs," said CH2M Chairman and CEO Jacqueline Hinman in the offical news release. "Since late 2014, we've been transparent about our plans to pursue an ownership transition, providing sustained access to capital for growth."

The transaction is expected to close at the end of the year.

COMPANIES

Entuitive opens Vancouver office

Toronto-based Entuitive has opened an office in Vancouver at 789 W Pender Street. Leading the Vancouver team are Mike Lembke (principal, building envelope) and Julien Fagnan (principal, structural engineering). With a team of 200 engineers, building envelope specialists, technologists and staff, Entuitive also has locations in Toronto, Calgary and Edmonton, along with London and Edinburgh in the UK and New York.

Associated Engineering's promotions

Alan Emery

Chris Skowronski

Two Associated Engineering technical leaders, John Fussell, sr. vp, transportation, and Herb Kuehne, sr. vp, civil infrastructure, have retired, but both will continue providing advice on an as-needed basis.

Alan Emery has taken on the role of sr. vp, transportation, while Chris Skowronski becomes sr. vp, infrastructure.

Emery has more than 35 years experience across Canada and the UK specializing in highway, roadway, and pathway design.

Skowronski brings 29 years of experience in municipal infrastructure and land development, specializing in pipeline design.

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Golder Associates/source: ACEC-SK

Slope stability monitoring in Saskatoon.

INDUSTRY

ACEC-SK survey reveals strong talent base in the province

The Association of Consulting Engineering Companies of Saskatchewan has released its first Industry Capacity Survey revealing that 75% of the work conducted by consulting engineering companies in Saskatchewan is done in the province, with less than 10% of personnel hours "imported" from other provinces.

ACEC-SK commissioned the study to establish labour market baseline data to help determine drivers of change, growth and retraction within the local industry. The survey was conducted in early 2016.

The association suggests that while the consulting engineering talent base in Saskatchewan remains strong, the government must continue working in partnership with industry to ensure the province retains the gains it has made in recent years. The concern for the association is that while industry knowledge and experience has been built up in this province over the past few years, some of that talent is starting to leave because supply is greater than demand.

"The boom we saw since 2007 helped Saskatchewan's consulting engineers companies gain a lot of expertise," said ACEC-SK Chair Paul Walsh, P.Eng., in a release. "We want to see Saskatchewan retain that knowledge going forward so our communities can benefit from smart, well designed and managed projects."

ACEC-SK has two calls to action for the provincial government:

- Continue investing into provincial infrastructure to spur growth and support communities.
- Continue making sure local companies benefit from government spending.

BUILDINGS

Over 100 LEED v4 registered projects in Canada

The Canada Green Building Council (CaGBC) has announced that Canada now has over 100 LEED v4 registrations, representing over 681,000 m^2 of building floor area.

To date, governments lead the way with 28 LEED v4 registrations (10 provincial and 18 municipal), with other top owner groups for LEED v4 registration including commercial owners (24 registrations) and residential owners (21 registrations).

Regionally, Ontario has 29 LEED v4 registrations (totaling 274,395 m^2 of registered space), and Alberta has 19 (with 189,459 m^2 registered space).

Other regions represented include: British Columbia with 15 projects, Quebec with 29, Manitoba with nine, and New Brunswick with one.

According to CaGBC, the cumulative impact of LEED certifications in Canada since 2005 includes enough energy saved (over 9,320,000 eMWh) to power 315,000 homes in Canada for a full year.

COMPANIES

David Bulger joins Stantec

Structural engineering specialist David Bulger has joined Stantec as sector leader for the Atlantic Canada buildings group.

David Bulger

Bulger's previous positions include manager, structural engineering, with SNC-Lavalin, and as senior structural engineer with BMR Structural Engineering.

Bulger works in the Dartmouth, Nova Scotia office.

WSP expands Canadian buildings team

WSP Canada announced that Armin von Eppinghoven has become sr. vp, key client strategy & engagement, and Terry Tommason joins the firm as national business line executive for Buildings.

Armin von Eppinghoven

Von Eppinghoven will direct client engagement and drive new business development.

Terry Tommason

Tommason has previously held managing director roles with two multi-disciplinary consultancy firms.

Both executives will be located in Markham, Ontario.

BUILDINGS

Ice Box Challenge in Vancouver: Passive House demonstration

The Ice Box Challenge, a contest to demonstrate the effectiveness of high performance buildings, took place in Vancouver's Olympic Village Square in late July/early August, as Passive House Canada, along with the City of Vancouver, Vancity and members of Vancouver's construction industry sponsored the public demonstration and awareness initiative.

The Challenge was a public science experiment pitting the BC Building Code against the Passive House Standard. On July 27, Passive House Canada filled two small structures with about 1 tonne of ice, then left them outdoors in the summer sun. Both were built with timber studs and plywood. The Passive House Ice Box was over-insulated with Roxul insulation and its window was triple-glazed.

Both structures were clad in treated oriented strand board, which was painted and waterproofed. The challenge ended after 18 days. For results visit iceboxchallenge.com.

INFRASTRUCTURE

Alberta commits to Calgary's Green Line LRT

On the eve of the Calgary Stampede, the province of Alberta announced it will provide one-third of the total project cost, up to $1.53 billion over eight years, to support Stage 1 of Calgary's Green Line LRT project.

Stage 1 is projected to begin construction in 2020 and is anticipated to open in 2026. This stage will include a 4 km tunnel in the downtown area.

In the 10 years leading up to opening day, Stage 1 of Green Line construction is estimated to create more than 12,000 direct jobs and over 8,000 supporting jobs, including engineering, planning and administration.

Stage 1 is set to include:

20 km of LRT track; 14 stations; eight bridges (Elbow River, Blackfoot Trail, Highfield Blvd, 46 Avenue SE, Deerfoot Trail, Bow River, 78 Avenue SE and 90 Avenue SE); 1 km of elevated track; three park and ride facilities with a total of 1800 – 1900 stalls; three tunnels; 4 km Centre City tunnel; 1 light rail vehicle (LRV) maintenance and storage facility; and approximately 70 low floor vehicles; all with $4.65 billion capital construction cost.

Global standard for costing infrastructure projects

The International Construction Measurement Standards Coalition (ICMSC), a growing group of more than 40 professional and not-for-profit organizations from around the world, has released its first standard designed to harmonize cost, classification and benchmarking definitions to enhance comparability and consistency of capital projects across the globe.

The launch of the ICMSC Standard "Global Consistency in Presenting Construction Costs" marks the culmination of two years' collaboration between the Coalition and 27 experts on the Standards Setting Committee.

The ICMS was formed during a meeting at the International Monetary Fund in June 2015. The group is working together to develop and implement international standards for benchmarking, measuring and reporting construction project cost in order to improve investor confidence and attract more private sector funding for infrastructure projects.

Among the coalition organizations listed online are the Canadian Association of Consulting Quantity Surveyors (CACQS), and the Canadian Institute of Quantity Surveyors (CIQS).

Craig Bye of the CIQS sits as General Secretary on the Board of Trustees, and Bruce van Ryn-Bocking of the CACQS also sits on the Board of Trustees .

COMPANIES

Arup principal announcement

Martin Landry, OAQ, PMP, LEED AP, has been named a principal with Arup. Landry has been responsible for Arup's Montreal office over the last four years, managing client relationships and market development in Québec and the Canadian east coast.

Joining Arup in 1998, he leads the global airport planning team.

AECOM's Douglas Allingham to Chair of U. of Ontario's Board

Douglas Allingham

The University of Ontario Institute of Technology in Oshawa, Ont. has announced that Douglas Allingham, P.Eng., an executive vp with AECOM, has been appointed Chair of the Board of Governors for the 2017-2018 academic year.

Peter Reist joins Viscor

Peter Reist has joined Viscor Inc. as vp of sales & marketing and asssistant general manager, leading customer service, marketing, and Canadian & U.S. sales teams.

Reist joins Viscor from OSRAM where he was national director of specifications. He spent the last eight years developing and selling ENCELIUM lighting management systems.

(Diamond Schmitt Architects)

Rendering of Robarts Common.

BUILDINGS

Expansion at U of T's Robarts Library breaks ground

Canada's largest academic library, Robarts Library at the University of Toronto, is about to undergo a major expansion that will add 1,200 work and study spaces to the iconic facility.

An example of the concrete Brutalist architecture from the 1960s, the addition of the new student study wing is the building's first expansion since opening in 1973.

The expansion, designed by Diamond Schmitt Architects will bring daylight and views to a five-storey, glass-enclosed space along the building's west side.

The primary structural consulting engineer is Blackwell, and the mechanical/electrical consultant is Smith + Andersen.

The original concept for Robarts Library included three pods surrounding the core of the library. Only two were realized, occupied today by the Thomas Fisher Rare Book Library and the Faculty of Information iSchool. The new student space completes the plan.

The wraparound glass façade and wood accents contrast with the concrete shell of the 14-storey Robarts.

The freestanding expansion will connect with the existing building via a four-storey bridge. In addition to study carrels and reading tables, there will be amphitheatre-style seating on levels two through five and 32 group study rooms. There will be Wi-Fi access and wireless printing throughout the building.

Sustainable design features include a rainfall recycling system, green roof and an electronic rolling blind system to control the amount of light and solar gain.

Diamond Schmitt previously completed a multi-year renovation of Robarts that opened up corridors and stacks to bring daylight deeper into the core, improved study space, data infrastructure, way-finding and transformed two exterior porticos into spacious entry halls.

Construction is expected to be complete for the start of the 2019-20 academic year.

City of Ottawa

Tunneling for Ottawa's Confederation LRT.

AWARDS

Ottawa's LRT Line tunnel shortlisted for international award

The International Tunnelling and Underground Space Association (ITA) has released the short list of nominees for its 2017 Tunnelling Awards, and making the list in the category for projects over 500 million Euro is the $2.1B Confederation Line light rail transit (LRT) in Ottawa.

The project is up against metro line projects in Delhi (India), Tehran (Iran) and Qatar.

The Awards will be presented on November 15 at a special ITA Tunnelling Awards ceremony held during the global AFTES Congress in Paris.

This is the first Canadian tunnelling project to be short-listed, the Confederation Line LRT downtown tunnel is 2.5 kilometers long with three underground stations.

Started in late fall 2013, the sequential excavation method (SEM) is being used to mine the tunnel. SEM consists of advancing in increments, which are supported with shotcrete (projected concrete), followed by the installation of reinforced shotcrete and steel supports.

The crews were mining through limestone as well as clay and sands.

The project is using roadheaders to dig the tunnel, instead of a tunnel boring machine. On average the tunnelling is taking place 15 metres below the surface.

The Rideau Transit Group is handling the design, build and will maintain the Line until 2038. The consortium includes: SNC-Lavalin, Ellis Don, Dragados Canada and ACS Infrastructure Canada.

Other firms include: adamson & associates, architects; Alstom; Dr. Sauer & Partners Corporation; bbb Architects; Fast & Epp; Hatch Mott MacDonald; IBI Group; WSP MMM; Jensen Hughes (Sereca Fire Consulting Ltd.); Thurber Industries

The Capital Transit Partners consortium of consulting firms (Morrison Hershfield Ltd., Jacobs Associates Canada Corporation, STV Consulting (Canada) Inc., and AECOM) began work on preliminary engineering for the 12-km LRT line in September 2010.

CHAIR'S MESSAGE

ACEC Launches New Member-Focused Grassroots Advocacy Campaign

The consulting engineering sector has a very strong brand and an excellent reputation among the Members of Parliament and Senators from all parties, a result of the ongoing advocacy efforts by ACEC on behalf of the sector. As Chair for the past year, I have had the opportunity to see these efforts first hand. The results? Strong support for infrastructure investment on Parliament Hill, recognition of ACEC as an authority and as a valuable resource by policy makers and decision makers.

Part of ACEC's success is being able to help federal politicians recognize the important impact infrastructure investments have on Canadians across the country and particularly in their own communities. We can strengthen this message and showcase the great projects by ACEC member firms by also engaging Members of Parliament in their own constituencies.

That is why ACEC is inviting you to showcase the valuable contribution you and your colleagues make to your community by participating in its new campaign ***Bring an MP to Work.***

It's designed to showcase the talents and resources of ACEC member firms, the campaign provides consulting engineers the opportunity to show off their projects and highlight the importance of consulting engineers in Canada to our federal decision makers, while establishing and enhancing relationships between ACEC members and their Members of Parliament. With ACEC's assistance, firms invite their MP to visit one of their current or completed project sites to showcase the tangible work engineers do for society.

I encourage you to take part in this unique opportunity which has already garnered great success. To learn more, contact ACEC at info@acec.ca.

RICHARD TILLER, M.ENG., P.ENG., FEC
CHAIR, ACEC BOARD OF DIRECTORS

MESSAGE DU PRÉSIDENT DU CONSEIL

L'AFIC lance une nouvelle campagne de représentation axée sur les membres

Le secteur du génie-conseil jouit d'une excellente réputation auprès des députés et sénateurs de tous les partis. Cette notoriété est le fruit des efforts de représentation continus déployés par l'AFIC. Dans le cadre de mes fonctions de président, depuis un an, j'ai été témoin de ces efforts, qui se sont soldés par un appui solide des parlementaires aux investissements dans l'infrastructure et par la reconnaissance de l'AFIC en tant qu'autorité et ressource de choix par les législateurs et les décideurs.

L'AFIC souhaite amener les politiciens fédéraux à se rendre compte de l'importance des investissements dans l'infrastructure pour l'ensemble de la population canadienne, et plus particulièrement dans leurs propres collectivités. Pour renforcer ce message et faire connaître les grands projets sur lesquels travaillent les firmes membres de l'AFIC, nous souhaitons mobiliser les députés autour de projets réalisés au sein de leur propre circonscription.

C'est pourquoi nous vous invitons à leur montrer ce que vous et vos collègues apportez à votre collectivité, en participant à notre nouvelle campagne ***Invitez vos députés sur vos chantiers.***

Conçue pour mettre en valeur le talent et les ressources des firmes membres de l'AFIC, cette campagne offre aux ingénieurs-conseils l'occasion de présenter leurs projets aux décideurs fédéraux et de faire valoir le génie-conseil au Canada, tout en établissant et en renforçant les relations entre les membres de l'AFIC et leurs députés. Ainsi, avec l'aide de l'AFIC, les firmes invitent leur député à visiter un chantier sur lequel elles travaillent actuellement ou encore le site d'un projet qu'elles ont réalisé par le passé afin de lui faire voir l'importante contribution des ingénieurs à la société.

Je vous encourage à profiter de cette occasion unique, qui a déjà permis un grand succès. Pour en savoir plus, communiquez avec l'AFIC à info@acec.ca.

RICHARD TILLER, M.ING., ING. P., FIC
PRÉSIDENT DU CONSEIL D'ADMINISTRATION

ACEC national leadership conference 2017

driving business / shaping policy

OCTOBER 22-24 2017

Register today for the second annual ACEC national leadership conference

The ACEC national leadership conference is tailored to the task of driving business for future success and shaping policy to create a positive environment for the sector. This two-day event for business leaders and decision makers in the consulting engineering sector will feature topics of discussion that are of importance to our industry, such as:

- THE FUTURE OF CANADA'S RESOURCE SECTOR
- NEW BUSINESS MODELS FOR A CHANGING ECONOMY
- RISKS, LIABILITY AND SECURITY
- MAKING THE RIGHT INFRASTRUCTURE INVESTMENTS

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ANDREW HEAL / PARTNER
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CATHERINE KARAKATSANIS / CHIEF OPERATING OFFICER
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National Corridors: Connecting Communities and Building a Legacy

With the federal government's recent commitment to investing significant resources into the building and renewal of our nation's infrastructure, it is important to discuss how we will address both economic and societal needs for the greatest benefit to Canadians. In the lead up to Canada's 150th birthday, a proposal for the boldest and perhaps most transformative infrastructure project since Sir John A. Macdonald went largely unnoticed. It was not necessarily a new idea, but it would do exactly what intelligent infrastructure investment is meant to do — connect our communities, enable commerce and protect our environment

A recent Senate report, entitled, *National Corridor: Enhancing and Facilitating Commerce and Internal Trade*, proposes the building of a national infrastructure "right-of-way" across Canada's north and near north. This is an opportunity to establish a national network of infrastructure corridors across northern Canada dedicated to accommodating multiple infrastructure assets, including road, rail, pipeline and communication projects. A nationwide network of these corridors would connect all regions of Canada, help address social and environmental concerns, and facilitate the planning, development and implementation of both public and private infrastructure projects in a less costly and more time effective manner. Imagine how much easier it would be to support some of the remote northern communities, once we have pre-established corridors? Imagine the cultural and societal impact. The value is immeasurable.

The Senate report drew upon a recent study by the University of Calgary School of Public Policy which in turn was inspired by a proposal by General Richard Rohmer during Canada's centennial back in 1967. (Why don't we see this as portrayed as a "heritage moment" on television?) It is frankly disappointing that we continue to discuss the value and importance of such a proposal, and 50 years later, we have yet to see action.

Canada's federal, provincial and territorial governments have all recognized that a lack of infrastructure is a limiting factor in the continued development of Canada's resource sector. This is especially true in the north. Infrastructure corridors would make it easier and more economically viable to connect northern and remote communities to vital economic and quality of life enhancing infrastructure (such as power, communications, road and rail) that most Canadians take for granted. Furthermore, corridors also protect infrastructure from advancing urban development and offer a long-term solution to many of the land use challenges associated with developing major facilities.

Currently, Canada has a fragmented and uncoordinated approach for planning and approvals which is delaying and discouraging projects that could otherwise provide market access for Canadian products, allow movement of goods and services, provide energy and otherwise grow the economy. The federal government should work with all levels of government and relevant stakeholders to identify and acquire lands and to facilitate the securing of required approvals for a network of corridors to connect all of Canada's major urban centres and regions. An integrated planning approach to infrastructure would eliminate the need for multiple reviews of major nation building projects and allow governments to better consult with aboriginal groups and local stakeholders on the correct path for a right-of-way where projects could then be built. One of the key benefits is that a national corridor would require a significantly smaller geographical and environmental footprint than the current fragmented approach.

A failure to act in a timely manner may result in the cost of developing these corridors becoming prohibitive as well as overlapping jurisdictional policies becoming even more entrenched. If Canada is to grow to its fullest potential and we wish to leave a lasting legacy from this era, a discussion on national corridors to accommodate nation-building infrastructure should commence sooner rather than later.

JOHN GAMBLE, PRESIDENT AND CEO
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By Chintana Herrin, Reality Modeling Product Marketing Manager, Bentley Systems

Penn State deploys ContextCapture to generate 3D reality mesh of its University Park campus

The University Park campus in State College, Pennsylvania, is Pennsylvania State University's (Penn State) largest of 24 campuses, with almost 1,000 buildings and structures housing numerous assets within each facility. Given that the asset data in the school's computerized maintenance management system (CMMS) is not geospatially referenced, it is difficult for facility managers to locate assets to efficiently meet campus maintenance demands. The university initiated the Virtual Penn State Campus project to simplify the process, which included developing a reality model of the campus that integrates geospatial and asset work order data.

Solution

Penn State used ContextCapture to quickly generate a highly detailed, geospatially accurate reality mesh of the entire campus and surrounding area from 2,500 aerial images captured with a high-resolution camera during a two-hour flight. Using Bentley's i-model technology, the team integrated asset work order data from the CMMS with building shape files from the GIS resulting in cohesive data files containing semantic information for each campus building, along with associated work order data. This dataset was then integrated with the 3D reality mesh in MicroStation and stored on ProjectWise.

Outcome

ContextCapture saved a significant amount of time enabling the team to process aerial images and create the reality mesh in less than two days. Using i-model Transformer enabled rapid integration of the data from the GIS and CMMS sources, and storing the model on ProjectWise provided project stakeholders Web-based access to the model, eliminating time for model transfer. The fully integrated virtual model of the campus enables facility managers to visualize accurate locations of work orders, increase response time, and improve performance for more efficient asset maintenance and management.

The New IQALUIT International Airport

Simple and intelligent design elements provide a bright and efficient terminal well adapted to its northern climate.

By Noel Best, Stantec

Iqaluit, formerly known as Frobisher Bay, is now the capital of Nunavut, the Territory spanning the eastern half of Canada's Arctic. The new Airport Terminal Building, slated for first flights in August of this year, is the first P3 (public-private partnership) airport building in North America. While a relatively modest size at just under 10,000 square metres, this is a very important facility, as it serves not only the immediate community, with all its government and public services, but also as the hub connecting the remote villages of the Territory with the south.

As there are virtually no roads in the far north, the airport takes on an especially important role in the community. So Stantec's role as the designers (architect and prime engineer) was to bring a strong architectural presence and distinctive cultural character, commensurate with the airport's dual role as critical transportation infrastructure and as an important community meeting place in the capital.

A compact building form

Given the severe climate and the high cost of construction in Iqaluit, a

compact building form is the most effective for both capital cost and energy efficiency.

For passenger convenience and operational efficiency, the building has been designed with all the public functions at the grade level, with a smaller, central, second level for administration and building services.

In plan the terminal is a simple rectangle, minimizing the number of building corners. The roof form is a sinuous curve containing both the single story and the two story areas. This form achieves two goals. It minimizes the surface area of the building envelope, and provides a smooth continuous surface for the prevailing winds to scour the roof free of drifting snow.

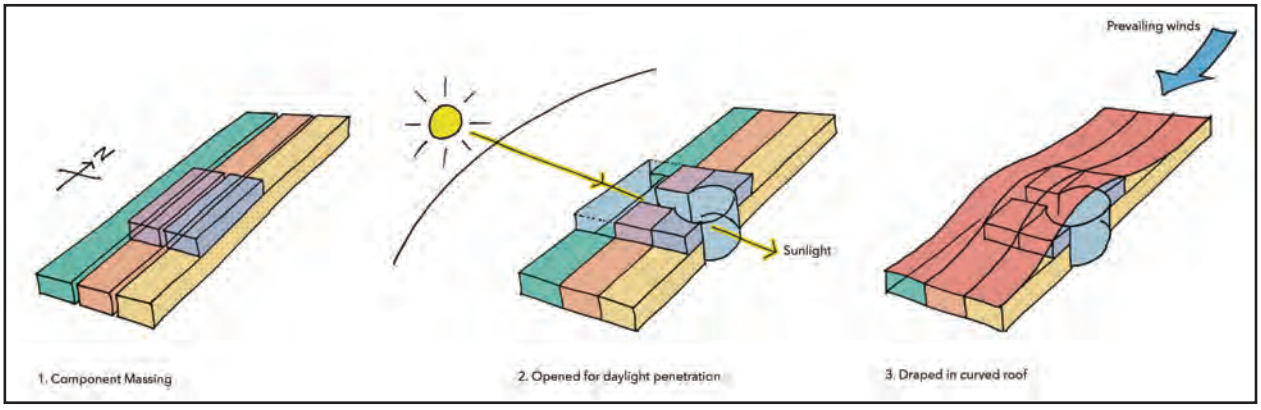
Iqaluit is actually a 'desert' climate with relatively low precipitation. However whatever snow does fall stays for the nine months and, with the high winds, snow drifts become a significant issue.

At the terminal building a major drift would certainly form at the lee, or south, side of the building. To address this we introduced a building element well tested in the north — a 'snow scoop', designed to move the drift away from the building face.

This is a metal panel, the width of the building, two metres high, and set one metre off the end of the roof.

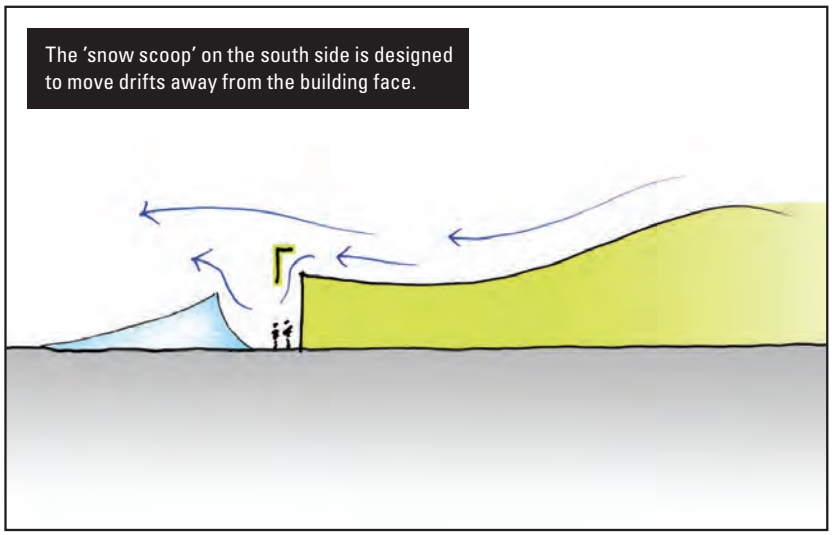
The way this functions is the north wind blowing over the length of the roof, hits the scoop and is deflected down the façade to the ground and then carries on south, taking the snow with it. So the drift, rather than forming against the façade, forms about 10 metres away from the building.

This concept was modelled by our wind consultant, RWDI, in a water tank with a 3D model of our building and beach sand standing in for snow.



Photos & images courtesy of Stantec

A simple rectangle design minimizes the number of building corners, and the sinuous curving roof minimizes surface area of the building envelope, and provides a smooth surface for winds to scour the roof free of drifting snow.



The 'snow scoop' on the south side is designed to move drifts away from the building face.

The sand drifts formed, as predicted, well clear of the model building.

Last winter, with the actual snow scoops in place — the snow drifts replicated exactly the sand drifts in the model.

Building on permafrost

The first question many people ask, when I tell them we are building a new airport terminal building in the Arctic, is "How do you deal with global warming?"

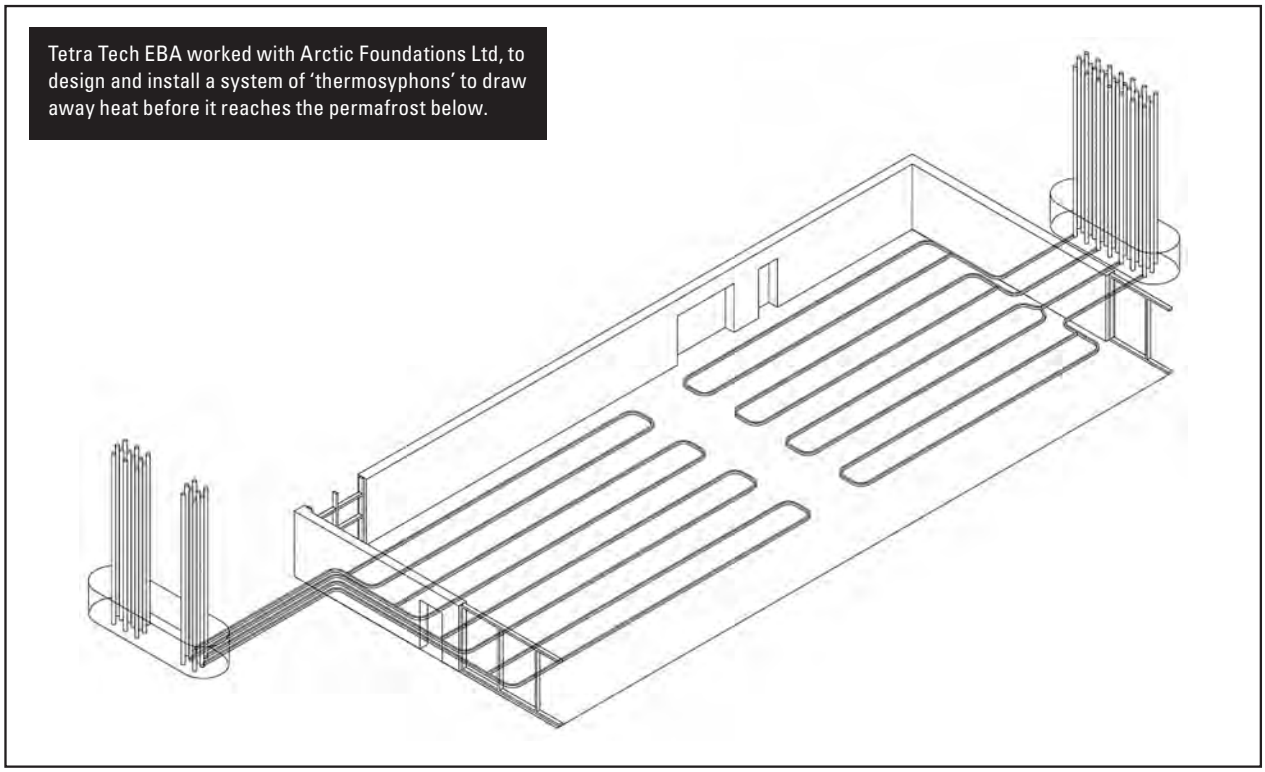
This is an especially pertinent question. Many of the buildings in the far north are built on stilts — which allows the wind to blow through, dissipating the building heat and allowing the snow drifts to pass by.

However, at the approximate dimensions of a football field, our building is too large for this strategy and the bedrock on the site is too deep to reach with the foundations. Consequently, our building is designed to 'float' on the permafrost.

Permafrost is overlain by an 'active' layer that thaws and freezes through the seasons, while the 'permanent' layer below is perpetually frozen. The foundations for the terminal are designed deep enough to rest on this solid, frozen layer. How do you keep the heat from the building radiating down to the permafrost — melting the support and allowing the building to sink into the resulting slush?

Tetra Tech EBA, a specialist consultant in this field, has worked with the subcontractor Arctic Foundations Ltd, to design and install a system of 'thermosyphons'.

As the name implies this system syphons the heat away before it reaches the layer of permafrost below. First there is a 200 mm thick layer of rigid insulation, located beneath the slab and projecting three metres beyond each edge of the building, to impede heat flow into the ground. Below that is a series



Tetra Tech EBA worked with Arctic Foundations Ltd, to design and install a system of 'thermosyphons' to draw away heat before it reaches the permafrost below.

Vertical eight-metre-high 'radiators' are positioned at five locations around the perimeter of the building.

of 25 mm diameter horizontal pipes, 'evaporators', embedded into a layer of stable gravel, the new, engineered active layer.

The pipes are spaced about 1.5 metres on centre, beneath the entire footprint of the building. These pipes lead to clusters of vertical 'radiators', eight metres high, positioned at five locations around the perimeter of the building. This is a passive system filled with CO_2 gas. Any building heat that makes it past the insulation is absorbed by the stable gravel in the active layer, where it vaporizes the gas in the evaporators. In the winter, the colder air then condenses the gas in the radiators into liquid, which, now cold, then flows back into the evaporators below, where the warmer ground again causes the gas to vaporize.

The cycle repeats, as long as the air is colder than the ground, maintaining the frozen state of the permafrost below.

Combined heat and power

As in most northern communities, energy is very expensive in Iqaluit and the systems somewhat erratic and unreliable. Fuel oil is shipped in by tanker in the ice-free months and converted to electricity in the city's generator plant.

In order to optimize their energy usage and to provide for self- sufficiency, the client and the design team have chosen a 'combined heat and power' (CHP) system for the new terminal building. This operates in parallel with the local power utility.

The system was prefabricated and tested in the U.S. and shipped to Iqaluit for installation.

The airport's own diesel fuel supply is used to power the two CHP generators. These supply both normal and standby power for the terminal. The heat from the system is then captured to serve the heating, ventilation and air conditioning (HVAC) systems — providing substantial energy savings.

Additional efficiency measures

The Airport Terminal Building was designed to meet stringent energy performance criteria set by the Government of Nunavut and the LEED Green Building Rating System. In addition to the combined heat and power system, the mechanical design features low flow domestic hot water fixtures, high efficiency boilers, high efficiency heat recovery system, and variable speed vans.

The lighting design reduces energy consumption by 50% over a typical building through reduced lighting power density inside and outside the building, and additional interior lighting controls. The building also features significant improvements in roof and wall insulation over a typical building (90% and 30% respectively). These measures result in an energy use reduction of more than 40% compared to a typical building in the North, and a similar reduction in potable water use. The building is

targeting LEED silver certification under LEED Canada 2009 for New Construction.

Daylight and Views

In the far north, through those long winter months, daylight is a valued commodity. However with the extreme weather conditions, there is a delicate balance in optimizing the fenestration and daylight with a high efficiency envelope.

Consequently the Client brief was very proscriptive for both the percentage of windows and the quantity of natural light in the public spaces. This requirement was 20% glazing in the façade and an average lux level of 75.

The essential focus for daylighting is the high volume in the centre of the building — bringing light deep into the rotunda, into the holdrooms and through the connecting corridor between.

Broad windows on the west provide panoramic vistas from the holdrooms. Clerestory windows provide high morning light into the check-in hall. The upper level offices benefit from their warm, interior location while still having a long view to the west and an intermediate interior view to their operations in the holdroom below.

The success of this project lies in the subtle integration of the operational imperatives of an airport, the technological solutions to environmental challenges and an authentic response to the culture and community. The new airport feels like it always has belonged in its place. **CCE**

Noel Best is a Principal at Stantec. He has been practicing architecture for 38 years. In addition to his usual role as design principal, Best is a specialist in passenger flows and wayfinding. He's well versed in ensuring that the airport planning, material selection, and lighting design all support intuitive travel.

Iqaluit International Airport

Client/Owner:	Government of Nunavut
Design:	Stantec Architecture Ltd.; Stantec Consulting Ltd.
Construction:	Bouygues Building Canada; Sintra Inc.
Other consulting engineers:	RWDI (wind consultant); Tetra Tech EBA (foundation)

Photos courtesy Saskatoon Health Region

Hospital receives THOROUGH CHECKUP

Saskatoon's Royal University Hospital funds facility upgrades from savings in utility costs.

By Doug Picklyk

Originally opened in 1955, the Royal University Hospital (RUH) on the campus of the University of Saskatchewan in Saskatoon is a seven-wing, seven-story hospital that took eight years to build. Today, as part of the Saskatoon Health Region, RUH provides acute-care services and serves as the main trauma center for the province, and it currently houses maternal and child services, neurosurgery and cardiovascular surgery.

The 1.6 million-sq. ft. facility has gone through expansions in 1978, 1988 and 2010, and construction is currently ongoing next door as the Jim Pattison Children's Hospital broke ground in September 2014, with completion expected in 2019 (see sidebar).

Operating as part of the Saskatoon Regional Health Network, in 2014, RUH entered an energy performance contract with Johnson Controls aimed at facility improvements to be paid for over time by energy, water and operational savings.

With provincial approval, the Saskatoon Region borrowed the funds to pay for the project, with the annual cost savings to be used to make the loan payments.

The hospital invested $13.6 million into facility upgrades designed to save $1.4 million per year. And along with the cost savings, the facility will be improving the environment—both the climate inside the hospital and the building's overall carbon footprint.

The facility improvements implemented spanned multiple areas including lighting, water use, building envelope, steam pipes and traps, hot water pumps along with speed drives, and ventilation systems.

The project was completed ahead of schedule, by June 2016, and through measurement and verification, the initial savings have proven to be almost double the guaranteed amount.

Over the first two reporting quarters, a total savings of $899,192 were achieved, exceeding the anticipated savings target by $433,304 or 48.2%.

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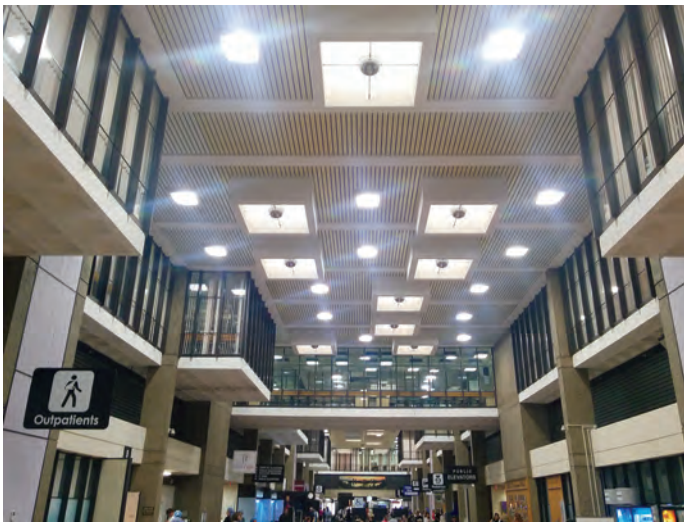


Lighting throughout the facility was reviewed, some 16,000 fixtures in total.

Initial audit

The early review of the facility revealed a few systems or operations that reflected the aging infrastructure of a 60-year-old healthcare building.

"Older DDC [direct digital control] technology and standalone pneumatic controls on the main HVAC systems were showing their age and beyond their life expectancy," says David Papillon, P.Eng, C.E.M., energy solutions development engineer, Western Canada Market Team, Johnson Controls.

Papillon adds that there were outdated pneumatic room controls for general and patient care areas, and the lighting system ranged in age and design. "It consisted of different technology creating a variety of appearances and levels of efficiency."

Other areas that stood out for Papillon included older and wasteful water fixtures throughout the facility, the many fan and pumping systems that required upgrading, the weather stripping and sealing of building components that failed to varying degrees, and the many failed steam traps throughout the facility.

Lighting

To address the lighting inconsistencies, lamps and ballasts of older light fixtures were retrofitted, as it was determined that keeping existing fixtures with some adjustments offered the greatest savings with the least impact on occupants. More than 16,000 fixtures were reviewed. Incandescent or compact fluorescent lamps were replaced with LEDs or T8 fluorescent light fixtures with electronic ballasts.

Steam system

The hospital is heated by steam purchased from the University of Saskatchewan's central heating plant that pipes in the steam. Jackets have been installed on 325 portions of the steam distribution system to insulate the pipes and prevent heat loss. And steam traps, that capture the latent

Raising a Children's Hospital

Saskatchewan's new children's hospital to open its doors in 2019.

A rendering of the new Jim Pattison Children's Hospital in Saskatoon.

Jim Pattison Children's Hospital Foundation

On May 30, Canadian billionaire Jim Pattison, businessman and philanthropist and originally from Luceland, Saskatchewan, announced a donation of $50 million to the Children's Hospital of Saskatchewan Foundation.

It was the largest one-time donation in the province's history, and in honour of the gift, the new hospital was renamed Jim Pattison Children's Hospital.

Scheduled to open in 2019, the new Jim Pattison Children's Hospital is located on the University of Saskatchewan campus in Saskatoon and linked to the adjacent Royal University Hospital.

The 176-bed children's hospital will offer neonatal intensive care, pediatric intensive care, general pediatrics, pediatric emergency, and ambulatory services. Maternal services will include labour and delivery, antepartum, and postpartum care.

The site broke ground on the $285.2 million project in September 2014. ZW Group Inc. of Ottawa is providing project management services, and the architecture team includes Saskatoon's Henry, Downing, Howlett (HDH) Architects and ZGF Architects.

The building's design is intended to maximize daylight exposure and the views from patient rooms. The exterior will include a combination of metal, glass and stone reflecting elements of the province and embracing the riverbank beauty of its location.

There are five floors where clinical care will be provided, plus a rooftop with a helipad, a basement for materials and support services and a sub-basement for mechanical and electrical services.

In August 2015 the Saskatoon Regional Health Authority awarded the main building construction contract to Graham Construction and Engineering.

Daniels Wingerak Engineering Ltd. of Saskatoon is the mechanical engineer.

Entuitive is providing structural engineering services.

heat before the water is sent back, were replaced to improve heating efficiency and reduce the need to cool the rooms where the steam may have been escaping.

Air quality controls

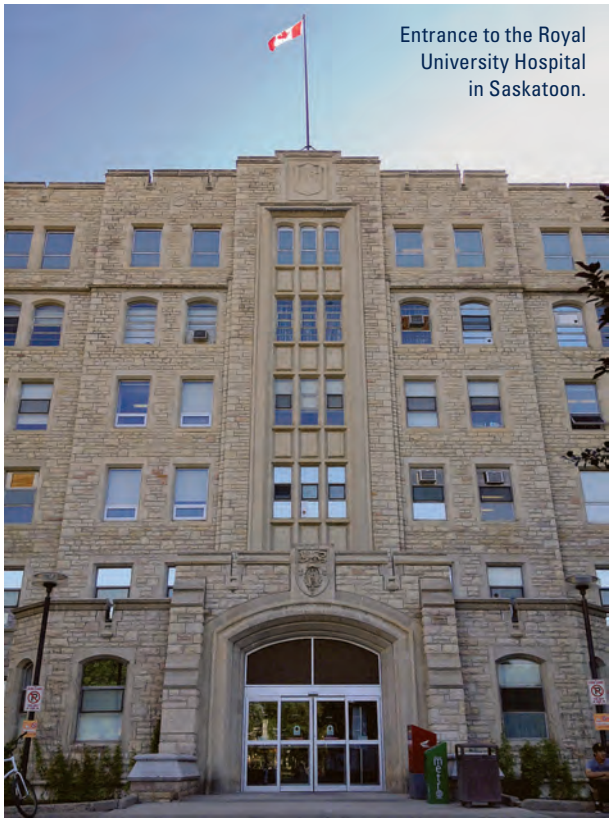
Papillon explains how improvements were made to the fresh air intake at the hospital: “Our initial site visits revealed strong air movements between the interconnections of the buildings (e.g.: certain doors wouldn’t remain shut, “windy” corridors, etc.).

“An outside air analysis was performed as a part of a robust Retro-Commissioning process. The minimum outside air volumes and exhaust air volumes were measured and compared against the minimum requirements from CSA Z317.2/ASHRAE 62.1.

“The minimums were adjusted to correct relative pressure deficiencies, or to meet the requirements, and significant heating cost savings were achieved as a result."

Building automation system

The RUH consists of five interconnected facilities, with the oldest building constructed in the 1950s and the newest in the 2000s. As Papillon explains, there are a variety



Entrance to the Royal University Hospital in Saskatoon.

The new fan wall systems provide redundancy capabilities that enhance facility operations and improve efficiency.

of control systems on site ranging in age, manufacturer and design—from 50-year-old standalone pneumatic controls to modern direct digital controls installed at the room level.

As part of the upgrade, occupancy sensors were connected to reduce energy use in vacant areas, and digital controls were upgraded to provide facility operators with better information to control the environment.

"Many existing HVAC systems were controlled by either standalone pneumatic controls or older digital technology," explains Papillon. "The controls were upgraded on many HVAC systems to allow scheduled occupancy and variable flow control to meet the spaces' requirement, providing the operators with better information needed to control the environment.

"The more complex retrofits were for the general air handling unit (AHU) and the operating room (OR) AHU. The general AHU, the largest ventilation system at RUH, is a dual duct system which consisted of five supply fans and a combination of 13 return fans and 12 exhaust fans serving a total of 300 dual duct mixing boxes.

"The mixing boxes were modulated based on the control signal from pneumatic thermostats. Over the years, the operators experienced many air leaks from the control lines and failures of old technology control components. As a result, most of the control signals were disconnected and the mixing boxes operated at full flow continuously.

"The controls were upgraded to allow for variable flow operation, to more accurately track the air flow requirements of the mixing boxes, and to enable the system to monitor the balance between air being brought into the building and air exhausting the building to maintain the correct pressurization.

"The mixing boxes were retrofitted with new digital controls and electric actuators. Zone-based wireless sensors were installed to allow control of the zone-associated mixing box temperature.

"The OR AHU is a dual duct system serving mixing boxes controlled from pneumatic thermostats. The boxes were designed to deliver a constant air volume to the zones. The controls were upgraded on the OR AHU and associated mixing boxes to allow occupancy air flow control and the building automation system (BAS) is now capable of remote monitoring of the airflow rates 24/7.

The fan walls

All fans in the wards, general and operating room systems were all at the end of their life cycle requiring constant maintenance, so new fan wall systems were put in place. Papillon explains: "The purpose of the new fan walls was to create an increased level of redundancy. The measure replaced the nine original axial fans with 62 modular fans within 3-fanwall systems (General AHU, Ward AHU, and OR AHU) with each fan module controlled by its own variable frequency drive (VFD) through the BAS.

"The original axial fans were equipped with variable pitch in motion vanes for pressure control in reaction to changing flows in the hot and cold decks."

Johnson Controls worked with Clark Engineering of Edmonton for the controls upgrade's related scope, and with Bouthillette Parizeau et Associes (BPA) out of Montreal for fan wall design and retro-commissioning.

Exceeding the target

In a release from Johnson Controls, Nilesh Kavia, vice president of finance and corporate services, Saskatoon Health Region notes, "We recognize that health care is a huge negative contributor to the environment, and that's contrary to the 'first do no harm' philosophy of medical professionals. We have a duty to mitigate the environmental impact on public health, and we're doing that by reducing energy and water waste."

It's been a year since the efficiency improvements were completed at RUH, and according to Papillon, the team is still working on reporting on the results for the last quarter of Year One, but based on the third quarter, they are continuing to exceed the savings target by nearly 40%. CCE

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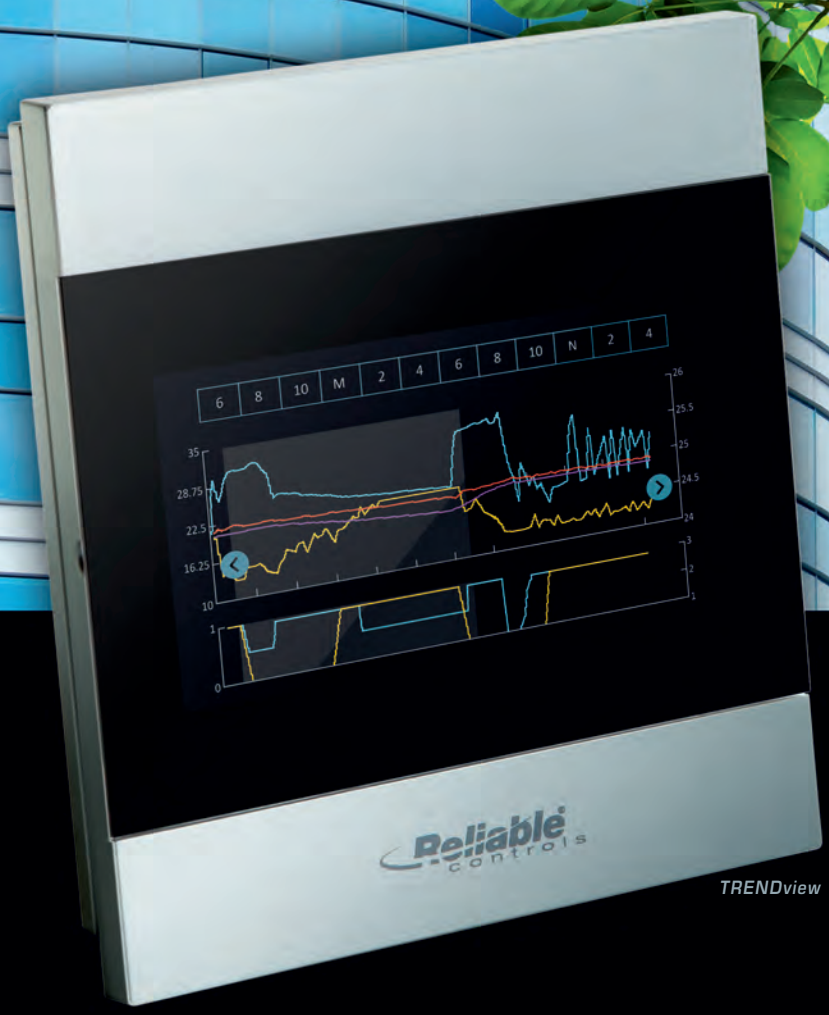

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By Doug Picklyk

The Cost of BEING SMART

Reviewing research on the rise of intelligent buildings and cybersecurity threats.

Last year the Continental Automated Buildings Association (CABA) released its 'Intelligent Buildings and Cybersecurity' research project, commissioned by the association's intelligent and integrated building's council.

The report, authored by Compass Intelligence, evaluated of the state of building management systems adoption, cybersecurity threats and levels of preparedness and also included an assessment of future market directions with specific recommendations for building owners, IT managers and 'smart' building product vendors.

"Advances in connectivity and evolving technology, which includes the Internet of Things, continues to change the trajectory of intelligent buildings, thus raising the need for protection against cyber threats," stated Ronald J. Zimmer, CABA President & CEO, in a release announcing the report.

As the report indicates, it's the rapid growth of Internet-enabled solutions that may present the greatest security challenge for building security.

Exploring the risks

Intelligent or 'smart' buildings have been defined as buildings with integrated technologies that communicate with each other to offer a level of control over the facility's environment, making it economically efficient, comfortable and secure.

Modern building operations are coordinated, through building automation systems (BAS) to operate and regulate multiple functions including: fire and life safety, security, energy management, lighting, elevators, heating, ventilation, air conditioning, indoor air quality, and more.

Building control systems to regulate room temperature, airflow and more have been around since the 1960s, with the earliest systems using mechanical, pneumatic and electromechanical communications and controls.

The introduction of direct digital controls (DDC) in the 1980s ultimately led to the computerization and more integrated centralized control. And in the 1990s demand for interoperability of systems led to the development of open protocols including BACnet, which actually began development in June, 1987.

Today, building automation systems connect with Internet-enabled hardware, making buildings part of the Internet of Things (IoT) movement.

This machine-to-machine technology has led to more integrated communications among sensors, actuators, and controllers all streaming and collecting data which is designed to lead to improved machine learning. According to product vendors, data gets compliled and anyalyzed to determine patterns, predict problems and develop better solutions. However, as long as a system is connected to the Internet, that system is at risk.

Open doors

Together with the great benefits this new technology promises is the growing risk of opening up channels for potentially nefarious activity. The challenge is that as every asset including every intelligent light bulb, sensor, and piece of hardware is issued an IoT-ready Internet Protocal (IP) address, it potentially opens up networks and makes them accessible through the Internet and Internet-based cloud systems.

Security begins with the building systems companies and products, and it ends with the owner. While structural engineers keep buildings standing tall, now electrical engineers may need to create more secure intelligent building technology infrastructure to keep buildings safe from virtual attacks.

Target becomes a target

A prime examples of a targeted attack was the security breach at U.S. retail giant Target in late 2013. The point of entry for that attack was gained through using login credentials acquired from an HVAC supplier who fell prey to a phishing email. Once inside Target's system, that attackers ultimately gained access to point-of-sale registers, which ultimately led to stolen contact and credit card information from up to 70 million people.

According to reports, Target has said the total cost of the data breach has been US$202 million.

Earlier this year Target agreed to pay $18.5 million in a multi-State settlement. As part of the settlement the company is required to adopt measures to secure customer information and hire an independent third party to conduct a security assessment and encrypt card information to make it useless if stolen.

Among the changes Target has made since the attack is limited or disabled network access for vendors; expanded use of two-factor authentication and password vaults; and disabled, reset, or reduced privileges on over 445,000 Target personnel and contractor accounts.

Although this crime didn't target a building's automation system, it reveals potentially vulnerable access points to an organization's IT network.

Types of crime

The threat of cyber crime is the covert nature of the activity, because the perpetrators of the crime can be coming from anywhere at anytime. There's the risk of criminals seeking to compromise systems and gain access to building systems, disabling internal security systems, putting people and intellectual property at risk.

Modern cyber attacks can include malware that can launch denial-of-service (DOS) attacks that shut out access to hardware controls.

Crypto-ransomware can also be used to shut down systems unless you pay a ransom. This is among the fastest growing kinds of cybersecurity crime.

Recommendations

The executive summary of the CABA report provides high-level recommendations for protecting building systems against cybersecurity breaches.

Among the suggestions, the report says building owners should create detailed assessments of processes, systems and technologies involved in integrated building and IT systems, and also building owners should identify and evaluate any potential sources of threats.

"These sources comprise both insiders and external entities, such as disgruntled employees or business partners, hackers, competitors, and rogue states (that may proactively sponsor and condone such activities). Moreover, cybersecurity breaches can occur through the intrusion of the building vendors' internal and external Web portals and applications."

It also recommends the establishment of a thorough understanding of the roles, responsibilities, and capabilities of various stakeholders (including building owners, tenants, building/industrial control system vendors, IT personnel, and third-party security vendors). "When developing cybersecurity strategies, analysis is vital prior to instituting changes to systems, people, and processes."

Routine audits of BAS hardware, software, and processes is also recommended to identify any potential cybersecurity vulnerabilities.

Planned protection

Cyber security should be considered during the specifica-

tion phase of intelligent building design, planning for threats and the protection of structures from malicious takeover of a building's control systems that could lock a building down.

Audits conducted at the design phase can define security measures. Suggestions include separation of a building's operations technology network from the information technology network.

Proper cybersecurity solutions for intelligent buildings will require collaboration among the vendors of the multiple systems in the building.

Prior to CABA's research, a Frost & Sullivan report "Cybersecurity in Smart Buildings, Inaction is not an Option Anymore" notes that cyber threats demand the utmost recognition and intervention of adminstrators and regulators to implement industry-wide changes.

Ultimately the cybersecurity role is to defend and protect all building systems, networks, and IT systems from unauthorized access. The challenge is building a virtual wall around every sensor and control device with an IP address that may be linked to the overall building's intelligent network.

In the Frost & Sullivan discussion paper, a major takeaway was: "As advancements in connectivity, new technology, and service deployments powered by IoT and Big Data continue to make their way into the smart buildings' landscape, cybersecurity concerns will intensify further."

The solution, they suggest, will be found in "recognizing the scope and magnitude of cyber crimes that can impact smart buildings, understanding industrial control systems vulnerabilities, evaluating cost of damage, devising mitigation methods and pursuing an ongoing robust cybersecurity plan for smart buildings."

As the demand by building owners for smarter and more efficient buildings grows, an equal amount of attention should be placed on a strategy for protecting a built environment that is increasingly becoming Internet enabled. **CCE**

CABA members that participated in CABA's "Intelligent Buildings and Cybersecurity" project included: Acuity Brands, Inc., Bodvoc Ltd., Cadillac Fairview Corp., CSA Group, Honeywell International, Inc., Hydro-Québec, Ingersoll Rand, Intel Corp., ISA Security Compliance Institute, Johnson Controls, Manulife Real Estate/John Hancock Real Estate, Philips, Robert Bosch LLC, Rogers Communications Inc., Schneider Electric, Siemens Industry, Inc., Tridium, Inc., United Technologies Building & Industrial Systems and Waterfall Security Solutions.

By William Kuffner, P.Eng.

Protecting the Exterior

A portion of Grenfell Tower in London, after the tragic fire

Fotolia

Following the tragedy of the Grenfell Tower fire in London, where flames consumed the building's exterior, could the same happen here?

When a building fire occurs that claims lives, the tragedy is followed by a period of reflection where we wonder if it could happen again elsewhere. It is certainly ill conceived to draw conclusions about what really happened without all the evidence, and it can be outright dangerous to do so. However, when those conclusions are reached through a proper course of study, we try to learn from it and take the opportunity to revise regulations to help better protect society where possible.

This article focuses in on one aspect of building fire safety that is being looked at as a result of the fire in the Grenfell Tower in London, UK. That aspect is fire growth on the exterior of a building.

An exterior building fire is probably the fastest way to spread fire through a building because there are no fire barriers to stop it once it starts, there are no compartments to contain it, it could be aided by wind, and the vertical nature of the fuel arrangement feeding the fire.

That is not to say that such a fire is necessarily larger, or that it releases more heat or even that it is more dangerous than any other building fire, just that it typically moves faster than other building fires. In order for such a fire to propagate up the side of a building, combustible material must be in place with flame spread properties that would allow it to happen along with other factors.

The building code system in Canada regulates the combustible content of construction materials including exterior cladding. Buildings over six stories high must be constructed with material determined to be non-combustible including the exterior cladding. Some relaxation of this requirement is provided for smaller buildings required to be of noncombustible construction, however those buildings require non-loadbearing walls to meet vertical flame spread criteria.

Grenfell Tower remains.

That covers newly constructed

Sentence 3.2.3.5.(3) NONCOMBUSTIBLE CLADDING

Article 3.1.4.5. requires all exterior cladding in buildings of noncombustible construction to be noncombustible including buildings 3 storeys or less in building height. This Sentence is a further restriction on the types of noncombustible cladding permitted in buildings over 3 storeys in height.

Figure 1 – 1980 National Building Code Appendix Note.

buildings, but what about buildings that have been around for a while that get renovated? Renovations are covered by provincial building codes that include provisions related to exterior cladding. Any project that includes replacing or adding to the exterior wall assembly of a building is subject to the requirements of the building code in the jurisdiction of the proposed project. In addition to the provisions of the building code, every occupied building is covered by the fire code that prohibits changes that would make a building less safe than originally designed without meeting the requirements of the building code.

History of Code Provisions related to exterior cladding

In the 1980 National Building Code of Canada the use of foamed plastics began to receive specific attention (see Figure 1, above). Starting with the 1990 version, combustible cladding for buildings required to be of noncombustible construction has been addressed in a separate article. From this we can see that for over 30 years the use of plastics in exterior building cladding has been included in Canadian Building Code regulations. The cladding on the Grenfell Tower included a polyethylene (thermoplastic) core.

Could the same thing happen here?

When comparing what is known about the fire at Grenfell Tower with the residential building inventory in Canada, the question "could that happen here?" comes up. Despite all of the protection measures put in place to limit the probability of such an occurrence, unfortunately, the answer is yes.

All it would take is the inattention, or lack of understanding of this potential risk, by a small group of key people involved with an exterior cladding renovation project to create similar conditions to those which ultimately turned a single unit apartment fire into one like we witnessed in London.

The consequences of such a fire in terms of lives lost and property damage caused is another matter altogether and will likely be the subject of many studies conducted in the

near future.

If a similar event were to occur in this country, the ultimate responsibility would be with the building owner who is responsible to ensure that renovations meet the requirements of the building and fire codes, but there would be plenty of blame to go around.

Product manufacturers should ensure their products are tested by accredited labs and listed as being non-combustible, or that they achieve flame spread criteria minimums before they are marketed to buildings in general. Architects, engineers, designers and installers should ensure that the proper application of materials is achieved and that construction permits are issued to achieve the requirements of Canadian building and fire code regulations with the assistance of building officials.

Cladding systems

There is no doubt that buildings operate more efficiently when they are insulated from the exterior environment, and one of the easiest ways to improve that efficiency on an existing building is through the addition of exterior insulated cladding.

Such cladding can also improve the look of an older building. For these reasons an increasing number of products and projects will seek to add exterior insulated cladding materials to buildings, but we must remain true to the objectives of our construction codes in order to ensure that safety is not sacrificed to achieve other goals.

The cladding used in the Grenfell Tower has been reported to be Reynobond PE, an architectural product intended to be part of a vented cladding system used for new construction or renovation.

Manufactured by Arconic, formerly part of Alcoa, the Reynobond product consists of two aluminum sheets bonded to a thermoplastic (polyethylene) core. The products are available as Reynobond PE, with the polyethylene core and Reynobond FR, which is fire-resistant and includes a polyethylene core loaded with mineral flame retardant.

A product sheet from a building supplier's website indicates that Reynobond is listed to ASTM E 84 (for use in the United States).

A search of the ULC database for that product shows it is not listed for use as either a noncombustible or an acceptable vertical flame propagation resistant material. The FR version of the product is listed by UL as part of several building exterior wall assemblies, but no listing for the PE product was found.

What this means is the material is not acceptable for use in any exterior cladding project in Canada for buildings over three storeys in height.

If all that sounds a bit confusing, that is because it can be and often is. So it's no stretch of the imagination to see how a bit of inattention on the part of some key players could affect public safety. **CCE**

William Kuffner, P.Eng. is Senior Fire Protection Engineer, Infrastructure Engineering with SNC-Lavalin.

Arconic reacts to tower tragedy

Following the Grenfell Tower fire in London, UK, Arconic, the company that manufactures the exterior cladding used on the building, issued a statement and announced it is removing that product from the market for high rise buildings.

Arconic, a spin-off from Alcoa, engineers and manufactures products for the aerospace, automotive, building, energy and industrial industries. Following is the company's statement:

The loss of lives, injuries and destruction following the Grenfell Tower fire are devastating, and our deepest condolences are with everyone affected by this tragedy. We have offered our full support to the authorities as they conduct their investigations.

While the official inquiry is continuing and all the facts concerning the causes of the fire are not yet known, we want to make sure that certain information is clear:

Arconic supplied one of our products, Reynobond PE, to our customer, a fabricator, which used the product as one component of the overall cladding system on Grenfell Tower. The fabricator supplied its portion of the cladding system to the façade installer, who delivered it to the general contractor. The other parts of the cladding system, including the insulation, were supplied by other parties. We were not involved in the installation of the system, nor did we have a role in any other aspect of the building's refurbishment or original design.

While we provided general parameters for potential usage universally, we sold our products with the expectation that they would be used in compliance with the various and different local building codes and regulations. Current regulations within the United States, Europe and the U.K. permit the use of aluminum composite material in various architectural applications, including in high-rise buildings depending on the cladding system and overall building design. Our product is one component in the overall cladding system; we don't control the overall system or its compliance.

Nevertheless, in light of this tragedy, we have taken the decision to no longer provide this product in any high-rise applications, regardless of local codes and regulations.

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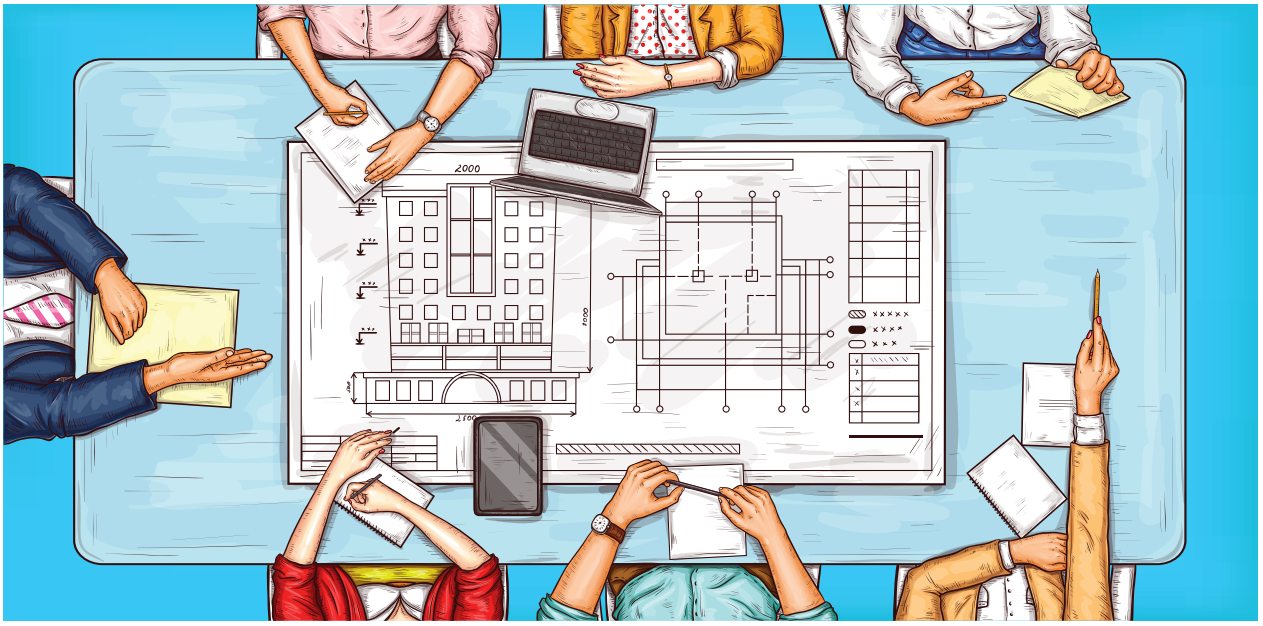
Predict-Ability

How Partnering Scorecards can dictate a project's succes.

By Sue Dyer



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How would you like to be able to predict the level of success (or failure) of your projects? Well, it seems that it is closer than you might think.

Studies show that by using a monthly Partnering Scorecard you can in fact have a great handle on what is actually happening on your project, and the scores turn out to be a great predictor of what is going to happen! How would you like to be able to predict the future for each of your projects? With insights, you and your team have time to make course corrections before they become inevitable.

It seems the scores that the team provides accurately and truly depict what is going on within a project. A recent study on the efficacy of partnership when constructing the Woodrow Wilson Bridge found that what the team members scored and said on the Partnering Scorecard was in fact what was going on (strong correlation) at that given time on the project. So, the collective wisdom of the team came forth in a clear snap-shot of the project's status.

In the International Partnering Institute's Study of 13 different projects that used a monthly Partnering Scorecard over a two-year period, 12 of the 13 projects' scores improved over the life of the project.

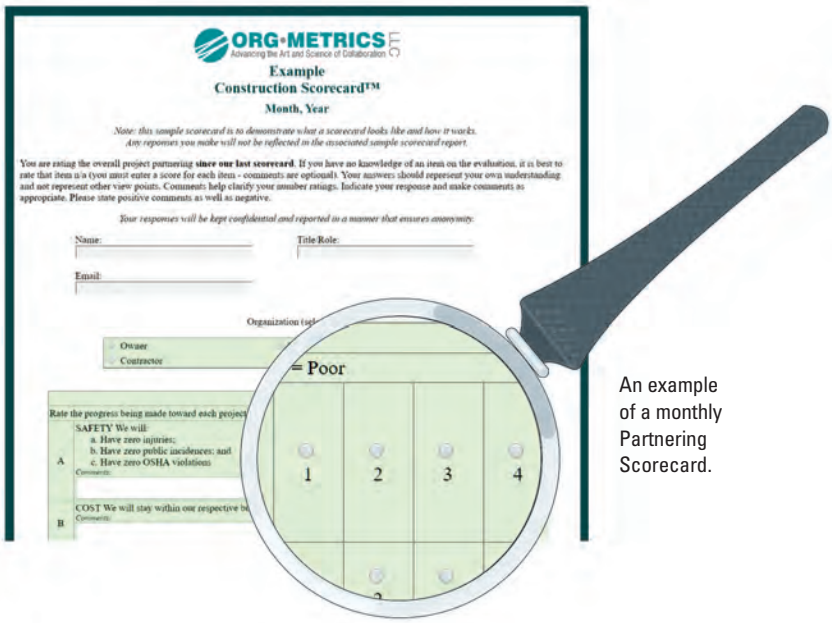
Overall, project scores improved by as much as 1.13 points (28%) over the life of the project. The average improvement was half-a-point (+0.54 = 14%).

Set deadlines and keep them. This will create trust and grow your predictability. It is not the issues that predict your success or failure; it is how the team deals with the issues."

Predict-Ability does take commitment. As a project manager you must use the construction Partnering Scorecard as a tool. Just like every tool, the better you are at using it, the better your results. Here are some tips for getting the most from your Partnering Scorecard.

Tip #1: Make the Partnering Scorecard a Requirement

The project scorecard must be a requirement and the team must feel that it is valued and valuable for them to take the time to share their scores and comments. It is the leader that can and must make this happen. If you take the scorecard seriously, so too will your team members. If you



An example of a monthly Partnering Scorecard.

ignore it and don't use it, they will do the same.

Putting the requirement into your project documents will help ensure everyone knows you are serious.

Having senior management remind everyone that you want 100% participation in this month's scorecard—and convey that it is an important part of your project's success—will get people to complete the scorecard.

Monitoring and acknowledging those who are completing the scorecard will reinforce its value. Monitoring who is not completing the scorecard will help ensure they will complete it next time.

Tip #2: Create an Atmosphere of Trust

Your partnering effort is designed to develop a culture of trust and collaboration. This fosters the open, honest atmosphere that will allow your scorecard to reflect the good, the bad and the ugly that occurs on your project. The truth will set you free—free to work on what is needed to succeed.

Trust happens when you grow certainty that you will be fair and resolve issues before they grow into problems or disputes. To have the most meaningful partnering and scorecard program takes commitment. Your actions show your commitment.

Trust can be built over time, but it is highly predictable that your expectations define your relationships. So, check yourself to make sure you are not defensive, protective or hostile toward your teammates. As a project manager you will define the atmosphere and it will heavily influence your results.

Tip #3: Understand the Tool

The Partnering Scorecard is a snapshot in time of what is occurring on your project and allows you to measure your teamwork effectiveness and the ability to achieve your project's goals.

Orienting your team members on the Partnering Scorecard and its importance can go a long way to overcoming barriers to its use.

Tip #4: Evaluate Your Results

Your Scorecard will be emailed to everyone on your project team each month—but you have to evaluate what the scores mean. This can easily be done during a regular weekly project meeting.

Look at any scores where you have a "1" or "2" as these indicate negative momentum. These are where the team is feeling frustrated or issues are emerging. Focusing on these areas will help a great deal.

Look at your scores in the "3's". These are OK, and with a little focus might be able to achieve a "4" or better. This will grow your positive momentum dramatically!

Tip #5: Make Course Corrections

Resolving issues where the team is stuck or they are creating frustration is your top priority and needs to happen before the next scorecard if possible. You can use your partnering session for this and get the help of a professional neutral partnering facilitator.

Elevating issues up your dispute ladder is needed and should not be put off because you want to hold on to the decision. Get a decision and move on.

Set deadlines and keep them. This will create trust and grow your predictability. It is not the issues that predict your success or failure; it is how the team deals with the issues. Correct your course so the team stays together and gains positive momentum!

Woody Allen said: "We are all interested in the future, because that is where we are all going to spend our lives." Think about using a Partnering Scorecard to allow you to predict how you and your project team will be spending your time. Will it be celebrating the building of great things? Or fighting over project disputes because things didn't turn out as hoped? **CCE**

Sue Dyer is president of OrgMetrics LLC, and the author of Partner Your Project, and a recognized thought leader on collaboration in construction. Sue has launched Partnering FIT, a training program using virtual training technology that allows her to include 30 years of lessons-learned and make them available any time, any place, 24/7. For more information about Sue Dyer, visit www.OrgMet.com.

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The Third Dimension TODAY

The evolution of vertical mobility includes horizontal travel.

By Andrew Wells, P.Eng., KJA Consultants Inc.

In June of this year German-based thyssenkrupp Elevator (TKE) announced the inauguration of the company's rope-less horizontal-vertical elevator system, MULTI, and their first planned installation project for the new East Side Tower building in Berlin.

TKE's MULTI represents the latest development with vertical elevating systems that are capable of horizontal movement. The product bears notable similarities and brings to life the concepts described in an industry forecasting article first published on our KJA website's 'General Interest' section which proposes the idea of people-moving 'pods' capable of horizontal travel as well as vertical.

The TKE design makes use of existing technology and new designs to accomplish this feat:

Matching concepts we presented such as (1) lightweight materials including carbon composites that "…reduce MULTI's cabin and door weight by up to 50%. …"

Addressing technical challenges we identified in our article with: (2) magnetic Levitation (MagLev) lifting forces eliminate energy storage questions and replaces the rack and pinion or traction concepts discussed,

Delivering the mechanism that allows a 90 degree turn in movement needed when a pod changes movement from horizontal to vertical with (3) TKE's exchange system "…allows the linear drive and guiding equipment to make 90° turns…"

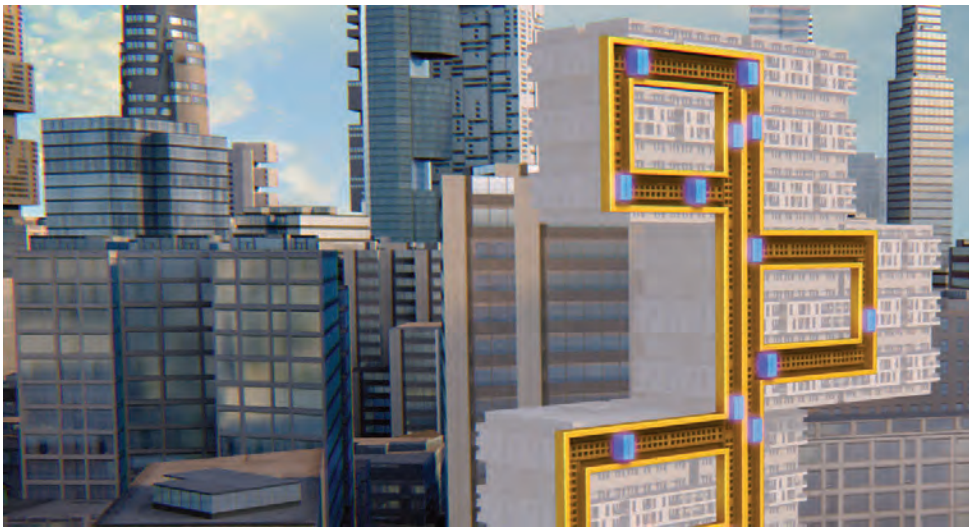
Rope-less

The MagLev technology used by TKE provides the lifting force for the MULTI elevator 'pods'. Today's elevators are suspended by steel braided hoist ropes, a construction design that has remained largely unchanged for decades. One can imagine the reaction of early railroad locomotive pioneers if they were to be told that trains in the future would float on a cushion of air, suspended by magnets (intense disbelief would be an understatement). The use of MagLev as a replacement for steel hoist ropes is overdue in our opinion, however, the technology's cost will be a barrier to mass consumption in the short term.

Early multi-cabin elevator designs

The earliest reciprocating (paternoster) elevators had cabins that moved both up and down inside a building (for readers unfamiliar with the concept, searching pasternoster on YouTube will clarify immediately).

In this design, direction reversal involves brief horizontal movement at the terminal floors and is achieved by



thyssenkrupp Elevator

Illustration concept of vertical-horizontal people moving system.

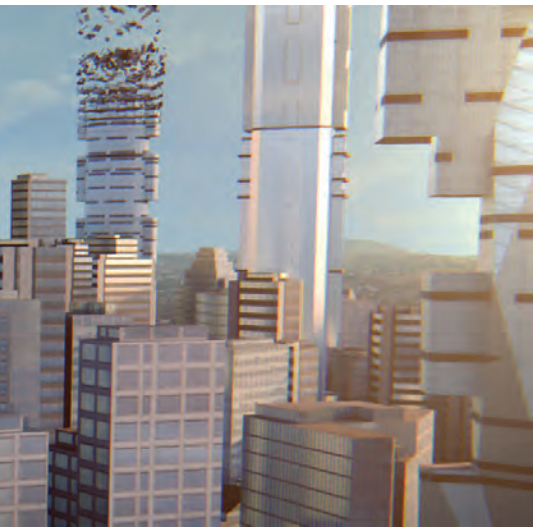
Illustration of the rope-less horizontal-vertical elevator system, MULTI.

thyssenkrupp Elevator

suspending the cabins in a continuous loop. For pasternoster design the direction reversals required car doors to be removed leaving elevator passengers exposed to moving hoistway openings at each floor level.

By comparison the MULTI is very similar to a typical modern elevator interior. The design is reported by TKE to have carried a "Focus on Safety" and would be expected to include car doors and entrance protection used commonly today.

In 1997 Otis, a unit of U.S.-based United Technologies Corp., constructed in its North American test tower their Odyssey product. The system enabled "…one elevator car to travel vertically and horizontally through a series of shafts to virtually unlimited heights…" The Odyssey system was never commercialized.



When compared to the paternoster, the modern designs bear no resemblance to their historical counterparts with their use of lightweight composites and state-of-the-art suspension means.

Applications

In our forecasting article we asked what is preventing the industry from immediately manufacturing pods and building new horizontally-vertically integrated complexes?

Scale is one factor. To develop such a system for a two-floor townhouse would not make much economic sense. To move forward with a new design such as this the building complex would have to be sizeable - probably in the 10 million square-foot range if not larger. Such a complex implies or demands government intervention or assistance in a major way.

Consideration of project scale will likely continue to drive decisions as to whether the technology makes sense for a project for many years.

A unique design TKE named as "TWIN" includes two elevators sharing the same hoistway; to date I am aware of 20-30 global installations. Designs such as TKE's TWIN remain exceptions to the rule in terms of the numbers of running installations globally.

For early adopters a building's design would center around the use of this technology and would effectively not be replaceable should building ownership or function or operating preferences change.

For such a unique installation, the cost of participation will not be the primary factor in choosing to use the technology. Put another way, designing around the MULTI product would happen right from the project's start, and cost will not be the primary determinant in making that decision.

Competition

Otis' decision to not release to market their developed product suggests that while interest was present and the concept warranted consideration, Otis did not expect the product to be financially successful.

As a technology's use continues to increase, so do opportunities for competitors to participate. It is unclear how quickly the product's adoption might proceed, but given the slow acceptance to date of other unique designs it is not likely to be early. Increased market acceptance will be required to expect to see entry or re-entry by other major manufacturers.

Design Considerations — what to expect?

All product marketing materials are arranged to serve a purpose. Consumers will be well served by conducting independent research to help generate impartial and informed decisions prior to selection.

Often marketing materials do not include or reference supporting data necessary for site-specific analysis. It is not uncommon for performance

ranges to be listed with:

... 'can increase a building's useable area by up to',

... 'can increase handling capacity by as much as' or

... 'can reduce power requirements by as much as'.

As with any vertical transportation (VT) system, the passenger movement patterns that are unique to each building need to be studied when considering possible applications.

KJA's new building design standards require elevators to 'respond' in less than 35 to 38 seconds; some of our class-A commercial office building designs deliver average waiting times near 30 seconds.

If a new building was modelled to see the MULTI system responding on average at 30 seconds during the busiest five minutes, this would warrant comparison against what might be expected from a traditional elevator system (at a fraction of the installation cost).

There can be disadvantages to being an early adopter of new technology. The major manufacturers over the years have released products that proved to be problematic.

Should a design prove to deliver operations not meeting expectations, the cost of building retrofits for replacement is high. In an effort to remain impartial on the topic, the designs need not be mentioned, however, they do exist and developers asked would say they are best avoided.

As we look forward into the future and ask when we might be expected to see more mainstream adoption of ropeless horizontal/vertical people pods, it may be helpful to look back into the past.

If we were to suggest in the 1960s to domestic automobile manufacturers that electric or autonomous vehicles could be expected within a few decades, responses would likely be that the concepts seem far-fetched.

It is my opinion that technology similar to TKE's MULTI, where buildings are designed around VT systems that have more than one elevating device sharing a common hoistway, will become more common within the next 25 to 50 years. **CCE**

Andrew Wells, P.Eng, CEI, EDM-F, SCO(AB), is vp technical services with KJA Consultants Inc., a consulting engineering firm specializing in elevators and escalators.

Unveiling the MULTI

Calling it the world's first rope-less and sideways-moving elevator system, thyssenkrupp Elevator launched its MULTI system to the world in June. In a media release the company announced that the first fully functional unit was operating at its purpose-built 246-metre-tall innovation test tower in Rottweil, Germany.

At its world premier, the company also announced the first customer for the MULTI was European developer OVG Real Estate, who will be installing systems in its new East Side Tower building in Berlin.

Thyssenkrupp Elevator 246-m test tower in Rottweil, Germany.

In the release, Andreas Schierenbeck, CEO of thyssenkrupp Elevator says: "We believe MULTI is a genuine game-changer that will truly transform the way people move, work and live in our built environment. It will reduce waiting times for passengers and take up significantly less space within the building."

Scale model of the MULTI system.

Unlike conventional elevators with one cabin moving up or down per shaft, the MULTI allows multiple cabins to be operating in a loop. And instead of using cables, the elevator uses linear motor technology and runs on a multi-level brake system and redundant wireless data and energy management on the cabins.

The company indicates that for high-rise buildings, MULTI can achieve up to 50% higher transport capacity and reduce peak power demand by as much as 60% when compared with conventional elevator systems.

The system's design also requires fewer and smaller shafts, increasing a building's usable area by up to 25%.

According to Antony Wood, executive director of the Council on Tall Buildings and Urban Habitat (CTBUH): "This is perhaps the biggest development in the elevator industry since the invention of the safety elevator some 165 years ago. The 'holy grail' for elevators has been to move beyond being pulled vertically by a rope under tension – towards a system that allows movement in inclined or horizontal directions. MULTI, more than any other product delivered to date, really shows the way forward for that potential. This has the capacity to transform the industry at large, changing the way tall buildings are designed, and allowing for much more efficient core designs, as well as better connectivity in buildings."

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The Ruskin TDP05K thermal dispersion air measurement system for air flow and temperature measuring averages multiple velocity and temperature points within a duct or plenum. Each probe can have up to eight flex sensors. Users can specify up to 16 probes for an opening, each capable of measuring a velocity range from 0 to 5,000 fpm. BACnet is standard. www.ruskin.com

Seresco Inc. offers the new R3 Expansion Module and compact furnace add-on option for its NE Series of indoor pool dehumidifiers. The R3 module reduces equipment size; reuses exhaust and energy; and recycles energy. R3 components include multiple transducers that report data to the NE Series dehumidifier's CommandCenter. www.serescodehumidifiers.com

The Danfoss VLT BACnet/IP MCA 125 is an interface connecting the Danfoss VLT HVAC Drive FC 102 to building management systems using the BACnet/IP protocol. This option helps to reduce the number of network components and effectively increases network bandwidth to the BMS controller. www.danfossdrives.com

IMAGINiT Technologies has announced updates for the IMAGINiT Utilities for Autodesk Revit 2018 and Autodesk Civil 3D 2018. The tools help BIM Coordinators focus on high-level design and less on manual tasks. They are available to subscribers of Autodesk products through IMAGINiT, others may purchase directly. www.imaginit.com

The Transportation Association of Canada's Design, Construction, Maintenance and Inspection Guide for Mechanically Stabilized Earth Walls provides engineers, with practical guidance on the selection, design, construction, and inspection of these structures with a focus on public works projects. The guide highlights the current state of practice in Canada and suggests modifications where deficiencies are apparent. www.tac-atc.ca/

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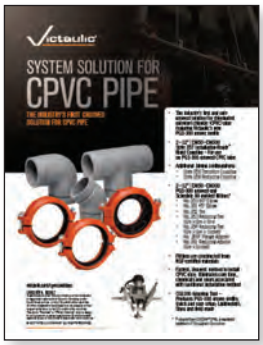

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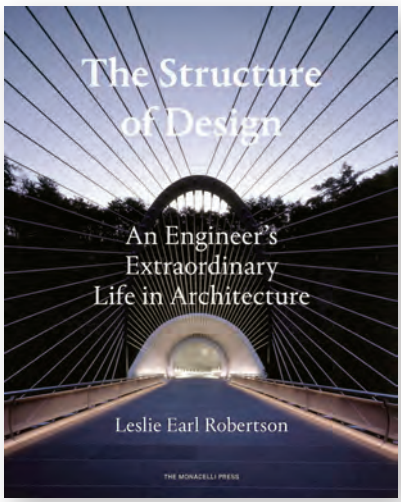
Life of an Engineer



On September 11, 2001, Leslie Earl Robertson was dining in Hong Kong when he was informed an airplane had flown into one of the World Trade Center towers in New York. "Having often watched small planes and helicopters well below the tops of the towers, I was not particularly concerned," he recalls. But after learning of the second aircraft crashing into the towers he left the dinner. "I ran to my room, turned on the television … and was devastated."

Robertson recounts this experience in his new book, The Structure of Design: An Engineer's Extraordinary Life in Architecture (published by The Monacelli Press, 2017). Born in Los Angeles in 1928, he left high school and joined the navy at 16. He went on to graduate from University of California, Berkeley in 1952 with a Bachelor of Science in civil engineering.

While at school he recalls attending a lecture by architect Frank Lloyd Wright. "He was an imposing figure who, having created a host of incredibly beautiful designs, even to this inexperienced student, could be seen as an extraordinary talent."

"… prior to his departure took me aside to say that I would learn nothing at Berkeley, that I should work for him at Taliesin West. Taking a deep breath, and braving his wrath, I told him I had learned from his personal example that architecture, as a profession, was not for me—a decision I have never regretted."

Robertson outlines his career path which ultimately led to architectural design and structural engineering. In the early 60s he worked on IBM buildings of 14 and 20 stories in Pittsburgh and Seattle respectively. Then came the World Trade Center project, initially to be 100 stories (later to become 110). He was 34 years old.

The central section of the book "Collaborations with Architects" shares his relationships and projects with master architects including I.M. Pei, with the largest chapter focused on Minoru Yamasaki, including 58 pages dedicated to working on the Twin Towers.

"Enumerating all of the innovations incorporated by us into the World Trade Center would be overly long. … Most, if not all, of this technology is now a part of the standard vocabulary of structural engineers."

Among the innovations: tubular framing system with outriggers; prefabrication of structural steel in large volumes; computerized purchasing and fabrication (using an IBM 1620 computer and punch cards); wind engineering (professor Alan G. Davenport from the University of Western Ontario led the wind engineering research group); motion simulation; structural damping; and glass design.

Robertson includes 18 pages on 9/11, which includes the following passage:

"… the events of September 11 have profoundly affected the lives of countless millions of people. To the extent that my structural design of the World Trade Center contributed to the loss of life, the responsibility must surely rest with me. At the same time, the fact that the structures stood long enough for tens of thousands of persons to escape is tribute to the many talented engineers of our company who spent endless hours toiling over the design and construction of the project, making me very proud of our profession. Surely, we've all learned the most important of all lessons: the sanctity of human life rises above all other values."

The book provides insights into many other building Robertson took part in around the globe, including the AT&T Headquarters in New York, the Parliament House in Canberra, Australia, the Bank of China Tower in Hong Kong, the Suzhou Museum, the Miho Museum Bridge, and the Shanghai World Financial Center.

The book includes moments of personal insights, technical knowledge and levity. A human rights activist from an early age, he also shares philosophical insights gained through work and life.

"Above all, I hope that, from this book, young architects and engineers will learn from my life-experience something of the joys as well as the trials and the tribulations of our professions. Indeed, it is exactly this point that has generated within me the energy required to bring this book to you."

Filled with many photos and illustrations, it is refreshing to find a hard cover structural engineering book that isn't a text book, but rather a reflection on one individual's life as an engineering professional. **CCE**

The Structure of Design: An Engineer's Extraordinary Life in Architecture, by Leslie Earl Robertson, edited by Janet Adams Strong, is published by The Monacelli Press (April, 2017).

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