IRC KeyNotes

STRATEGIC CONSTRUCTION MODELING AND DELIVERY
INDUSTRIAL RESEARCH CHAIR

ISSUE 5
March 2016

EVENTS

MAY 10 & 11, 2016
COAA Best Practices Conference 2016
Shaw Conference Centre, Edmonton

JUNE 16, 2016
IRC Management Advisory Committee Meeting
University of Alberta, Edmonton

OCTOBER 27, 2016
IRC Management Advisory Committee Meeting
University of Alberta, Edmonton

INDUSTRY PARTNERS

- Aecon Industrial Western
- Building Trades of Alberta
- Capital Power Corporation
- Christian Labour Association of Canada
- Construction Owners Association of Alberta
- Merit Contractors Association
- Progressive Contractors Association of Canada
- Suncor Energy Inc.
- TransAlta Corporation

NSERC CRSNG

Message from the Chair

Reflections entering IRC year five

Aminah Robinson Fayek, PhD, PEng, Professor of Construction Engineering, University of Alberta.

As Chairholder, I play a critical role in balancing the needs of a group that, on the one hand, shares a mutual goal of improving the competitive performance and technological sophistication of the Albertan and Canadian construction industries, yet that also comprises organizations representing vastly different perspectives and that have varied goals associated with their individual participation in the IRC. Entering into its fifth year and backed by a dedicated partner base, the IRC has established a strong foundation of research and products, all of which will ensure a productive beginning to the 2017–2021 renewal term. Even as the program continues to mature and evolve, I remain conscientious of new opportunities for growth. Each year has provided new insights that have contributed to the advancement of my knowledge and skills as program leader, inasmuch as they have helped to improve communication among the group and to enhance the efficiency and effectiveness of the IRC's research.

While the past four years have revealed that successful outcomes for the IRC can take many forms, an environment of active collaboration has been essential in maximizing the value delivered to our stakeholders. The feedback that we receive from our industry partners helps us to understand the way that their organizations interpret and apply the results of the program. Three to four times a year, the IRC's Management Advisory Committee comes together to discuss the strategic direction of the program and its projects; recommendations made by the committee allow us to better develop resources and present findings in a way that is most conducive to their successful uptake. In this edition of *KeyNotes*, we profile our newest Management Advisory Committee Chair, Paul de Jong, on his position as president of the Progressive Contractors Association of Canada, in addition to discussing the goals and benefits of partnering with the IRC, as well as the value of a career in the Alberta construction industry (see page 3). The Management Advisory Committee Chair plays an integral role in facilitating group discussion and in promoting dialogue around industry needs.

In the coming year, the IRC will focus extensively on knowledge and technology transfer.

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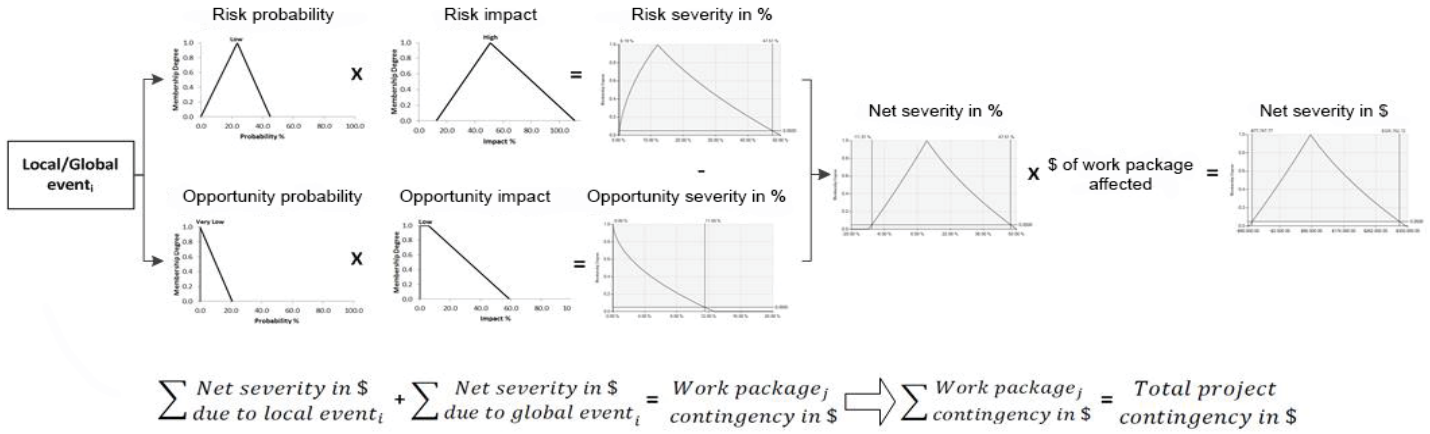
Aminah Robinson Fayek, PhD, PEng
NSERC Industrial Research Chair
in Strategic Construction Modeling and Delivery
Professor, University of Alberta

FEATURE

Fuzzy Contingency Determinator©: A Risk Analysis and Management Tool



Fuzzy arithmetic procedure to determine work package and project contingency.[1]

by Cassandra Ommerli

As the IRC enters into its fifth year and planning for the renewal term begins, the program's successes in applied research provide a strong foundation for future projects. One such case includes the IRC's extensive work with industry partner and Edmonton-based power generation producer, Capital Power, in developing a novel software tool for risk analysis and management. The project began in January 2012, backed by a mutual goal of remedying limitations in traditional risk analysis approaches. In particular, research has been heavily focused on methods to account for the uncertainty involved when allocating contingency. "Construction projects typically require that decisions be made far in advance of project execution," explains key project researcher and IRC PhD student, Nasir Siraj, "moreover, decision-makers are often faced with a lack of data regarding previous risk events. When such data are unavailable, organizations rely on a group of experts to reach consensus through subjective evaluation regarding the probability and impact of project risks." Currently, Monte Carlo Simulation (MCS) represents the industry standard in risk assessment. Despite its widespread application, MCS is not fully equipped to handle the subjective uncertainty associated with its input values, relying instead on historical data and probabilistic distributions. Siraj also notes that traditional risk analysis approaches often do not consider opportunity, which is a crucial component of the decision-making process for contingency allocation.

In order to remedy these issues, IRC researchers have utilized their wide repertoire of expertise in fuzzy logic, an artificial intelligence technique known for its capacity to process subjective and linguistically-expressed variables. On the industry side of the relationship, Capital Power has played an integral role in solution development by providing Chairholder, Dr. Aminah Robinson Fayek, and her team with strategic insight regarding industry conventions in risk management, including helping researchers understand the limitations of the systems and tools currently available to local construction groups. Dr. Robinson Fayek notes that by facilitating a relationship between academia and industry, the IRC affords both groups the opportunity to conduct a much more dynamic and rigorous analysis of construction issues that might not otherwise be possible by either group alone.

Four years later, the result of this long-standing collaboration has been the creation of the fuzzy contingency determination model (FCDM), which has been implemented in a user-friendly software tool known as Fuzzy Contingency Determinator© (FCD©). The tool applies advanced fuzzy modeling techniques that allow experts to express the probability and impact of a risk or opportunity using clearly defined linguistic terms, which are then converted to fuzzy numbers and processed using fuzzy arithmetic. The FCD© analyses both local and global risks and provides contingency values at both the work package and project levels, which can be expressed as either an interval of values with an associated confidence level or as a single contingency value. The overall outcome is improved accuracy in predicting work package and project contingency and freedom from reliance on historical data.

During the past year, Capital Power has successfully implemented FCD© on a major project and will continue to work closely with the IRC to further enhance its capabilities. Future research will explore methods to account for correlation between risk and opportunity events as well as expanding functionality to weight experts' opinions in order to improve the ease and accuracy of the expert assessment process. Capital Power's vice president of construction, Steve Owens, remarked on the flexibility of the tool, noting that the ability to assess risk and opportunity using linguistic terms is in line with the way Capital Power has traditionally practiced risk assessment and thus facilitates easy integration with their existing processes. Owens also discussed the improved predictability afforded by fuzzy logic, expressing that FCD© is demonstrating itself to be a powerful resource that will help practitioners to spot gaps in contingency allocation early on and to allow organizations to gradually draw down contingency amounts over the life cycle of a project.

With the support of the IRC's industry partners, Dr. Robinson Fayek hopes to eventually develop generalized versions of software tools such as FCD© in order to deliver value to groups within the wider construction industry. "Above all else, the IRC is intended to affect change," she suggests, "both by challenging the boundaries of scientific inquiry and by developing practical applications that will help construction groups to significantly improve their project performance and to maintain their competitive advantage." ■

[1]Figure created by Nasir Siraj, 2016, Department of Civil and Environmental Engineering, University of Alberta, Edmontom, AB.

Partner Profile

Paul de Jong: Facilitating communication and collaboration

Paul de Jong, President, Progressive Contractors Association of Canada (PCA).

byCassandra Ommerli

In November 2015, Paul de Jong was announced as the IRC's newest Management Advisory Committee Chair. Acting as a liaison between NSERC and the participants of the IRC and serving as chairperson of the quarterly meetings of the Management Advisory Committee, Paul plays a major role in facilitating group collaboration. Moreover, his services help to ensure representation of the IRC's wide range of stakeholder perspectives in project planning and discussion. With over 25 years of experience in areas including labour relations, government relations, business development, and strategic management, Paul brings an extensive and diverse background of expertise to his position as Management Advisory Committee Chair.

Outside of the IRC, Paul serves as president of the Progressive Contractors Association of Canada (PCA), an organization that provides advocacy, labour-management advice, networking opportunities, and organizational services to its member companies, which represent more than 25,000 skilled construction workers across Canada. As president, Paul is responsible for the full gamut of the association's national operations; this includes providing oversight on PCA's internal finance and administration as well as ensuring the effective management of its external business areas. Prior to joining PCA, Paul worked with the Christian Labour Association of Canada (CLAC), beginning as a labour relations field representative and eventually moving into roles including regional director of CLAC's Calgary office and provincial director of prairie provinces. In 2010, Paul made the transition from CLAC to PCA, joining Dr. Robinson Fayek's IRC shortly thereafter as PCA's representative on both the Management Advisory Committee and Technical Advisory Committee.

Four years later, Paul has stepped into his new role with the IRC just as planning for the 2017–2021 renewal term commences. He notes that PCA's continued involvement in the IRC has been motivated in part by an understanding that investments in education and in research and development programs are integral to the progression of industry practice and performance. Furthermore, Paul suggests that collaborations such as the IRC are essential in promoting the exchange of knowledge and technologies between industry and academia, which allows for the development products and solutions that move beyond the status quo. For PCA, Dr. Robinson Fayek's unique scholarly work has been particularly compelling: "The fuzzy logic approach provides a fascinating and dynamic means of investigating construction productivity from not only a traditional, quantitative standpoint, but it is also able to capture critical elements that are more subjective in nature."

> "The program has only just begun to explore the potency in areas such as innovation and productivity, which are critical to the growth and modernization of the construction industry."
>
> **—Paul de Jong**
> *IRC Management Advisory Committee Chair*

While Paul expresses confidence in the strong body of research and products developed by the IRC during the current term, he maintains that "the program has only just begun to explore the potency in areas such as innovation and productivity, which are critical to the growth and modernization of the construction industry." For PCA and its members, the value of participation in the IRC is multifaceted. "The program is designed to deliver meaningful results to its partner organizations in the short term," Paul notes, "however, our involvement in the IRC also represents a larger investment in research that will provide industry and government practitioners with the resources necessary to drive further advancement beyond the scope of the program."

> "Young professionals should be encouraged that a construction trade is first and foremost a highly valuable commodity in Canada."
>
> **—Paul de Jong**
> *IRC Management Advisory Committee Chair*

Over the years, Paul has devoted his career to working with organizations that aim to establish a progressive and productive industry environment. Ultimately, Paul remains optimistic about the future of the Alberta construction industry and sees the province as being supported by a foundation of highly skilled and passionate stakeholders. He hopes to motivate the next generation of Alberta's workforce to recognize the versatility of a career in construction and the opportunities it offers for professional growth and advancement: "Young professionals should be encouraged that a construction trade is first and foremost a highly valuable commodity in Canada. Exploring a construction trade may only be the first of many steps in the endless opportunities afforded in this rich and diverse sector." In regards to his own career development, Paul identifies the importance of maintaining a "healthy balance" between meeting the daily, practical requirements of his career and staying focused on the broader strategic issues and developments within the industry. For Paul, a commitment to excellence through willingness to learn and adapt is key. ■

Message from the Chair

Continued from page 1

The IRC team is currently planning a workshop series for mid-2016, which will provide an educational opportunity for industry personnel to learn about the program's key findings from recent studies on labour productivity and organizational competencies; future workshops will showcase the software tools developed to support these studies (more details TBA at ***www.strategic-construction.ualberta.ca***).

During the past year, I was honoured to receive several awards for my scholarly work and other contributions to academia; see our awards summary on page 4. I would like to acknowledge the continued support of the IRC partner base and my hard-working academic team in helping to make these achievements possible through inspiring innovation in my work and challenging me to push boundaries as a researcher. I look forward to new accomplishments from our group in 2016 and beyond.

Looking ahead, I would like to take a moment to discuss our plans for the renewal term. Moving into 2017, the IRC will extend its current work on a number of projects areas, including risk analysis and modeling, productivity analysis and modeling, and construction organizational competencies and project performance; a strong focus will be placed on further enhancing software tools and other applied resources developed during the IRC's 2012–2016 term.

In the upcoming term, we also intend to kick off new projects to explore areas such as capital project productivity, modeling construction crew motivation and behaviour, and the development of an assessment framework to measure the impacts of research and development programs. Moreover, the IRC will continue to investigate the hybridization of fuzzy logic with artificial intelligence and other simulation techniques in order to enhance existing processes, systems, and tools in the aforementioned research areas. Propelled by the rigorous work of our academic team, the knowledge gained from past projects, and insights contributed by our base of new and continuing industry partners, the renewal term is sure to produce resources that are smarter and more powerful than ever before. ■

CONGRATULATIONS

The IRC would like to congratulate Chairholder, Dr. Aminah Robinson Fayek on her achievements in 2015:

- During the past year, the American Society for Civil Engineering (ASCE) recognized Dr. Robinson Fayek's exemplary service to the *Journal of Construction Engineering and Management* with an Outstanding Reviewer Award.
- Dr. Robinson Fayek was also presented with the Stephen G. Revay Award by the Canadian Society for Civil Engineering (CSCE). Issued every two years, this award recognizes the best paper published in *Canadian Journal of Civil Engineering* in areas of construction engineering, construction management, or project management. As a long-standing contributor to the *Canadian Journal of Civil Engineering*, Dr. Robinson Fayek is currently a four-time recipient of the Stephen G. Revay Award, having had her scholarly works recognized in previous years including 2004–2005, 2010–2011, and 2012–2013.

The IRC wishes Dr. Robinson Fayek continued success in 2016. ■

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