



CORS · SCRO

Canadian Operational Research Society

Société canadienne de recherche opérationnelle

The
Bulletin

Volume 56, Number 1 – February 2022

ISSN 0315-1417

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IN THIS ISSUE

Dear CORS members,

In this issue, there are a lot of opportunities to seize this upcoming quarter. The society has open council positions and is seeking nominations for CORS awards and there are many competition submissions to consider. So get cracking and take a look at all the great ways to get involved with CORS right now.

The keynote speakers and plenary events have been confirmed for this year's conference in Vancouver. Please spread the word about the conference and make sure graduate students know about the funding program.

In SIG news, the Health Care SIG is offering a micro-event later this month. Sign up today because it will be here before you know it.

Cheers,

Andrea

Bulletin Editor

Andrea Friars

Elected Officers

President	Jules Comeau
Vice President	Peter VanBerkel
Past President	Michael Pavlin
Secretary	Marco Bijvank
Treasurer	Gregory Paradis
Councillors	Samira Abbasgholizadeh Rahimi (20–22)
	Majid Taghavi (20–22)
	Nadia Lahrichi (21–23)
	Masoud Chitsaz (21–23)

Standing Committees

Awards	Peter VanBerkel
Education	Nadia Lahrichi
Membership Program	Samira Abbasgholizadeh Rahimi
	Peter VanBerkel (chair)
	Fatma Gzara
	Taraneh Sowlati
Public Relations	Masoud Chitsaz
Publications	Joe Naoum-Sawaya (chair), Andrea Friars
SIG Relations	Peter VanBerkel
Past Presidents Advisory Board	Michael Pavlin (chair)
	Jules Comeau
	past presidents

Ad hoc Committees

Practice Prize	Antoine Legrain
Award of Merit	Michael Pavlin (chair)
	Mikael Rönqvist
	David Stanford
Student Paper Competition	Nadia Lahrichi
	Tamon Stephen (Open)
	Andre Cire (Undergraduate)
Financial Planning	Gregory Paradis (chair), Michael Pavlin
	Jules Comeau, Peter VanBerkel
Industry	Masoud Chitsaz (Kinaxis)
	Fredrik Odegaard (Ivey Business School)
	Olivia Sengupta (Kinaxis)
	Jeremy Adamson (WestJet)
Nominating	Michael Pavlin
INFOR Editor	Joe Naoum-Sawaya
Travelling Speakers Program	Peter VanBerkel
Micro Events	Majid Taghavi
	Samira Abbasgholizadeh Rahimi
IFORS Representative	Marco Bijvank

CORS COUNCIL

CORS Council consists of the officers of the society, four councillors, the immediate past president, and the standing committee chairs. Contact information for council representatives is below. See www.cors.ca for a complete listing.

President	Jules Comeau, Université de Moncton, president@cors.ca
Vice President	Peter VanBerkel, Dalhousie University, vicepresident@cors.ca
Secretary	Marco Bijvank, University of Calgary, secretary@cors.ca
Treasurer	Gregory Paradis, University of British Columbia, treasurer@cors.ca
Past-President	Michael Pavlin, Wilfrid Laurier University, mpavlin@wlu.ca
Councillor (2020–2022)	Samira Abbasgholizadeh Rahimi, McGill University, samira.rahimi@mcgill.ca
Councillor (2020–2022)	Majid Taghavi, Saint Mary's University, Majid.Taghavi@smu.ca
Councillor (2021–2023)	Nadia Lahrichi, École Polytechnique de Montréal, nadia.lahrichi@polymtl.ca
Councillor (2021–2023)	Masoud Chitsaz, Kinaxis, masoud.chitsaz@cirrelt.net

SIG, SECTION, & CHAPTER PRESIDENTS

Analytics SIG	Gregory Paradis, University of British Columbia, cors.analytics.sig@01101.io
Forestry SIG	Forough Abasian, FPInnovations, forough.abasian@fpinnovations.ca
Health Care OR SIG	Nadia Lahrichi, École Polytechnique de Montréal, nadia.lahrichi@polymtl.ca
Queueing Theory SIG	Opher Baron, University of Toronto, Opher.Baron@rotman.utoronto.ca
Atlantic	Claver Diallo, Dalhousie University, claver.diallo@dal.ca
Quebec & Quebec Student	Irène Abi-Zeid, Université Laval, irene.abi-zeid@osd.ulaval.ca
Montreal	Nadia Lahrichi, École Polytechnique de Montréal, nadia.lahrichi@polymtl.ca
Ottawa	Dragos Calitoiu, Carleton University, calitoiu@math.carleton.ca
Kingston	Mohan Chaudhry, Royal Military College of Canada, chaudhry-ml@rmc.ca
Toronto	Hassan Anis, University of Toronto, hassan.anis@mail.utoronto.ca
Southwest Ontario	Joe Naoum-Sawaya, Western University, jnaoum-sawaya@ivey.ca
Saskatoon	Hamed Samarghandi, University of Saskatchewan, samarghandi@edwards.usask.ca
Calgary	Owen James, Associated Engineering, jameso@ae.ca
Edmonton	Armann Ingolfsson, University of Alberta, armann.ingolfsson@ualberta.ca
Vancouver	Currently vacant
Winnipeg	Currently vacant
Waterloo Student	Khaled Shah, University of Waterloo, khaled.mostafa.shah@uwaterloo.ca
Montreal Student	Başak Tozlu, Concordia University, basaktozlu@gmail.com
Toronto Student	Maryam Daryalal, University of Toronto, m.daryalal@mail.utoronto.ca

PRESIDENT'S MESSAGE

Dear CORS members,

Days are getting longer and that could only mean one thing: we are getting closer to the next CORS conference. I for one am very excited to be heading to Vancouver in June! Mark your calendars so you don't miss any important deadlines, submit your abstracts, take advantage of early-bird registration rates, and get ready for the first in-person CORS conference since the summer of 2019! The meetings team at INFORMS and our CORS representatives are working hard to bring you the best experience in Vancouver.

Your council has met twice since the last bulletin in November. One of the key news-worthy items to come from these meetings is that our INFOR journal has a new editor in chief. I would like to thank Joe Naoum-Sawaya for accepting this responsibility. He is already hard at work with the editorial board and is already working with the publisher in finding the best way to manage and promote our journal. Many thanks to Elkafi Hassini and Samir Elhedhli for their many years of work building the journal to what it is today.



We are making great strides with our accounting project. Details of what we are doing will be explained to members at the AGM in June. Many thanks go to Greg Paradis, our treasurer, for his tremendous work with Ernst & Young, the accounting firm retained to work for CORS.

So far this year, we have had two micro-events related to the practice of analytics in industry. Thank you to the organizers. At least one more micro-event is planned before the summer conference, so stay tuned for that announcement.

If you have not renewed your membership, please do so as we would love to keep you around for at least another year! Even better, nominations for Council are open. Why not throw in your hat for a seat on Council, where you'll get an opportunity to see how the society is run from the inside?

Please promote our society to your colleagues and invite them to check out what we do. Set your sights for Vancouver in June and take care of yourselves.

Jules Comeau



ANNOUNCEMENTS

Council Corner

This section highlights recent discussions by the CORS Council and motions of particular interest that have been passed.

- Council approved a motion for the process to start a new Student Chapter and new local Section.

CORS Membership

It's time to renew your CORS membership for the year **April 1, 2022 through March 31, 2023**. Fees are due by **April 1, 2022**.

You may be able to use an NSERC grant to pay membership dues for yourself and your graduate students.

Please renew your membership at (http://www.cors.ca/sites/cors_php/en/membership/renewal.php) For more information, please email members@cors.ca



CORS FUNDING OPPORTUNITIES

Graduate Student Funding

<https://cors.ca/?q=content/graduate-student-funding>

CORS funds graduate students attending the CORS Annual Conference, using funds from SSHRC, when available. This funding is subject to availability and the following eligibility criteria:

- Student is a member of CORS, enrolled in a graduate program in a field related to operational research, studying at a Canadian university, or student is a Canadian citizen or permanent resident studying abroad
- Student must attend the CORS Annual Conference and present their registration receipt to receive any funding

The following criteria will be used to determine the amount awarded to each eligible applicant:

- If the applicant is presenting a paper at the conference.
- Travel cost from student's home city to the conference.

Students in the Undergraduate Category of the Student Paper Competition who attend the CORS Annual Conference as finalists or in any other capacity are eligible for partial financial assistance for their travel expenses.

Applicants fill out the online application form. The application deadline is **March 31, 2022**. Applicants who meet this deadline will be notified at least one month before the conference date whether or not their application was successful. For more information, contact Nadia Lahrichi (nadia.lahrichi@polymtl.ca)

Traveling Speakers Program (TSP)

<https://cors.ca/?q=content/traveling-speakers-program>

The TSP enables local sections to bring Canadian OR practitioners / researchers as speakers to their local events. To keep costs in line while maximizing the CORS national profile, CORS sponsorship will be limited to 50% of the total expenses, up to a maximum of \$500 per speaker or \$1000 for a single event (conference, workshop). Other expenses can be covered by the local section. The program of the event must acknowledge the contribution of CORS. The president of the local section must contact the CORS Vice President to obtain approval for funding preferably at least one month in advance of the event date.

Payment will be made by the CORS Treasurer upon receipt of the expense form. The president of the local section fills out the application form and submits the form to Peter VanBerkel (vicepresident@cors.ca)



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Société canadienne de recherche opérationnelle



CORS – INFORMS International Conference

Vancouver, BC

June 5–8, 2022

Website: <http://meetings2.informs.org/wordpress/2022international>

Dear CORS members,

We are pleased to announce that the keynote/plenary and tutorial sessions are all confirmed. Please see the list below for the titles and presenters.

Keynotes and Plenaries

Keynote 1: “Managing supply chains in turbulent times”; Presenter: Hau Lee (Stanford Graduate School of Business)

Keynote 2: “Using operations research to combat human trafficking”; Presenter: Renata Konrad (Worcester Polytechnic Institute)

Keynote 3: “Infrastructure resilience and sustainability”; Presenter: Elise Miller-Hooks (George Mason University)

Keynote 4: “AI and social good”; presenter: Bistra Dilkina (University of Southern California)



Panel 1: “Role of operations research in pandemic preparedness: lessons learned from COVID-19”;
Moderator: Tinglong Dai (Johns Hopkins University)

Panel 2: “Future of quantum computing in optimization”; Moderator: Tamás Terlaky (Lehigh University)

Tutorials (alphabetical order by last name)

Tutorial 1: “The continuous approximation paradigm in logistics systems analysis”; John Carlsson
(University of Southern California)

Tutorial 2: “Inverse optimization: Theory and application”; Timothy Chan (University of Toronto)

Tutorial 3: “Accelerated and Variance-Reduced Primal-Dual Methods”; Jelena Diakonikolas (University
of Wisconsin-Madison)

Tutorial 4: “OR and Analytics for Public Policy: Lessons from the Pandemic”; Peter Frazier (Cornell
University)

Tutorial 5: “Wildfire Management: An Operational Research Perspective”; David Martell (University of
Toronto)

Tutorial 6: “Opinion dynamics on directed random graphs”; Mariana Olvera-Cravioto (University of
North Carolina)

Tutorial 7: “Markov Decision Processes in Health Care”; Steven Shechter (University of British
Columbia)

Tutorial 8: “Analytics for Social Impact”; Phebe Vayanos (University of Southern California)

Tutorial 9: “Causal Inference in the Presence of Network Interference”; Christina Lee Yu (Cornell
University)

The abstract submission is open now. Please check this link for more information on abstract
submission and important deadlines: <https://meetings.informs.org/wordpress/2022international/submit/>

The conference is fast approaching, please share the information about the conference with your
colleagues, students, and friends. In addition, please consider chairing a session and submit your
abstracts as soon as possible.

We look forward to seeing you in Vancouver.

Best regards,

Taraneh Sowlati
Professor
University of British Columbia
Conference Chair

CALL FOR NOMINATIONS 2022–2023 CORS COUNCIL

There are three positions to fill for the 2022–2023 CORS Council.

To nominate a CORS member to serve in one of these positions send their name and contact information by **March 14, 2022** to Michael Pavlin (mpavlin@wlu.ca).

Please make sure your nominee is aware of the nomination. Note that self-nominations are welcomed.

For more details regarding the various positions visit: www.cors.ca in particular, see the Bylaws and Administrative Handbook documents online at www.cors.ca/?q=content/library

All nominees will be contacted and asked to provide a write-up for the May edition of the Bulletin.

Vice-President (President Elect)

The Vice President (one-year term) assists the President, participates in special projects and ad-hoc committees through the year, and takes over the role of President at the following Annual General Meeting (AGM). Only those who have served at least one year on Council are eligible for the office of Vice-President.

Two Councillors (Two-year term)

Four councillors sit on council and participate in the management of the society. Often, councillors are called upon to chair or serve on ad hoc or standing committees and to work on special projects.

CORS AWARDS: CALL FOR NOMINATIONS

CORS AWARD OF MERIT

The Award of Merit acknowledges significant contributions of a current or past member of CORS to the profession of operational research. Significant contributions can include:

- being specially recognized as an operational research practitioner;
- the development of a methodology relevant to the use of operational research;
- the supervision and development of operational research competence in others;
- the promotion of operational research in Canada through talks, presentations, articles, books, or by other means; and
- service to CORS at either the national or local level.

To nominate an individual for the award, please email Michael Pavlin (mpavlin@wlu.ca) by **March 21, 2022** with the nominee's name, affiliation, and a brief statement supporting the nomination. Note that the nominee must be a present or past member of CORS.

ELDON GUNN SERVICE AWARD

The Eldon Gunn Service Award is presented to Members of the Society who have made outstanding contributions of time and service to the Society, at the national or local level, as conference organisers or as editors of CORS publications. Eldon Gunn was a major contributor to the Society since the early 1980s and to operational research in Canada since the 1970s. He was one of the first recipients of the service award in 1987 after serving in Council and acting as conference chair for the 27th CORS Annual Conference in Halifax in 1985. He went on to serve as president of the Society in 1991 and continued his service with passion up until his passing in 2016.

If you know of anyone who has dedicated their time to CORS and who has a longstanding service record, please consider nominating him or her for the Eldon Gunn Service Award. CORS Council urges all local sections to consider and nominate their best candidates. Nominations should include the candidate's name, activities, positions, and corresponding years of service. The Awards Committee will evaluate the submissions and bring forward potential recipients to Council for approval.

Eligibility is determined based on the point system outlined below. As a guideline, winners should be at or above the 2000-point level. Typically, three to four awards will be given each year. In exceptional circumstances self-nominations will be accepted. Previous winners are not eligible for additional service awards. A list of past recipients can be found at www.cors.ca

To nominate an individual for the award, please email Peter VanBerkel (vicepresident@cors.ca) by **March 6, 2022** with the nominee's name, affiliation, and a brief statement supporting the nomination. Note that the nominee must be a present or past member of CORS.

POINT SYSTEM

Responsibility	Points	Responsibility	Points
CORS Council		Publications	
President	500	Bulletin Editor	200
Vice-President	350	INFOR Editor	350
Secretary	300	INFOR Special Issue	250
Treasurer	300	Others	150
Councillor	250		
Appointed Member	200	Local Council	
Past President	250	President	250
		Vice-President	175
International Conference		Secretary	150
Conference Chair	350	Treasurer	150
Committee Chair	300	Others	100
Committee Member	200	Past President	100
National Conference			
Conference Chair	300		
Committee Chair	250		
Committee Member	200		

COMPETITIONS

PRACTICE PRIZE COMPETITION

The Practice Prize Competition recognizes the outstanding application of OR by practitioners in Canada and it attracts quality papers to the CORS Annual Conference.

Award: The Prize Committee will determine, at its discretion, First, Second and Honourable Mention awards and the distribution of up to \$1800 in prize money according to the extent to which the finalists have reported on a completed, practical application with results that had a significant, verifiable and (preferably) quantifiable impact on the performance of the client organization. Every member of the winning teams receives a certificate.

Eligibility: The applicant must be a resident of Canada. The submission must include work completed over the last two years, but the entire project may have taken place over a longer period. The project may include published work, but it cannot have been previously submitted to this competition.

Application Instructions:

By March 8, 2022 submit e-copies of the following to

Antoine Legrain, Chair (antoine.legrain@polymtl.ca):

- An abstract, not exceeding 500 words, outlining the successful application of OR
- A letter from an executive of the client organization attesting that the application had an impact and giving permission for the project to be presented at the CORS Annual Conference
- The names, titles, phone numbers and email addresses of all authors and of at least one executive of the client organization

By March 29, 2022 the judging committee will select up to four finalists according to these criteria:

- The challenge of the application of OR and the significance of the problem
- The quality of the analysis and modeling, and implementation of the results
- The impact on the client organization

By May 10, 2022 the finalists must:

- Submit a detailed written report, not exceeding 25 pages in the body, presenting a "case history" of the project describing its development from start to finish and focussing on the challenges and results
- Submit a one-page project summary including key messages and best practices, suitable for publication in the CORS Bulletin and on the CORS website
- Present the project at the Practice Prize Sessions at the CORS Annual Conference

Based on the written report and the oral presentation, the judges will determine the prizes to be awarded and announced at the banquet. The committee reserves the right not to award any prize.



STUDENT PAPER COMPETITION

Description:

Each year CORS conducts a student paper competition to recognize the contribution of a paper either directly to the field of operational research through the development of methodology or to another field through the application of operational research. The competition serves to showcase the high quality of OR education in Canada as well as the excellence of the new generation of operational researchers. Prizes are awarded in two categories: Undergraduate and Open.

Requirements:

The applicant must be enrolled as a full-time student in a Canadian institution, in an undergraduate, masters, or PhD program during the school year 2021–2022. Canadians who are studying outside of Canada are also eligible. Papers where all applicants are undergraduates may be submitted to either category: Open or Undergraduate, but not to both. Papers where some authors are graduate students must be submitted to the Open category. MBA students (and other specialized master students) must submit to the Open category with their applied projects. Published papers are eligible for the competition only if their initial submission date (for publication) is after the previous year's CORS Annual Conference.

All competitors should apply for CORS student funding by the deadline, in case they become a finalist (<https://cors.ca/?q=content/student-funding-cors-conference-financement-des-étudiants-au-congrès-de-la-scro>)

Instructions:

Open Competition

Chair: Tamon Stephen (spc@cors.ca)

Submit entries by **April 5, 2022** via EasyChair: <https://easychair.org/conferences/?conf=corsospc2022>

Undergraduate Competition

Chair: Andre Augusto Cire (andre.cire@rotman.utoronto.ca)

Submit your intent to participate by **March 1, 2022** by sending an email with the title and abstract to andre.cire@rotman.utoronto.ca

Deadline to submit your full paper: **April 5, 2022**

Please kindly submit your manuscript through EasyChair at:
<https://easychair.org/my/conference?conf=corsspuc2022#>



STUDENT PAPER COMPETITION

The entry includes:

1. Abstract of 200 words or less. Author's name, address, phone number, and email address. Make sure the abstract clearly highlights the motivation, contribution, and potential impact of the paper.
2. Academic institution and supervisor's name, if applicable.
3. Indication of whether the team is planning to attend the CORS Annual Conference if selected as Finalists. Note that papers selected as Finalists must be presented at the conference in order to further be considered for First Prize or Honourable Mention.
4. A PDF copy of the paper:
 - No longer than 35 pages (with minimum 1-inch margins, maximum 34 lines per page, and minimum font size of Times 11) including all figures, tables, appendices, and references.
 - The submitted paper must not contain any information identifying the authors or their institutions.
5. An email from the supervisor indicating that the participant is the first author of the paper should be sent to the competition chair. Supervisors must agree to be on the refereeing committee for the competition, which requires evaluating three competition papers in April. If this is not possible, the supervisor should identify a suitable alternate committee member.

Selection Criteria:

- Contribution of the paper either directly to the field of operational research through the development of methodology or to another field through the application of operational research.
- Originality.
- Writing style, clarity, organization, and conciseness of the paper.

Awards:

- Prizes are awarded per paper. Cheques are sent to the first authors (unless otherwise specified), and allocation of prize money is up to the co-authors.
- Open Category: First Prize \$500, Honorable Mention \$100. One award per team.
- Undergraduate Category: First Prize \$200, Honorable Mention \$50. One award per team.
- All papers selected as Finalists receive a certificate.
- If an undergraduate student wins the open competition, no undergraduate prize will be awarded. Honourable mentions will be provided if there is no winner.



CORS SPECIAL INTEREST GROUPS

CORS Council approved a policy on Special Interest Groups (SIGs). A SIG provides a mechanism to promote CORS, the SIG area and the SIG members, as well as the opportunity for CORS members with common interests to interact and network.

Analytics SIG

Gregory Paradis, cors.analytics.sig@01101.io
University of British Columbia
www.cors.ca/SIG/Analytics

Forestry SIG

Foroogh Abasian, foroogh.abasian@fpinnovations.ca
FPInnovations
www.cors.ca/SIG/Forestry

Health Care Operational Research SIG

Nadia Lahrichi, nadia.lahrichi@polymtl.ca
École Polytechnique de Montréal
www.cors.ca/SIG/HCOR

Queueing Theory SIG

Opher Baron, Opher.Baron@rotman.utoronto.ca
University of Toronto
www.cors.ca/SIG/Queueing

If you would like to join a SIG, contact the people listed above, or indicate that you would like to join when you renew your CORS membership.

CORS encourages members with common interest in an area within or related to operational research to form additional SIGs.

More information about SIGs can be found online at www.cors.ca/?q=content/communities

If you are interested in forming a SIG in a particular area, contact:

Peter VanBerkel (vicepresident@cors.ca)

SIG NEWS

Health Care OR SIG

Micro-event: Health Care Operations Research SIG Student Presentation Prize

The CORS Health Care Operational Research SIG oral presentation competition for graduate students emphasizes the importance of presentation skills and provides an opportunity for students to receive formal feedback, learn best practices from their peers, and be recognized for excellence in this area.

The goal is to have students demonstrate mastery of coherent and engaging presentations describing a completed research project on a significant healthcare topic within a ten-minute time limit. This year competition will be held during an online CORS micro-event organized by the HCOR SIG and will be followed by a seminar on how to design effective scientific presentations, including tips and tricks from experienced professors (further information will be provided soon).

Submission process

The competition will involve **three-minute self-videotaped submissions** judged on the presentation quality. The deadline for self-videotaped presentations is **February 18, 2022**, with the announcement of finalists expected by **February 25, 2022**. The self-videotaped presentation should be submitted by email to valerie.3.belanger@hec.ca

Presentation competition

Judge-chosen finalists will be invited to present their **ten-minute presentation** live at the online CORS micro-event on **March 11, 2022, from 1:00 p.m. to 3.30 p.m.**

This is a free event, but registration will be required (information will be provided soon).

If you have any questions, please feel free to contact us at valerie.3.belanger@hec.ca

Looking forward to seeing you all!

A Decision Support System for Scheduling the Canadian Football League

Kent J. Kostuk, Federated Co-Operatives Limited, Saskatoon

Keith A. Willoughby, University of Saskatchewan

Reprinted from the CORS Bulletin Volume 45, 1 (February 2011)

The 8-team Canadian Football League (CFL) features an 18-game regular season played between late June and early November. The regular season schedule is manually created using an iterative process between league management, teams and a television sports broadcaster.

The problem of developing suitable schedules presents challenges for the CFL. In particular, league franchises submit specific days—known as "stadium blocks"—in which they are unable to host games. Moreover, some franchises play their home games in multi-tenant facilities, thus suggesting that league management may have to revise schedules based on the requirements of other events. Football games are televised by a single broadcaster which limits the number of games that may be scheduled on a single day. Further, time zone restrictions dictate that particular pairs of teams may be unable to simultaneously host games on a given day. League management must provide each team with an appropriate number of days off between their games so as not to generate a competitive imbalance by forcing a team to play consecutive contests in quick succession. The league desires to schedule particular matchups around key holidays (e.g. Labour Day). It also seeks to limit the number of times two teams face each other during consecutive weeks (so-called "back-to-backs"); however, such instances are quite likely for an entity such as the CFL featuring a relatively small number of teams. The objective function for this scheduling problem is ill-defined, thus making the notion of a particularly "good" schedule unclear. Finally, regular turnover within team management implies that different individuals may be interfacing with league officials on schedule creation on a year-to-year basis. This lack of continuity disrupts schedule development.

We approached the CFL about applying OR to this particularly challenging problem and collaborated with league officials on the construction of the 2010 regular season schedule. Specifically, we developed a MIP-driven decision support system that provided league officials with multiple schedule versions in relatively quick fashion. We selected a basic 0-1 IP formulation in which the decision variable $x(i,j,k)$ took on the value of 1 when team i visits team j on day k . We introduced a series of modeling constraints, broadly classifying them as: structural, stadium blocks, preassignments, and pattern assignments.

Structural constraints represented the basic logic of the schedule. They included features such as scheduling at least one game every Friday, requiring all teams to play nine games at home and nine games on the road, and scheduling four games each week (except for weeks eight and nine ("bye weeks") in which only two games are slated).

Stadium blocks represented a list of dates during the season in which any of three mutually exclusive outcomes could occur: the team prefers to play a home game (i.e., preferred dates), the stadium is not available (therefore, the team cannot be scheduled to play at home), and the stadium is available but the team would prefer not to play.

Preassignments involve instances in which the CFL has predetermined which teams will play against each other on particular dates. For example, the league features several rivalries wherein specific pairings are an annual ritual at set times (e.g., Saskatchewan plays Winnipeg around the Labour Day weekend). These games are promoted heavily, help teams to maximize attendance, and enhance league ratings.

Pattern assignments include pairings that follow a pattern but are not constrained to occur on specific dates or between specific teams. Examples of such assignments include:

- teams that play on a Sunday do not play on the following Thursday or Friday (to ensure a sufficient number of days of rest before the next scheduled game);
- teams playing on a Monday do not play the following Thursday, Friday, or Saturday;
- teams do not play on the road more than two weeks in a row, or two weeks at home;
- teams should not finish the season with a home-home or away-away pattern.

Although classifying the constraints in this hierarchical manner was unnecessary from an analytical perspective, it was appreciably invaluable from an organizational viewpoint. As we spent time with the decision maker, we were able to better communicate each other's requirements and develop a more sophisticated model. The classification system provided a basis for expanding and reevaluating the model. Initially, we introduced structural constraints. If the model could not be solved with only considering the structural constraints, this would indicate that the league's basic requirements were infeasible. Fortunately, this was never the case.

Once we established that the structural constraints provided for a feasible schedule, the next step was to introduce the stadium blocks. This permitted us to factor in the requirements of the teams and the facilities they shared with other tenants. Any infeasibilities identified at this time resulted in a review of team preferences and of stadium availability.

We next introduced preassignment constraints. Recall that these assignments are league mandated. If their introduction induced infeasibilities, then trade-offs associated with these preassignments and the resulting impossibilities would need to be addressed. In practice, this was not an issue. The most likely reason the preassignments proved feasible is that most of these game pairings are long-held rivalries based on rich CFL tradition. Had they been problematic, they would not have survived the annual process associated with the scheduling efforts of previous years.

Admittedly, the pattern-assignment constraints were the ones most likely to generate conflicts with previously introduced restrictions. Given stadium availabilities, it was not always possible for a team playing on a Sunday to be given a rest period until the following Saturday. At this point, the decision maker must draw upon past experience and determine how best to trade off these various inconsistencies. For example, he could use an alternative set of rules or constraints that would generate a schedule without compromising the intended pattern of games.

We set up our decision support system as a 0-1 integer optimization model (consisting of 5,320 binary variables) using the mathematical programming language (MPL) modeling system with the 2008 version of FICO's XPressMP on a Lenovo ThinkPad T42—Pentium M735. In this MPLXPressMP environment, we were able to solve the model in roughly two minutes, including the time required for data transfer activities. The actual optimization period was in the range of 30 seconds or less. These rapid solution times—a far cry from the one-day effort required under the league manager's manual approach—enabled us to feed multiple versions in quick succession to CFL headquarters.

When solving our models, we found it particularly helpful to initially optimize on a specific performance measure, for example, the number of intradivisional matchups during the season's final four weeks. After determining the optimal value for this criterion, we would subsequently set this value as a constraint and then reoptimize on another performance measure (e.g., the minimum number of

Thursday games). This enabled us to identify how we could obtain the best performance on a specific measure, while ensuring reasonably good outcomes on the first criterion.

During an intense period between December 10, 2009 and January 20, 2010, we provided the official scheduler with 22 schedule versions. The respective versions resulted from the modeling of different objective functions (e.g., maximizing the number of Friday games), or from incorporating additional constraints the league provided to us in our real-time, iterative work. Examples of such constraints could be new requirements that the league wanted to include in a version (e.g., restricting Team A from hosting two home games in consecutive weeks) or revised stadium availabilities.

The luxury of assessing a fair number of acceptable versions was appealing to the league scheduler. Trade-offs became evident with our different versions. Achieving benefits along one dimension came at the expense of another measure. For example, we demonstrated that the league could lessen the number of back-to-back matchups, but this would necessitate fewer preferred dates and more Friday games. In addition, the league could reduce the number of Thursday contests, but this would entail fewer intradivisional matchups, more Friday games, and a drop in the number of Sunday contests.

A further example of our approach's advantages involved its ability to inform league management of proper courses of action to mitigate several stumbling blocks that emerged as the league began composing the schedule. Because of stadium availability issues, one franchise (Montreal) was forced to begin the 2010 season with three consecutive road games. League management duly recognized that Montreal's situation was inevitable. However, it was concerned that such a scenario would oblige another team to start its season with three consecutive home games. This would entail a team playing one-third of its entire home game complement by the middle of July, hardly a result that would engender ongoing fan interest throughout the remainder of the season. By virtue of our model's results, we demonstrated that a team would be forced to start its season with a three-game home stand, given the current (stringent) stadium availabilities throughout the league. Only by obtaining relaxed stadium availabilities could the number of home games be sufficiently distributed during the first three weeks of the season so that no team would start with three consecutive home contests. The league used this finding to request various franchises to submit more flexible stadium availabilities for the start of the season.

Obviously, regardless of our assistance, the league would have generated and released an actual schedule. However, our analysis reduced the labour hours required by the scheduler to create and disseminate the final schedule. In previous seasons using his manual schedule creation method, he readily admitted that he would only end up with two or three suitable versions that could be circulated to the teams and television broadcaster for further scrutiny. With our approach, he enjoyed the luxury of several acceptable versions that league stakeholders could evaluate. The league considered our various versions and subsequently fine-tuned them manually to create the final 2010 schedule. We anticipate continuing our relationship with the league in its development of the 2011 regular-season schedule. Our experiences with the CFL demonstrate the successful role that OR modeling can play in informing actual practice.

MEETINGS AND CONFERENCES

CORS Business Meetings

June 16, 2021	Council Meeting, Teleconference
Sep 17, 2021	Council Meeting, Teleconference
Nov 19, 2021	Council Meeting, Teleconference
Jan 21, 2022	Council Meeting, Teleconference
March 18, 2022	Council Meeting, Teleconference
May 20, 2022	Financial Planning Committee Meeting
TBA, 2022	Council Meeting (Conference)
TBA, 2022	Council Meeting (Conference with SIGs, Sections, Chapters)
TBA, 2022	CORS AGM (Conference)

CORS Annual Conferences

June 5–8, 2022	CORS-INFORMS International Conference Vancouver, BC http://meetings2.informs.org/wordpress/2022international
TBA, 2023	CORS Annual Conference Joint with Optimization Days Montreal, QC

WWW Conference Listings

CORS: www.cors.ca/?q=content/cors-annual-conferences

INFORMS: <https://www.informs.org/Meetings-Conferences>

IFORS: www.ifors.org/web

Netlib Conference Database: <ftp://ftp.cc.ac.cn/netlib/confdb/Conferences.html>

SIAM: www.siam.org/meetings/calendar.php

POMS: <https://pomsmeetings.org>

EURO: www.euro-online.org/web/pages/460/calendar



THE NEXT ISSUE

The next issue of the Bulletin will be published in **May**. Contributions to this issue, especially news on the activities of local sections or CORS members, should be submitted by **April 22, 2022** to:

Andrea Friars
Editor, CORS Bulletin
Email: AndreaFriars@gmail.com

The preferred method of submission is by an MS Word attachment to an email.

CORS BULLETIN TRANSLATION POLICY

Items that are CORS business will be translated into English and French. All other items will be published in the language they are submitted in.

CORS BULLETIN ADVERTISING POLICY

Ads cost \$120 per page, proportional for fractional pages. Logos and prepared layouts can be accommodated. This fee also includes distribution of the advertisement on the CORS Mailing List. Direct inquiries to the Editor.

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As a benefit of membership, members may use the CORS Mailing List to transmit messages, announcements, and job postings to the entire membership or to a targeted subgroup such as a local section. For example, you can send

- messages regarding the activities and business of the society
- announcements about conferences, conference sessions, special journal issues, seminars, or other activities if these are related to operational research in its broadest sense
- job postings of general interest to CORS members

The Mailing List is not used for commercial purposes, and all messages are vetted before they are sent out. To submit items to the Mailing List, please email members@cors.ca

For non-members, a fee of \$60 is charged for the distribution of job postings and other announcements or messages of interest to the CORS membership.



The **Canadian Operational Research Society** was founded in 1958. Its goal is to advance the theory and practice of OR and to stimulate and promote contacts between people interested in the subject.

Publications: A quarterly scientific journal called *INFOR* and a news *Bulletin*.

Meetings: An annual national conference with an award ceremony, occasionally organized jointly with an international society (IFORS, INFORMS), and numerous local events organized by local sections.

Local Sections & Chapters: CORS has twelve local sections located throughout Canada and four student chapters.

Awards and Prizes: CORS presents the following annual awards and prizes at its conference:

Award of Merit for significant contributions of a present or past member of CORS to the profession of OR.

Harold Larnder Award to an individual who has achieved international distinction in OR.

Omond Solandt Award to an organization, private or governmental, that is deemed to have made an outstanding contribution to OR in Canada.

Practice Prize for the challenging application of the OR approach to the solution of applied problems.

Eldon Gunn Service Award for outstanding contributions of time and service to the society.

Student Paper Competition to recognize the contribution of a paper either directly to the field of OR through the development of methodology or to another field through the application of OR.

Graduate Student Funding: CORS encourages attendance of graduate students at its conference by providing partial funding. Visit CORS website for details.

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To join CORS: Go to the CORS website and join online by credit card using the form found under membership or complete the PDF application form found on the CORS website and mail it with payment to the address below.

Fees: Member \$110; Retired Member \$55; Student Member \$45 (including post-doctoral fellows)

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