DECISION ANALYSIS TODAY

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The newsletter of the INFORMS Decision Analysis Society

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President's Letter

Jeffrey Keisler

Hello and happy holidays.

Since my last letter in August, we had a very successful DAS cluster at the INFORMS conference. Attendance was strong, many sessions, and much positive energy. What a group! Thanks again to Cluster co-chairs Victor, Alec and Jag. Victor will be repeating for the 2014 cluster, joined by Debarun Bhattacharjya and Eric Bickel (serving double duty as a third co-chair in anticipation of an extremely active cluster in San Francisco).

We thank outgoing DAS council members Canan Ulu and Seth Guikema for their extensive service over the last three years, and we welcome new council members Frank Koch and Jun Zhuang who are both hitting the ground running. We also thank others who have provided service to DAS, including all of our award committees chaired by Jim Dyer (Ramsey), Frank Koch (Practice), Robin Dillon-Merrill (Publication), and Lea Deleris and Jun Zhuang (Student Paper). In addition, the DA Journal has a new award of its own, and we thank Jason Merrick for chairing its first year. Congratulations to all of the award winners, listed elsewhere in this issue.

For next year, the chairs (tentatively) will be Seth Guikema (Student Paper), Jim Matheson (Ramsey), and Ali Abbas (Publication). Frank Koch is chairing a group strategizing about the Practice Award and how we might leverage it for further outreach to the practitioner community.

We are fortunate to have Heather Rosoff and Jun Zhuang continuing as editors of this publication for another year. But we are also starting to think about transitions.

I hope you have all taken note of the announcement of the first DAS research conference, coming in June under the leadership of Jason Merrick.

At the DAS Council meeting and Business meeting, among other things, we discussed the results of the membership survey you may have seen from last fall. We found in this survey that members are satisfied, but we can do better, especially with some subgroups; the survey responses were also full of good ideas and suggestions. So, we held an open strategic planning meeting Tuesday morning for early risers at the INFORMS conference and came up with a number of developments (thanks to Andrea Hupman for helping me prepare the notes on this meeting):

1) To build on the momentum from last year, we (Vicki Bier) are working on a job description for a publicity officer. We (Vicki) also took the opportunity of the annual awards to get some press for DAS through recipients' organizations.
2) We are exploring ways to create more structure for student activities and involvement. There are plenty of great ideas ranging from conference activities to creation of professional opportunities, but implementing them will require a more specific plans and responsibilities.
3) There are several directions to improve our visibility and links with DA communities around the world, and a number of members willing to help make those connections with organizations and conferences in Asia (Jun Z and others), Europe (Alec Morton, Gilberto Montibeller and Johannes Siebert), and Latin America (Gilberto Montibeller). Please follow up with them if you have any interest or ideas along these lines.
4) We also discussed possibilities of a summer school that could support our objectives of serving students and making international connections. This interesting idea is in an early exploratory stage. In the short term, we may be able to take some smaller steps such as student tutorials. More on this as it develops.
5) We are exploring ways to increase non-dues revenue sources both to improve our stability and to have the flexibility to undertake and support new initiatives. This could range from adding donation capabilities online to holding revenue generating events. Yael Grushka-Cockayne has been exploring this and we hope to have more to report by the next issue.
6) We discussed the research conference – ideas for this year and for developing it in future years.
7) We discussed extensively the connection between DAS and the practitioner community – there is a strong feeling that we should improve this connection for the health of the field. To that end, we are working closely with leadership of the Society of Decision Professionals around issues such as the DAAG Conference, webinars, and the INFORMS conference. With respect to the latter, we are working with the Cluster organizers to structure something new for this year's conference to allow for creative ways for the two groups (academic & practitioners) to interact with and inspire one another.
8) We discussed the position of DA in education and curricula. We feel DA education has a lot of potential at this point in time, but that it is not currently prominent, so it is moving up the agenda for next year.

9) Finally, with our web and social media strategy, it seems that changes are starting to happen in the INFORMS system and there are a number of ways we will be able to leverage that. Jay Simon and Eric Bickel are keeping on top of that, and as is develops there will be opportunity and need for DAS members to get involved by providing content and editing.

That's where we are on the threshold of 2014. May you cross that threshold in good health, peace and wisdom!

Letter from the Editors

Heather Rosoff, Jun Zhuang, and Jing Zhang

Hello everyone,

We hope that everyone had a great holiday and happy New Year! We also want to say how nice it was to see and meet everyone this year at all the DAS events at this year's INFORMS meeting! With the New Year comes the first issue of the newsletter in 2014.

For starters, we open with a brief photo summary of DAS activities at INFORMS. This is followed by a summary of the December issue of Decision Analysis provided by Rakesh Sarin and Kelly Kophazi. Next we travel around the world where Matthias Seifert introduces us to our DA colleagues and the activities they engage in at the Federal University of Pernambuco (Brazil). Returning back to the United States, in the DA Practice column, Bill Klimack has invited Don Kleimuntz, the current president of the INFORMS Analytics Section, to share his thoughts on how decision analysts have a key role in the developing field of analytics. Next SDP asks for us to save the date for the DAAG 2014 Conference, scheduled for March 26-29th in Boston. This is followed by the Research Column where Debarun Bhattacharjya has received a contribution from Jyrki Wallenius on the importance of behavioral decision research in the MCDM context. As always, this is followed by the Ask DAS column, where John Coles and Florian Federspiel provide a quick look at the current state of improving decision analytic skills in society at large through interviews with Chris Spetzler, executive director of the Decision Education Foundation in the US, as well as Nadine Oeser, chair of Wahlweise e.V. in Germany. We close this issue of DA Today with a guest column contribution from Janne Kettunen who asked Ms. Fahimeh Ziarati Omid to provide a brief overview of how decision analysis tools are used to manage projects in Iran.

As always, the editorial team and column editors themselves are looking for feedback, ideas, and suggestions for the newsletter. So please, don't be shy - we would love to hear from you! On that note, we hope that your Spring semesters are starting off well!

Enjoy the read,

Heather, Jun, and Jing

Upcoming Conferences

February 20, 2014
European Decision Professionals Network (EDPN), Erasmus University (EUR) in Rotterdam
http://www.edpn.org/wp/?page_id=398

May 31 - June 3, 2014
2014 Industrial and Systems Engineering Research Conference (ISERC), Palais des Congrés de Montréal, Montréal, Canada
http://www.iienet.org/Annual2/

June 16, 2014 – June 18, 2014
Advances in Decision Analysis Conference
Georgetown University
Washington, D.C.
https://www.informs.org/Community/DAS/DAS-Conference

June 30, 2014 – July 2, 2014
Foundations of Utility and Risk (FUR) conference XVI, Erasmus University, Rotterdam, the Netherlands
http://www.eur.nl/ese/fur2014/

July 13, 2014 – July 18, 2014
20th Conference of the International Federation of Operational Research Societies, Centre de Convencions Internacional de Barcelona – CCIB Rambla Prim 1-17 08019 Barcelona
http://www.ifors2014.org/

2013 INFORMS *DAS* Awards

Congratulations to **Peter Wakker** on receiving the 2013 Frank P. Ramsey Medal!!

Congratulations to **William J. Haskett** on receiving the 2013 DAS Practice Award!!

Congratulations to **Ahti Salo**, **Jeff Keisler**, and **Alec Morton** on receiving the Decision Analysis Publication Award!!

Congratulations to **Ali Abbas** on receiving the runner-up award for the 2013 Decision Analysis Publication Award!!

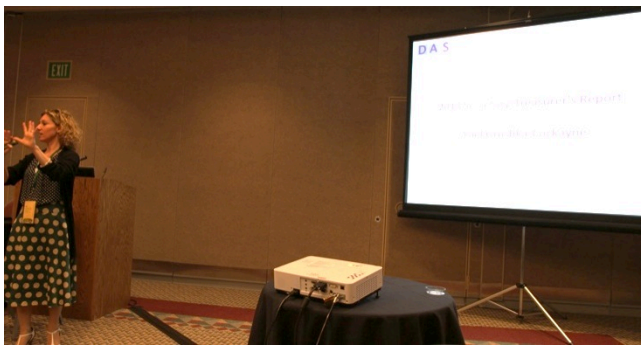
Congratulations to **Chen Wang** on receiving the 2013 DAS Student Paper Award!!

Thanks to **Seth Guikema** as an outgoing DAS council member!!

Thanks to **Canan Ulu** as an outgoing DAS council member!!

DAS Highlights

Kevin McCardle presenting at the DAS Business Meeting.



Yael Grushka-Cockayne presenting at the DAS Business Meeting.

Ali Abbas presenting at the DAS Business Meeting.

Jay Simon presenting at the DAS Business Meeting.

Vicki Bier presenting at the DAS Business Meeting.

Jason Merrick presenting at the DAS Business Meeting.

Jun Zhuang presenting at the DAS Business Meeting on *Decision Analysis Today*.

Carl Spetzler was presenting at the DAS Business Meeting.

Frank Koch and Bill Klimack presenting at the DAS Business Meeting.

DAS Strategic Meeting on Tuesday morning.

…and still time for fun.

Social time before the DAS Businiess Meeting.

Call for Papers

ISBA-George Box Research Workshop on Frontiers of Statistics, The George Washington University, Washington D.C., May 20th-22nd, 2014. The ISBA-George Box Research Workshop on Frontiers of Statistics is co-organized by the ISBA Section on Economics, Finance and Business, the Section on Industrial Statistics, and the Section on Objective Bayes. The program will highlight currently topical and challenging research linked to many of the areas Box worked in. In part, this will recognize the contributions of George Box in Bayesian statistics and his legacy in terms of impact and connections with many other scientific research areas. Focus areas include: Dynamics and Control; Design and Experimentation; Time Series and Forecasting; Industrial, Commercial and Other Applications; Model Assessment and Criticism; Objective Bayes and Bayes/frequentist Interfaces; and others.

The workshop will feature invited and contributed talks as well as contributed poster presentations. Some preliminary information about the workshop can be found at the web site: http://business.gwu.edu/decisionsciences/i2sds/conferences.cfm.

People interested in presenting a contributed paper or poster are kindly invited to send an abstract by December 15th, 2013 to soyer@gwu.edu. A limited number of papers will be selected by the organizing committee as contributed talks, while all others will presented at the evening poster session and workshop reception. The workshop is endorsed by ISBA and co-sponsored by the Institute for Integrating Statistics in Decision Sciences, The George Washington University.

Position Announcement

USC Announcement of CREATE Director/Professor Search

Director, National Center for Risk and Economic Analysis of Terrorism Events

University of Southern California

The University of Southern California (USC) seeks a prominent scholar to lead the National Center for Risk and Economic Analysis of Terrorism Events (CREATE). CREATE was the first university-based Center of Excellence funded by the Department of Homeland Security (DHS), with a mission to improve the Nation's decisions to reduce terrorism risks through the advancement of risk and economic science. Now in its ninth year, CREATE has an annual DHS funding base of $3 million plus significant funding from other sources to perform independent research on a broad set of threats to society, including natural disasters.

The Director of CREATE should have an accomplished research record in risk analysis, economics or related fields (e.g., operations research, management science, public policy). Experience with managing an interdisciplinary research center is also important. CREATE is a joint center of the Viterbi School of Engineering and the Sol Price School of Public Policy, and it is expected that the Director will receive a joint tenured or tenure-track faculty appointment, with the primary appointment in the School most closely aligned to the candidate's field of study.

Applications must include a letter summarizing the candidate's experience in the designated fields, a curriculum vitae, a one-page statement on current and future research, and names of at least four professional references. All applications will be held in the strictest confidence. Candidates should apply via the on-line application website:

http://create.usc.edu/2013/12/usc_seeks_next_director_of_cre.html

Interested individuals are welcome to contact the chair of the search committee, Detlof von Winterfeldt, for further information at (949) 436 1775 or at his e-mail, winterfe@usc.edu. Please do not provide letters of reference or copies of publications until requested to do so. The review process will begin immediately and continue until this position is filled.

USC is one of the world's premiere research universities, and the Price School and the Viterbi School are major contributors to the university's reputation. The Price School, one of the nation's top schools of public policy, is unique in having integrated within one school the strategic intellectual and problem-solving resources needed to address society's most pressing contemporary issues. Price has more than 50 full-time faculty members and an endowment of over $165 million. It provides an exceptionally rich research environment, with over $40 million in active funded research. Much of the research activity takes place under the auspices of its nationally and internationally known research centers and groups. For more information, see www.usc.edu/schools/price. The Viterbi School is among the top engineering schools in the world. More than a third of its 177 tenured/tenure-track faculty members are fellows in their respective professional societies and 35 affiliated faculty members have been elected to the National Academy of Engineering. The School is home to over 45 research centers and institutes, including the Information Sciences Institute (ISI), two National Science Foundation Engineering Research Centers, and an Energy Frontiers Research Center (EFRC) supported by the Department of Energy. USC Viterbi faculty conducts research in leading-edge technologies with annual research expenditures typically exceeding $180 million (go to http://viterbi.usc.edu).

The University of Southern California strongly values diversity and is committed to equal opportunity in employment. Women, men, and members of all racial and ethnic groups are encouraged to apply.

Ramsey Medal Announcement

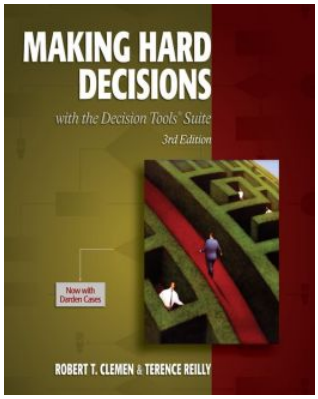
Peter Wakker has been selected to receive the 2013 Frank P. Ramsey Medal, which is the highest award of the Decision Analysis Society. It was created to recognize distinguished contributions to the field of decision analysis. These contributions can be internal, such as theoretical or procedural advances in decision analysis, or external, such as developing or spreading decision analysis in new fields.

Peter Wakker is a professor of decisions under uncertainty at the Department of Econometrics of the Erasmus School of Economics (ESE) where he is director, jointly with Professor Han Bleichrodt, of the research group Behavioral Economics. He works in behavioral economics, primarily on the differences between normative and descriptive decisions, and on decisions under risk and uncertainty.

Wakker has published in leading journals in economics, business, medicine, psychology, statistics, and mathematics. In addition to his many research articles, he recently published the book Prospect Theory: For Risk and Ambiguity (Cambridge University Press, 2010). He was recognized as the best-publishing Dutch economist in the years 1994, 1998, 2003, and 2007, and was ranked 90th in the world in the ISI's most cited scientists in economics and business in 2003. He received a Medical Decision Making Career Achievement Award in 2007. He also won the DAS Best Publication Award in 2002 and 2003, and recently served as Departmental Editor for Decision Analysis for Management Science.

The Ramsey Medal award committee for 2013 was Jim Dyer (Chair), David Bell, Jim Smith, and Carl Spetzler.

New Book Announcement



Making Hard Decisions with Decision Tools, 3rd Edition, is now available. Hard copies can be obtained through your local bookstore or directly from the publisher at www.cengage.com. Electronic copies are available from the publisher as well as online booksellers such as Amazon, Barnes and Noble, and AbeBooks. Major changes to the text include the following:

- Software and tutorials are updated to Palisade's DecisionTools Suite 7.0.
- Addition of several Darden cases at the end of each of the three major sections of the text.
- Chapters 5 (Sensitivity Analysis) and 11 (Monte Carlo Simulation) have been completely rewritten.
- Thanks to Sam Bodily, Chapter 6 has been revised to focus on organizational use of decision analysis, and the all-new Chapter 13 covers Real Options.
- Thanks to Jeffery Guyse, material on behavioral decision theory has been updated in key chapters.
- The text, problems, and examples have been revised and updated throughout.

New book on Project and Portfolio Decision Analysis and Risk Management

New book "ProjectThink" by Lev Virine and Michael Trumper was published by Gower (UK). "ProjectThink" is a book for project managers who want to use decisions and risk analysis to solve their real life problems. Project management is the art and science of human interactions. Projects are constantly beset by problems, often caused by seemingly small mistakes which collectively lead to larger issues. ProjectThink identifies and explains the paths of those intentional and unintentional actions that lead to trouble. Examples that portray different projects, real-life stories, and popular culture will help readers acquire the essential knowledge and skills required for effective project decision-making. For more information about the book please visit www.projectdecisions.org or the publisher's web site http://www.ashgate.com/default.aspx?page=637&calcTitle=1&isbn=9781409454991&lang=cy-gb.

Professional Postings

INFORMS Wants You to Become CAP® Certified

Certified Analytics Professional (CAP®) is the new vendor-, application-, and software-neutral analytics certification offered by INFORMS, the world's largest professional association devoted to analytics. Certification is designed to enhance the credibility of the analytics professional profile and separate you from the crowd. Surveys show that certification has a positive impact on salaries and continued professional development. See other benefits of certification. Be among the first to earn the prestigious CAP® designation. Upcoming in-person, paper and pencil exams are scheduled for Toronto on Dec. 12, Northern Virginia on January 11, Tuscaloosa, Alabama on January 29, Philadelphia on March 6, Boston on March 29, Las Vegas on March 30, and San Jose, California on June 21. Also watch for computer-based testing at testing centers across North American in 2014. It is easy to apply.

Not sure analytics certification is for you? Take a look at our Candidate Handbook online. It includes detailed instructions on eligibility criteria, how to apply, prepare, earn, and use your new CAP® credential. Take a look at the 24 sample questions to help you judge your readiness, but remember, you don't have to get them all right to pass the exam. The detailed Analytics Job Task Analysis will give you a good idea of what the exam will cover. We have also just released the CAP study guide. CAP study guide is an easy and efficient way to prepare for the exam. Questions? See Frequently Asked Questions and then Contact INFORMS.

Decision Analysis Journal

The *Decision Analysis* December 2013 issue...
http://da.journal.informs.org/content/10/4.toc (link will activate upon publication)

From the Editor: Median Aggregation, Scoring Rules, Expert Forecasts, Choices with Binary Attributes, Portfolio with Dependent Projects, and Information Security
Rakesh K. Sarin

The December issue of Decision Analysis contains six articles. Our first three papers aim to improve the quality of probability judgments. Hora, Fransen, Hawkins, and Susel argue that medium aggregation of distribution functions works better than mean aggregation of probabilities. Merkle and Steyvers examine the relative attractiveness of different scorings rules. Karvetski, Olson, Mandel, and Twardy propose a coherence weighted probability aggregation rule for combining expert forecasts. Our fourth paper by Katsikopoulos presents a theory that explains why simple heuristics often perform well in multiattribute choices with binary attributes. Bhattacharjya, Eidsvik, and Mukerji provide closed-form results for value of information in the context of portfolio selection with dependent projects. Finally, Gao, Zhong, and Mei use game theory to analyze information security. All of the papers have a common purpose of improving decisions in private and public domains.

Median Aggregation of Distribution Functions
Stephen C. Hora, Benjamin R. Fransen, Natasha Hawkins, and Irving Susel

Our first paper investigates aggregation of probability judgments provided by experts or managers. The authors propose that medium aggregations of distribution functions work better than mean aggregation of probabilities. The usefulness of the method is demonstrated in the context of national security. The simplicity of the method is likely to be appealing to risk analysis in private and public sectors.

Choosing a Strictly Proper Scoring Rule
Edgar C. Merkle and Mark Steyvers

Our second paper examines the relative attractiveness of alternative scoring rules for a specific forecasting domain. It has been widely believed that scoring roles are robust and provide essentially similar ranking of forecasters. This paper argues that depending on the forecasting domain, different scoring rules may yield a different ranking of forecasters. The authors compare 10 forecasters with respect to their forecasts on a number of world events. The results of this paper are specifically useful to a decision maker who must choose a scoring rule from a large number of possibilities that best suits his needs.

Probabilistic Coherence Weighting for Optimizing Expert Forecasts
Christopher W. Karvetski, Kenneth C. Olson, David R. Mandel, and Charles R. Twardy

Our third paper proposes an approach for combining expert forecasts. A simple average of forecasts (equal weighting of forecasters) often yields a good result. It is, however, possible that some forecasters are more "able" than others, and giving a higher weight to their opinion may yield more accurate

forecasts. The question is how one can identify the able forecasters in advance. The authors use "coherence" of probability judgments as a criterion to distinguish among forecasters. Coherence-weighted estimates improve accuracy over equal weighting.

Why Do Simple Heuristics Perform Well in Choices with Binary Attributes?
Konstantinos V. Katsikopoulos

Our fourth paper presents a theory that explains why simple heuristics often perform well in multiattribute choices with binary attributes. Examples of simple heuristics are equal weighting and elimination by aspects. It is clear that for decisions of strategic importance one is better served by conducting a thorough multiattribute utility analysis. In a number of decisions one faces in daily life, a quick analysis that respects the decision maker's preferences but imposes small cognitive burden, may be sufficient to yield good results. Using the theory of combinatorics, this paper provides useful insights into conditions when heuristics perform well, and therefore a preferred choice can be identified with minimal input from the decision maker.

The Value of Information in Portfolio Problems with Dependent Projects
Debarun Bhattacharjya, Jo Eidsvik, and Tapan Mukerji

Our fifth paper examines value of information in the context of portfolio selection. In many economic and science problems, projects contained in the portfolio are probabilistically dependent. A smart approach to information gathering can improve the overall value of portfolio. Under the assumptions of risk neutrality and project returns as multivariate Gaussian distribution, the authors provide closed-form analytical results. In public sector applications, risk neutrality may be a reasonable assumption. Similarly, Gaussian models, though not perfect, may be approximately valid in a variety of applications.

Information Security Investment When Hackers Disseminate Knowledge
Xing Gao, Weijun Zhong, and Shue Mei

Our final paper addresses the important question of information security. Firms invest heavily to protect their information systems but hackers seek to breach the security. The decision environment is dynamic and requires strategic calculations from both the firm and hackers. The contribution of this paper is to utilize a differential game to analyze dynamic interactions. Both simultaneous and sequential moves are considered. The results of this paper are also applicable to strategic choices of a government, and terrorists who disseminate knowledge within a network of terrorists.

Attention INFORMS Decision Analysis Society Members!
By special arrangement with the Decision Analysis Society Council, **dues-paying regular members of the DAS receive a subscription to the journal as part of their membership dues**. The DAS is a subdivision of INFORMS. For information on DAS: https://www.informs.org/Community/DAS .

Decision Analysis is a quarterly journal dedicated to advancing the theory, application, and teaching of all aspects of decision analysis. The primary focus of the journal is to develop and study operational decision-making methods, drawing on all aspects of decision theory and decision analysis, with the ultimate objective of providing practical guidance for decision makers. As such, the journal aims to bridge the theory and practice of decision analysis, facilitating communication and the exchange of knowledge

among decision analysts in academia, business, industry, and government. *Decision Analysis* is published in March, June, September, and December by the Institute for Operations Research and the Management Sciences (INFORMS) at 5521 Research Park Drive, Suite 200, Catonsville, Maryland 21228. Please visit our website at http://pubsonline.informs.org/journal/deca.

DA Around the World

Column Editors: Matthias Seifert

In this column we introduce different kinds of Decision Analysis communities around the world with the purpose of promoting their visibility and strengthening the ties between DA researchers and practitioners across borders. In the current issue we have the pleasure to hear from Adiel de Almeida Filho, Danielle Costa Morais and Luciana Hazin Alencar - three of our much-valued colleagues at the Federal University of Pernambuco (UFPE) - about the lively research and consulting activities that take place in Recife, Brazil. I hope you will enjoy reading about their local DA community. I would like to encourage you to get in touch with our guest contributors if you are interested in learning more (email contacts are provided below).

DAS in Recife-Brazil

by Adiel T. de Almeida Filho, atalmeidafilho@yahoo.com.br; Danielle Costa Morais, daniellemorais@yahoo.com.br; and Luciana Hazin Alencar, alencarlh@gmail.com

The members of the DAS community in Brazil come from the south to the northeast. The DAS membership directory from the INFORMS database shows there are 16 members in Brazil based in the States of Paraná (1), São Paulo (4), Minas Gerais (3), Rio de Janeiro (1) and Pernambuco (7).

Recife is the fifth largest metropolitan area in Brazil and the capital of Pernambuco. The population of Recife is about 1.5 million and the metropolitan area has a population of about 3.7 million. Recife is located in the Northeast Region of Brazil and the city is noted for its two rivers (the Rivers Capibaribe and Beberibe) and its Atlantic Ocean shoreline. It is Recife (Pernambuco) that is the base of The Center for Decision Systems and Information Development (CDSID - http://www.cdsid.org.br/index.php?area=&idioma=ing), which is one of the most active groups working with decision analysis (DA) in the country. The CDSID is linked to the Universidade Federal de Pernambuco (UFPE). It started its activities as a research group in 1987, and was granted the status of being a consolidated research group in 1996 by CNPq (the Brazilian Research Council).

The research members of CDSID include 17 researchers (Full and Assistant Professors) and more than 50 collaborators (20 PhD students and almost 40 MSc students). They work in areas related to Information and Decision Systems by conducting research, training and project activities with private and public institutions. Most of the research members have achieved recognition for their contributions from CNPq.

At present, the CDSID is among the highest rated research groups in Brazil, as evaluated by CNPq. Members of the group have also participated in various front-line academic activities in Brazil, such as through membership to the Advisory Board of SOBRAPO (the Operational Research Society of Brazil),

committees of CNPq and CAPES (the Brazilian Post-Graduate Evaluation Bureau), ABEPRO (the Brazilian Association for Production and Management Engineering) and so on.

To support decision making and disseminate DA, CDSID has organized events such as seminars since 2005 and had the honor to have Professor Ralph Keeney in 2008 as a keynote speaker (http://www.cdsid.org.br/geep/homeVertical.php?e=27&l=Ingles). CDSID has researchers in many of the INFORMS communities in accordance with the application field and context in which they are working (Reliability and Maintenance Engineering, Water Resources, Logistics, Project Management, Project Portfolio, Multidimensional Risk Evaluation, Information Systems Planning), but all of them have one thing in common: DA. The CDSID members are associated with a postgraduate program of Management Engineering (http://www.ppgep.org.br/ingPpgep.php) that has been rated this year as level 6, one of the highest ratings given by Capes (the National Agency that evaluates and funds post graduate programs under the Ministry of Education).

In Brazil due to the national academic structure, operations research (OR) and management science (MS) are associated with Management Engineering Schools and these programs are grouped by Capes within the "Engenharias III" group, a subgroup of Engineering that deals with OR, MS and Analytics. After the last term evaluation (usually a 3 year term), Capes rated only the Management Engineering program in Recife and one other with 6, which was the highest rating for this area in this evaluation.

To date CDSID and PPGEP have already had students/researchers and visiting fellows from South America, North America and Europe. We continue to welcome applications for fulltime student places or for visiting fellowships.

DA Practice

Column Editor: Bill Klimack

It was great seeing everyone at the INFORMS annual meeting in Minneapolis in October. It was well attended by decision analysis professionals. The conference as a whole was a great success, although federal government funding issues unfortunately kept some away.

In 2014 the Analytics Conference will be held at the Westin Boston Waterfront, March 30 – April 1 and will continue to offer a strong DA practice component. The next Decision Analysis Affinity Group (DAAG) meeting will again be held just prior to this, on March 27 and 28, at the Hyatt Boston Harbor Hotel. The Society of Decision Professionals (SDP) will offer a short course on March 26 and hold their annual business meeting that day.

The Decision Analysis Society (DAS) will host its first separate meeting June 16-18, 2014, at Georgetown. The meeting will focus on decision analysis research. Keep the INFORMS Big Data Conference in mind as well. It will be held June 22-24 in San Jose. The 2014 Annual Meeting will be November 9-12 at the Hilton San Francisco Union Square and the Parc 55 Wyndham. See https://www.informs.org/Attend-a-Conference for more information.

A major INFORMS strategic initiative, the Certified Analytics Professional (CAP™) program is still in its initial year of offering. As of October, there were 53 CAPs and over 200 people in various stages of

application to take the exam. Information on CAP is available at https://www.informs.org/Build-Your-Career/Analytics-Certification.

Last issue in this column, Don Buckshaw offered his observations as a decision analyst who passed the CAP exam. Don Kleinmuntz, who many active DAS members know as a decision analyst, is also the current president of the INFORMS Analytics Section. Below he shares his thoughts on how decision analysts have a key role in the developing field of analytics. A big thank you to Don for his willingness to share his thoughts.

Please send your comments, suggestions, and, especially, offers to be a guest columnist to me at billklimack@chevron.com. You can help improve the practice of decision analysis!

Analytics, Data Science, and Decision Science

Don Kleinmuntz, Ph.D.
Executive VP, Strata Decision Technology (through December 2013)
Principal, Kleinmuntz Associates

In the August 2013 issue of this newsletter, Don Buckshaw contributed an excellent perspective on his career move into the burgeoning field of Analytics, including his experience sitting for the INFORMS Certified Analytics Professional (CAP) Exam. My goal is to elaborate on several of the themes in that discussion and provide some thoughts on the potential for a mutually beneficial relationship between Decision Analysis and Analytics. My perspective comes from my own background as an experienced decision analyst who has spent most of the last twenty years developing and implementing software for financial analytics and decision support. I have also been heavily involved in the INFORMS efforts to reach out to analytics professionals, both as an INFORMS Board member and, more recently, as President of INFORMS' Analytics Section.

To start out, I want to try to provide a clear and simple definition of Analytics. This is easier said than done, since like any relatively new field, there are no universally accepted definitions. My favorite definition is taken from INFORMS web page titled "What is Analytics?" (https://www.informs.org/About-INFORMS/What-is-Analytics):

"Analytics is defined as the scientific process of transforming data into insight for making better decisions."

This definition emphasizes several key aspects as they have evolved in practice. First, data has a primary role. A major driver has been the rise of "Big Data," as companies and other organizations become literally awash in data. Many have come to realize that there is value to be generated by tapping into this information. Second, the process of transforming Big Data into insight is challenging. Most discussions of the challenges cite the "three V's" of big data: Volume (as the size of datasets have increased by orders of magnitude), Variety (not just traditional structured relational databases but increasingly varied unstructured formats that include narrative text, social media content, web pages, audio files, images, and video recordings), and Velocity (information that changes constantly and that in many instances, requires action or response in seconds or minutes). This has led to the rise of what some call a new discipline, Data Science, which blends aspects of Computer Science, Mathematics, and Statistics, among other areas. Data Scientists are the professionals who bring to bear a set of computational techniques and technologies

for taming big data. To date, the demand for these practitioners far outstrips the supply, which is certainly good news for those who have acquired these skills.

In the mad rush to tame Big Data, people often overlook the latter part of the definition of Analytics, which emphasizes "insight for making better decisions." A basic principle of decision making, familiar to all Decision Analysts, is that information is only valuable to the extent that it is relevant for decision making. If the goal of Analytics is to achieve high quality data-driven decision making, then good command of Data Science may be necessary, but is not sufficient. To maximize the value of the information derived from our data, we must also attend to the characteristics of our decision process, and strive to make the highest quality decisions that the data allow. In a nutshell, high quality Analytics requires a thorough command of both Data Science and Decision Science.

Decision Analysts have a great deal to offer to this endeavor, but it requires a shift in focus and emphasis for many of us. As we have come to understand it, the prototypical Decision Analysis engagement is a "high-touch" consultative process, where the analyst owns the models, elicits inputs often with an emphasis on subjective elicitation rather than data-driven estimation. The analyst performs the analyses, and then provides results and recommendations to the decision maker. In contrast, the prototypical Analytics engagement can be high-touch during the design phase of the problem, but the typical end goal for the consultant is to develop and implement software tools that are placed in the decision makers hands for use by them without direct involvement with the analyst. The data-driven nature of the analytics process leads to much less reliance on subjective elicitation, and much more reliance on inputs derived from data or data-linked models, often using automated scripts to fit model parameters.

So if we define the end product of Analytics as technology-enabled data-driven decision making tools, then what role can Decision Analysts play? Here are some thoughts on places where we can help:

(1) *Problem structuring and framing.* This is an area that Decision Analysis already emphasizes in practice and that Analytics professionals are coming to recognize as equally vital. What is the decision to be made? What are the objectives? While some Analytics is about unstructured data mining for discovery, an effective set of decision making tools depends upon how the problem is defined and the tools selected.
(2) *Data selection and validation*. One of the challenges of good data-driven decision making is identifying the relevant data. This can require a complicated mix of both substantive and analytical expertise. How should analysts and decision makers select the right data to guide their decisions? Should data which is less than completely relevant be ignored? Is there an optimal mix of data-driven estimation and subjective elicitation?
(3) *Model selection and validation.* Decision models vary in sophistication and complexity. Picking the right model requires developing a good understanding of the trade-offs between factors like validity of the assumptions, computation time, and ease of use and acceptance of results by the decision maker. This may even require expert elicitations about model soundness and relevance.
(4) *Evaluation of decision effectiveness.* Ultimately, is the data-driven decision process that we put into place a sound, effective basis for action? Are the decisions better than the old way of doing things? Is the decision process of sufficiently high quality to warrant the costs of constructing and maintaining the models and analyses?

This view goes beyond some of the traditional roles of Decision Analysis practice, but is quite consistent with our mission to provide decision makers with a sound, systematic process for decision making. If we want to be recognized as relevant to the process, it is up to us to engage with Data Scientists and others in the Analytics community and help them understand our relevance and our value.

Society for Decision Professionals

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Research

Column Editor: Debarun Bhattacharjya
Contribution from: Professor Jyrki Wallenius, Aalto University School of Business

Behavioral Decision Research Revisited: The Deterministic MCDM Perspective

Introduction

Herbert Simon and Ward Edwards can rightly be considered the fathers of behavioral decision research as they have both conducted pioneering research on the subject. Simon (1955) questioned the cognitive and computing capacity of humans for making rational choices, creating the concept of limited or bounded rationality and coining the term "satisficing" as opposed to "optimizing" behavior. Edwards published two articles that launched behavioral decision research as a new field of inquiry (Edwards, 1954; 1961). In his 1954 article, Edwards introduced the expected utility model to psychologists and asked: does anybody really behave in this way? It was his 1961 paper that more or less established the field of behavioral decision making. Both Simon and Edwards were critical of the assumption of 'a rational person' and urged scholars to look for alternative behavioral and normative theories. Note that their criticism essentially concerned individual decision making – not the behavior of aggregate entities. Yet, despite calls for "additional behavioral realism" in decision research by these prominent individuals, the mainstream of decision analysis/management science research has, until recently, largely (but not totally) ignored behavioral issues.[1] Why has the decision analysis community neglected behavioral issues? One obvious reason is that much of decision analysis research is normative or prescriptive in nature; implicitly, scholars have felt that behavioral issues might not be as relevant. However, perhaps as a consequence of awarding the Nobel Prize in Economics to Daniel Kahneman in 2002, the debate about the importance of behavioral decision research has resurfaced. For example, there is heightened interest in prospect theory.

I welcome the new interest in behavioral decision making as I have always had an interest in the subject. I have always thought it important – and fun. Our field is not only about mathematics – a lot of it has to do with the psychology of decision making. My view is a pragmatic one: I feel that we can do a much better job of supporting decision making if we have a better understanding of how decisions are actually made in the real-world. I would like to take this opportunity to briefly highlight some aspects of behavioral decision research in a deterministic MCDM context. Typically, two types of problems are considered in MCDM: 1) discrete choice problems, where we know an explicit list of decision alternatives; 2) mathematical programming problems, which only implicitly, via constraints, define the set of available decision alternatives. I argue that behavioral issues are important and would like to generate interest in further research along similar lines.

[1] Pekka Korhonen and I wrote a Letter to the Editor of the *Journal of Multi-Criteria Decision Analysis* in 1996, inviting additional behavioral decision theory research (Korhonen and Wallenius, 1996).

Examples of Behavioral MCDM Research

The purpose of this type of behavioral research is to question some of the myths of our field and to gain a better understanding of how humans make choices in a deterministic, multi-attribute setting. With an improved understanding of how humans make choices, we can build better normative models.

Linear models, criterion weights and importance

(1) The use of **linear models** is not uncommon in MCDM. Can a linear value function be used in predicting choices? To what extent are humans inconsistent with this model? The evidence indicates that a linear value function seems to work surprisingly well in predicting choices, although it is not uncommon for humans to be inconsistent with a linear value function. However, the estimation of the weights in such a function is important. We advocate the use of pair-wise comparisons and the estimation of weights based on them (Korhonen et al., 2012).

(2) Do **criterion weights** and **criterion importance** have a connection? It is commonly believed that a bigger weight is associated with higher importance, but is this the case? In some research we conducted, we found that weights and criterion importance statements are dependent; however, a larger weight does not necessarily imply higher importance. In an experiment, we asked subjects to make a number of binary comparisons, based on which we estimated criterion weights. We noted which criterion had a larger weight and compared this against what the subjects had initially said about the relative importance of the two criteria. Obviously, weights and the underlying criterion scale go hand in hand. In theory, we can find a scale so that the magnitude of weights and criterion importance are in line. However, in practice, it is not possible to find such a scale (Korhonen et al., 2013)! Note that our experiments were conducted only in a two criteria setting - we are currently working to extend them to higher dimensions.

Human aspects of Evolutionary Multi-objective Optimization (EMO)

(3) **Evolutionary Multi-objective Optimization** (EMO) has been a tremendously active area of research for almost 20 years (see Deb (2001). It was largely developed by engineers to solve difficult (nonlinear, nonconvex) multi-objective optimization problems. The idea is to build (heuristic) optimization routines mimicking natural survival processes from nature. In contrast to classical optimization, evolutionary algorithms work with a population of solutions, which they seek to improve upon from generation to generation. Much of the early research was for two criteria problems; it completely ignored the role of the human decision maker and simply focused on approximating the efficient frontier. However, with the emphasis shifting to more general multi-criteria problems, it has been realized that it is necessary to incorporate a human decision maker into EMO schemes. As is clear from research in MCDM, there are different ways and different frequencies at which one can interact with a decision maker. What is the best way to interact with a decision maker? What is the impact of different interaction patterns on the convergence of hybrid interactive EMO techniques?

Collecting preference information: What is the mental load?

(4) In what form should we collect preference information? What is the mental load of different interaction styles in **interactive MCDM tools**? Should we elicit aspiration levels from the decision

maker, and project them onto the efficient frontier? Or should we ask traditional tradeoff questions? Or perhaps ask them to make binary comparisons? Many scholars have opinions, but there is surprisingly little research on this. Furthermore, how do the number of alternatives and the number of attributes impact the load? Our personal favorite is to obtain preference information from binary comparisons, and to estimate weights based on such binary comparisons (Korhonen et al., 2012).

(5) Tradeoffs play a central role in MCDM. Most of the available multi-criteria decision tools are based on requesting humans to make tradeoffs between the criteria. An alternative is to use **"win-win" questions**. In such questions, all values of attributes improve. If we work with "win-win" questions, the starting point (reference point) must be dominated. Incidentally, this is a common strategy in negotiations.

(6) **Neurophysiological measurements** provide a new set of exciting tools to analyze decision making behavior[2] and to study the mental load of decision tasks (Zysset et al., 2006). Such measurements do not lie. Prior to such measurements, scholars could only ask experimental subjects how they felt about the decisions, questions, etc. The use of neurophysiological measurements requires special skills in data analysis and interpretation, and collaboration with psychologists trained in their use (Ravaja et al., 2013).

Further research on prospect theory

(7) The original **prospect theory** of Kahneman and Tversky was developed for decision making under risk (Kahneman and Tversky, 1979). It is, however, a rather straightforward adaptation to apply it to the deterministic MCDM setting (Korhonen et al., 1990). In prospect theory, the role of the reference point is important – but what reference point do humans use? How do they update the reference point as a function of information? In their original paper, Kahneman and Tversky only briefly comment about this issue.

Conclusion

I would like to correct what I consider a myth. Behavioral decision theorists are sometimes labeled as advocates of "irrationality". This is by no means the case - I am not advocating irrationality. However, I find it plausible that the traditional concept of individual rationality needs to be mended. For example, a person who acts according to prospect theory easily violates assumptions of classical rationality, perhaps because of loss aversion or the reference point effect. Yet, I would not call such a person "irrational" from an individual's perspective. I would call such a person "conditionally rational", or rational (consistent) in the sense of prospect theory.

Acknowledgment

I have been influenced by Pekka Korhonen (Aalto University School of Business) and the deceased Russian Academician, Oleg Larichev, in my thinking about the importance of behavioral decision research. I have also had extensive discussions with Raimo P. Hämäläinen (Aalto University School of Science)

[2] Examples include Electroencephalographic (EEG), Facial EMG, and Electrodermal Activity (EDA) measurements.

about these issues. Incidentally, Hämäläinen et al. (2013) is a recently published paper that highlights the importance of behavioral issues in Operations Research.

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Ask DAS

Column Editors: John Coles and Florian Federspiel

How do we improve decision-making skills in society at large? Two accounts from the frontlines: USA and Germany

In our last column we posed the question of whether we faced a crisis in academic communication and incentives. We planned on writing a follow up to share voices of disagreement, agreement, and to discuss the feasibility of proposed alternatives. We have, however, decided to postpone the follow up for now due to a lack of reactions. If you have thoughts on the previous piece (or this piece) please send us your comments.

In this piece we offer a quick look at the current state of improving decision analytic skills in society at large. All of us are continually making decisions, from the mundane to life or death. Although each of us would like to make the best decisions, very few people have been systematically trained from a decision analytic perspective to achieve that goal. As of now, such training is not well integrated in most primary or secondary education, and this is what organizations such as the Decision Education Foundation and Wahlweise e.V. aim to change. To get some perspective on the topic we have asked Chris Spetzler, executive director of the Decision Education Foundation in the US, as well as Nadine Oeser, chair of Wahlweise e.V. in Germany, to share some thoughts on the state of decision analysis in society at large.

The questions

- What is your current assessment on the level of integration of crucial decision-making skills in primary and secondary education?
- What is your strategy in order to further the integration of decision education into primary or secondary education?
- What are the barriers that you may have encountered when trying to push for the integration of decision education?
- Also, as far as we know, there is no traditional subject as or particularly close to decision education. Do you believe it would eventually be best to have it as a stand-alone or do you believe decision education could well be integrated into subjects such as mathematics, history or others?
- What is your outlook for the future in terms of its adoption etc.?
- Is there anything any of us can do to get involved to further the cause?

Chris Spetzler's Take

Decision-making is rarely taught in a direct manner in primary or secondary education in the US. While some exceptions in "life skills" areas exist, the rigor does not match what the Decision Science community might hope for. State standards and the common core curriculum incorporate critical thinking, but no integrated approach to decision-making exists to our knowledge.

The DA community is familiar with the challenges we face in bringing decision education to the mainstream. Our primary competition is with a status quo where adults (and kids) think they know how to do it, but are typically impressed by what they never learned and the value they discover given the opportunity to learn more. Decision Education Foundation (DEF) has demonstrated this value both anecdotally, through great outcomes with educators and students, as well as formally, with positive results showing academic improvement in a randomized study.[1]

Assembling this evidence is required in order to compete for space in an overloaded curriculum. One strategy has been to show students can learn a traditional subject better while learning decision-making, too. In the formal study, where the Decision Quality framework was taught within US History, students improved both history knowledge and Decision Making Competence compared to the control group. We believe this approach improved students' classroom experience and learning.

At DEF we have developed curriculum that integrates decision-making where there is room and alignment, so that teachers have materials immediately at hand. We evolved to this after teaching the principles of decision-making and finding teachers appreciated the material, but struggled to find space or time to integrate them adequately. More recently, we developed online modules to make decision skills more accessible. An animated talk show called "It's Your Choice" carries the content and has proven successful in summer courses and a recent Massively Open Online Classroom (MOOC) delivered through NovoEd.[2] We continue to build on these experiences to reach more students, educators, and institutions.

Ultimately, for students to get to the depth we believe will benefit them most, decision skills must be introduced and reinforced in different subject areas at appropriate intervals. Without this reinforcement, the knowledge fades. Building proficiency requires integration across an institution, a challenging goal we are pursuing. Even as we build toward that goal, we recognize that some students (and parents) will be interested in obtaining decision skills in an independent manner. The MOOC is a step in this direction, as is a Summer Institute planned for next summer through Stanford Pre-Collegiate Studies. We have also developed materials and a model to support decision professionals as volunteers to deliver this material to extend our reach.

We believe that decision-making is fundamental to everyone's success – that Better Decisions lead to Better Lives. Competition and uncertainty are only increasing. Decision skills will become increasingly important. Some areas of education evolve slowly, but a transformative shift is under way. We are demonstrating the power of these principles and extending the resources available, so that more individuals and institutions can learn and participate. The challenge is great. The benefits are greater still. We welcome the support of the Decision Analysis community in helping to extend our reach.

Nadine Oeser's take (translated from German)

To start things off, the following snapshot results from a survey of 100 students studying to become teachers are very interesting:

Do you have a good idea of what the term "decision-making competence" stands for?

69% - Yes, I believe so

31% - No, not quite

Do you believe that students would profit from being taught how to make good decisions? (E.g. choosing a suitable internship, university major or apprenticeship)

- 100% - Yes

How important do you believe decision making competence is for our daily livelihood?

- 48% - Very important

- 52% - Important

Do you believe it is important to teach such competence in school?

- 92% - Yes

Are decision-making skills covered in today's curricula?

- 3% - Yes, to a large extent

- 41% - Yes, partly

- 52% - No, hardly

- 3% - No, basically not at all

The results of this survey summarize our impression of, and experience with, the issue quite well. The general public in Germany largely lacks awareness of the issue. Whilst bestsellers by Gerd Gigerenzer about intuitive decisions or books about decision biases bring some attention to the topic, the general prevalent lack of awareness is by far the greatest hurdle when it comes to integrating decision-making competence into education.

There are of course certain aspects of decision-making competence that are taught in school (yet indeed somewhat at random). For instance, calculating an expected value of a game of dice is part of the basic mathematical curriculum at high school. Different problem solving techniques are also taught across different subjects. Providing students with a well-rounded individual decision making competence to tackle complex life decisions is, however, unfortunately a rare exception. This is very unfortunate because children and adolescents often see complex life decisions as very overwhelming. They often feel inadequate to rise to the challenge and lack the appropriate toolbox to lead their lives more proactively.

As such, it would of course be a great enrichment to the German education system and every individual pupil to become familiarized with a decision analytical approach in order to achieve decision-making competence. We believe that the most successful integration of decision analytical techniques may be

achieved by incorporating it as an interdisciplinary teaching method. It could then for example be used to analyze the medieval crusades in history or to interpret Shakespeare's Romeo and Juliet in English [subject]. The repeated use of decision analytical techniques across different subjects may lead to such techniques feeling increasingly more natural and as such may eventually lead students to use such techniques when faced with real life problems in the wild.

Wahlweise e.V. aims to achieve just that, i.e. the adoption of decision analytical skills as an interdisciplinary teaching method. Yet whilst teachers are ideal facilitators to achieve such a goal and to propagate the method, several tries over the last months and years have shown this to prove difficult because teachers regularly suffer from a heavy load and are, as such, not as accessible.

For this reason we plan to focus on two things in the following year to reach our target groups (children, adolescents and young adults):

1.) We aim to establish mentoring programs as alternative propagators of the technique. Mentors accompany students for longer periods of time and support students regarding both scholarly as well as life matters. Through educating mentors first, mentors can pass on decision-making competence to their mentees in a very personal and direct fashion.
2.) We plan to offer and publicize a range of online- training and educational material to raise the general awareness and appreciation of decision-making competence.

We are always happy for support with regards to these to aims, be it by offering time, insight, contacts, or donations.

The "Ask DAS" column is intended to target the interests, needs, and questions of members of the Decision Analysis Society. If you have a response to this piece, or if you have ideas or questions that you would like us to deal with in future Ask DAS columns, please just send us an email (jbcoles@buffalo.edu, ffederspiel.phd2014@student.ie.edu).

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Guest Column

Column Editor: Janne Kettunen, Asst. Professor, The George Washington University
Contribution By: Fahimeh Ziarati Omid, Regional Project Manager of the Middle Eastern Region

Using Decision Analysis Tools To Manage Project Risk in Iran

In the current issue, Ms. Fahimeh Ziarati Omid who has spent the past nine years as a turnkey project manager for telecommunication vendors and operators in Iran, describes her experience in using decision

analysis tools in the management of project risks. You can contact Fahimeh Ziarati Omid via the following email address: fahimehomid@gwmail.gwu.edu.

In Iran, one of the distinct external risks is the political risk. Almost every time when an Iranian politician makes a public statement in regards to the western countries these risks became greater making it more probably that sanctions are added on Iran. Political relation between United States and Iran has been in turmoil for over three decades now and as US and EU countries apply stricter sanctions on Iran, finishing projects on time within the budget and required quality has become a dream of the past. Due to this situation, necessary equipments almost never arrive on time and these delays add extra cost to the project.

Therefore, it has been necessary for the project management teams to actively evaluate and mitigate exposure to the political risks. For this purpose we have applied several decision analysis techniques and approaches. Particularly, our project management team has found the scenario analysis approach to be useful in assessing both economical and political risks in different phases of projects. A typical choice of scenarios has been 'optimistic, most likely, and pessimistic project management teams to actively evaluate and mitigate exposure to the political risks. For this purposenable spread of outcomes and based on them draw conclusions and obtain insights what could happen and how to prepare for the future.

During the last three years, the economy in Iran was not stable at all and we found it really difficult to forecast what the future holds or what probabilities to assign for the different levels of political risks. We took the more risk averse approach and assigned higher probabilities to the pessimistic political outcomes than what we expected and monitored these risks in quarterly intervals. At each quarter, depending on how the political events had folded out, we made decisions for the following quarter and updated our scenario estimates and developed new risk mitigation plans. Thus, all the major project management decisions and risks were evaluated in a quarterly based rolling horizon. This allowed the project managers to react to political changes dynamically and developed the whole project management teams future holds or what probabilities to assign for the different lev political and economic circumstances.

Let me give one specific example. We were given a project to upgrade one of the major telecommunication networks in Iran. The existing equipments were purchased from a European vendor and we had to decide whether to continue with them or to select another vendor locally or from Asia. This decision was strongly driven by the scenario analysis of political risk that was manifested in the form of possible trade sanctions. If the trade sanctions were tightened, some of these firms would not be able to participate in the project. We, at the project management team, decided to put an order with the Chinese equipment vendor. This decision was supported our scenario based risk analysis and it proved to be the correct one as at the end, the European firms had to leave the country and could not have supplied the equipment. The operator was able to upgrade the network successfully whilst we had to solve lots of technical difficulties related to the system integration.

Most of the projects that I have been involved have included a significant component of uncertainty, making projects risky to execute and harder to manage. Coping with the risky outcomes ad hoc in the project's implementation phase has typically led to difficult situations and costly fixes. Therefore, I have found it useful to conduct risk analysis frequently in a rolling horizon. This allows identifying and assessing risks early on and most importantly developing risk mitigation or contingency plan.

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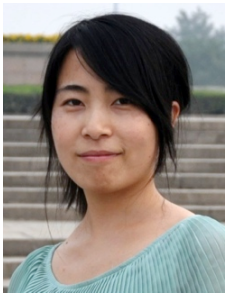

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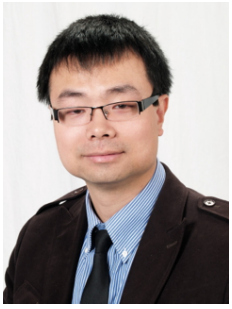

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