The Newsletter of the
RAILWAY APPLICATIONS SECTION

informs ras

› Feature Article: Railway Education for the 21st Century

### Results of the 2017 Global Railway Education Survey

Steven Harrod, **Technical University Denmark,** stehar@dtu.dk

Inside

In spite of doubts and detractors, railway growth continues unabated. In high speed rail alone, the International Energy Agency forecasts that there will be a tripling of high speed rail route kilometers between 2010 and 2030 (28,000 kilometers of new network), and then there are numerous investments in conventional railways worldwide as well. Closer to my home, there are enormous commitments to "HS2" in the United Kingdom, the Danish "Togfonden", and to a completely new high speed rail alignment connecting Stockholm, Malmö, and Göteborg, Sweden with a design speed of 320 km/h (198 mph). A question heard frequently is, "Where are all the engineers going to come from?" A colleague of mine returned recently from a set of meetings in Sweden, where the opinion was expressed that it very well could become a Chinese construction project, for lack of available European talent.

Here in Denmark, our "Banebranchen" (Danish for *Railway Industry Group*) raised this same question ten years ago, and a partnership was formed in which Banebranchen provided financial support to initiate a dedicated railway education program at the Technical University of Denmark (DTU). Our first students entered what was then called the "Railway Technology" study line in 2008. Today, a structural reorganization has placed this program under the Department of Management Engineering, and the program has been renamed "Railway Technology and Planning" to reflect the increase in management content. Banebranchen also sponsors a railway research center, "RailTech DTU", which coordinates and promotes railway research at DTU. As part of a re-

Career Tracks to Success

What job interests you, and what skills do you require? Morson International, a recruiting and human resources firm headquartered in the United Kingdom, offers career advice and links to education programs at https://www.morson.com/tracks-to-success . At the top of this page is this animated graphic that offers different career descriptions at each of the stations on this metro map. In a recent news item, Gary Smithson of Morson says "A 2015 report from The Office of Rail and Road [United Kingdom] estimated that by 2020, 900 engineering and technical workers will be needed to fulfil positions in conventional rail, while in high speed rail this figure is estimated to be closer to 7,200."
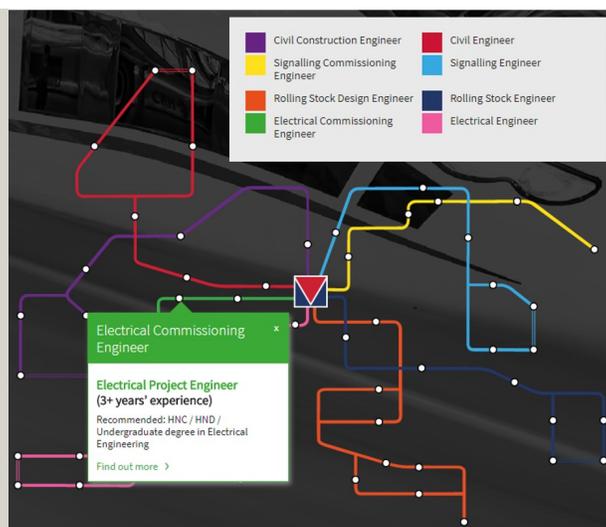
> ## Feature Article: Railway Education for the 21st Century, continued.

evaluation of our program in 2017, we organized a survey of other railway education programs to see how our program fit and compared amongst other international railway education programs.

A lot has changed in the last 30 years in railway education. The program where I studied at MIT in the 1990s effectively no longer exists, following a trend of decline in railway and transportation education generally at many universities. Did you ever wonder why Purdue University in Indiana is called the "Boilermakers"? Purdue was originally founded as a railway engineering school (and once had a locomotive testing plant and a collection of historic steam locomotives), but you will not find any railway specialists there today. Yet, there are new programs, like the one at Michigan Tech University, which did not exist fifteen years ago.

Figure 1: Map of respondents to the 2017 Global Railway Education Survey

Our survey was only distributed to institutions that offer an English language program, although we did not refuse any other responses (hence the response from Belgrade). The mailing list was limited by the contacts of INFORMS Railway Applications Section and other personal contacts, so our apologies to those who feel left out. After cleaning of the data, we have fifteen unique responses. One or two schools actually offer more than one program, and sometimes at different departments. This year we chose to list only the larger program at each school. Many of the respondents remarked in their comments that they did not offer a full degree in railways, but offered a "minor" or add-on study program to their standard degree program. This is very typical and so long as a program offers at least three railway focused courses, we did not mark it separately.

Figure 1 shows a map of the fifteen respondents to our survey, which include the United States, Europe, and China. "China?", you say? Yes, Beijing Jiaotong University from this year offers a joint Master of Science degree, in English, with

> *"Where are all the engineers going to come from?"*

Delft University of Technology. Lingyun Meng, Vice Dean of the School of Traffic and Transportation, says that Beijing Jiaotong has had an active partnership with Chinese railways for over a hundred years, and it shows. Of the fifteen programs responding, Beijing Jiaotong is by far the largest with approximately 190 undergraduate and graduate degrees awarded annually. Table 1 provides the contact information for each of the respondents, and Table 2 provides the website URLs for further information.

There is a familiar pattern at many of the schools. Many of the schools offer their undergraduate programs in the local nation's language, but increasingly the graduate programs are taught in English. English, the international language of business, is also increasingly the international language of railways. The one school that has capitalized on this the most has to be the University of Birmingham. Prof. Felix Schmid, of the Birmingham Cen-

tre for Railway Research and Education, described in an interview to me how their program is now over 20 years old, and attracts students from many nations, too many to count, actually, "We have students from the Middle East, Spain, Italy, America, Asia...and partnerships with the Indonesian and Thailand railways". Schmid also mentioned their home industry partnerships extend to over 100 railway related firms in the UK. Today, Schmid's program offers two Master of Science in Civil Engineering (MSCE) degrees: Railway Systems Engineering and Integration, and Railway Risk and Safety Management, which is a joint program with the University of York. This coming fall a new MSCE program, Railway Command and Control, will begin.

> *"Of the fifteen programs responding, Beijing Jiaotong is by far the largest with approximately 190 undergraduate and graduate degrees awarded annually."*

Many of these programs value highly relations with industry and hands on experience, and sponsor tours and visits for students. The Birmingham program sponsors an annual study tour in the spring. Last year, the program visited Copenhagen Metro, the Danish railway conference "RailCPH", and the Swedish railway network all the way from Göteborg to Stockholm, and on to the iron ore line in Narvik, Norway. Next year, Schmid will have to operate two separate tours, because the student population has become too large to manage on a single tour. Here at our own DTU, we also send students on study tours, ranging from railway facilities in close by Aarhus, to longer trips such as last year's Innotrans railway exposition in Berlin.

The prize for best student recruiting must go to Michigan Tech, which since 2010 has offered a residential summer rail camp experience to students in the 9th through 12th years (American high school). Michigan Tech is the scrappy underdog of railway education. Michigan Tech is located on the top of the upper peninsula of Michigan, where you can look out your kitchen window and see Canada, and where the only connection to the outside world is a two lane highway and an airport that offers two flights per day. How did Michigan Tech become one of the top railway education centers in the United States? It all started with the current program director, Pasi Lautala, who came to Michigan Tech in 1997 as an exchange student from Finland. Faculty members Bill Sproul and Eric Petersen shared a mutual interest in rail, and took an interest in Lautala. In 2002, they invited Lautala back to Michigan Tech to teach some courses in railways and pursue his PhD. About this time, 2004-2005, the railroad industry was recovering strongly with a growing economy,

Career Tracks to Success

Even in Europe, where railways are a normal part of everyday transportation, most students do not know the technical foundations of railways. That is why so many railway education programs make visits to railway facilities a priority in their education programs.
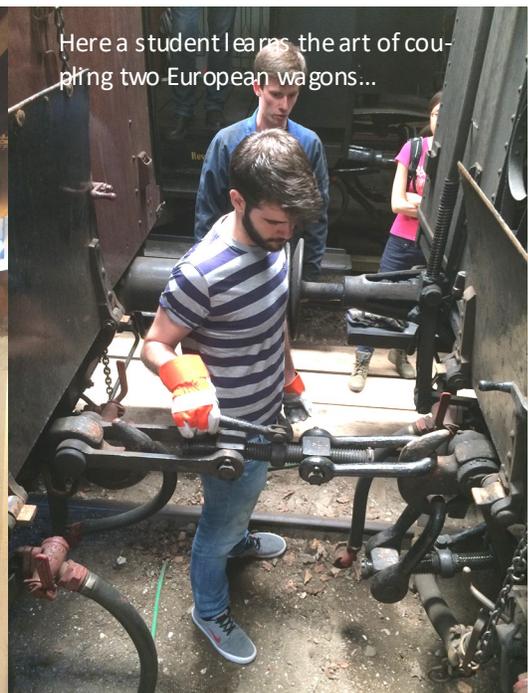

On field visits, students get a view of railways that is otherwise not possible...

Here a student learns the art of coupling two European wagons...

❯ Feature Article: Railway Education for the 21st Century, continued.

Table 1: 2017 global railway education survey respondents

University	Department	Nation	Contact	Email
Beijing Jiaotong University	School of Traffic and Transportation	China	Lingyun Meng	lymeng@bjtu.edu.cn
Colorado State University - Pueblo	The Department of Engineering	USA	Nebojsa Jaksic	n.jaksic@csupueblo.edu
Delft University of Technology	Faculty of Civil Engineering and Geosciences	Netherlands	Rob Goverde	r.m.p.goverde@tudelft.nl
KTH Royal Institute of Technology	KTH Railway Group	Sweden	Sebastian Stichel	stichel@kth.se
Michigan Technological University	Civil and Environmental Engineering	USA	David Nelson	dannelso@mtu.edu
Norwegian University of Science and Technology	Civil and Environmental Engineering	Norway	Elias Kassa	elias.kassa@ntnu.no
University of Belgrade	Faculty of Transport and Traffic Engineering Department for Railway Transport	Serbia	Nebojsa Bojovic	nb.bojovic@sf.bg.ac.rs
University of Birmingham	Birmingham Centre for Railway Research and Education	UK	Felix Schmid	f.schmid@bham.ac.uk
University of Illinois at Urbana-Champaign	Rail Transportation and Engineering Center (RailTEC)	USA	Christopher Barkan	RailTEC-Central@illinois.edu
University of Leeds	Institute for Transport Studies	UK	A.E. Whiteing	ITScourses@leeds.ac.uk
University of South Carolina	Civil Engineering - Advanced Railway Technology	USA	Dimitris C. Rizos	rizos@cec.sc.edu
Penn State Altoona	Division of Business, Engineering, and Information Sciences and Technology (BEIST)	USA	Stephen Dillen	sld130@psu.edu
Technical University of Denmark	Department of Management Engineering	Denmark	Steven Harrod	stehar@dtudk
Sapienza, University of Rome	Civil, Buildings, and Environmental Engineering Department	Italy	Stefano Ricci	stefano.ricci@uniroma1.it
University of Southampton	Transportation Research Group	UK	John Preston	jpreston@soton.ac.uk

Table 2: Web addresses for respondent programs

| University	URL
Beijing Jiaotong University	http://bjtu.edu.cn/ (in Chinese)
Colorado State University - Pueblo	csupueblo.edu/engineering/index.html
Delft University of Technology	www.citg.tudelft.nl/en/about-faculty/departments/transport-and-planning/education/master-programme
KTH Royal Institute of Technology	www.kth.se/en/studies/master/railway-engineering
Michigan Technological University	www.rail.mtu.edu/
Norwegian University of Science and Technology	www.ntnu.edu/studies/mibygg
University of Belgrade	www.sf.bg.ac.rs/index.php/en/
University of Birmingham	www.birmingham.ac.uk/research/activity/railway/index.aspx
University of Illinois at Urbana-Champaign	railtec.illinois.edu/index.php
University of Leeds	https://www.its.leeds.ac.uk/
University of South Carolina	oat.engr.sc.edu/art/
Penn State Altoona	altoona.psu.edu/academics/rail-transportation-engineering
Technical University of Denmark	http://www.dtu.dk/english/education/msc/programmes/transport_and_logistics
Sapienza, University of Rome	https://web.uniroma1.it/cdaingtrasporti/
University of Southampton	www.southampton.ac.uk/engineering/postgraduate/taught_courses/engineering/msc_transportation_planning_and_engineering.page

Working on the Railroad

Where can I find a job on the railroad, in North America? Here are some of the major North American railways and their career websites.

RAILWAY	JOB SITE	HEADQUARTERS
BNSF	https://jobs.bnsf.com/	Ft. Worth, Texas
UP	https://up.jobs/index.htm	Omaha, Nebraska
NS	https://jobs.nscorp.com/	Norfolk, Virginia, and Atlanta, Georgia
CSX	https://www.csx.com/index.cfm/working-at-csx/	Jacksonville, Florida
CN	http://www.cn.ca/en/careers	Montreal, Quebec, Canada
CP	http://www.cpr.ca/en/careers	Calgary, Alberta, Canada
AMTRAK	https://jobs.amtrak.com/	Washington D.C.

Working on the Railroad

Norfolk Southern has a job map that shows how many jobs are available, and where, on the NS system. Clicking on the markers brings up a job description and application link.
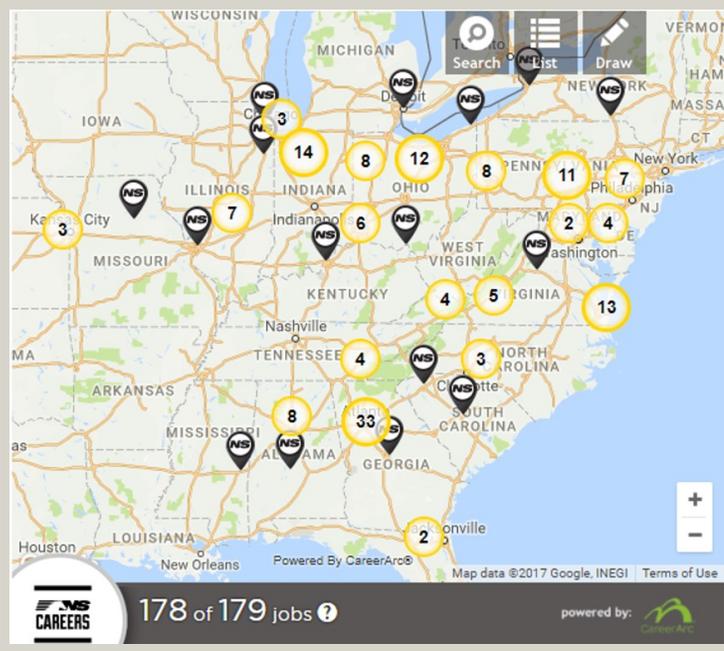
and also facing a labor shortage due to retirements, and Michigan Tech was able to secure sponsorship from major railroads such as Canadian National, BNSF, the Intermodal Association of North America, and from 2012-2015, NuRail, a United States government research program.

The summer youth program is the jewel of Michigan Tech's program. Founded in 2010, the program is unique at Michigan Tech, because unlike other youth programs at Michigan Tech, it attracts students from all over the United States (Michigan Tech is otherwise strictly a regional school). At its peak under NuRail funding, the program offered 100% scholarship and enrolled a capacity group of 25 students. Today, without NuRail funding, the program offers 50% scholarship and enrolled 14 students last year. Commenting on the geographic variety, Lautala reasons, "Students come because they *want* to come." Indeed, the rail camp students are highly motivated, and Lautala estimates that 10-20% of rail camp participants later enroll in the Michigan Tech degree program.

As successful as the Michigan Tech program has been, Lautala remarks that the program will not just keep going on its own, "The marketing and getting in front of the students never ends." Lautala remarks that there is an ironic challenge in maintaining industry enthusiasm for the program. Michigan Tech has been very successful in marketing its graduates to industry, and easily has a 98% placement rate on graduation, but railway firms have actually been weak in competing for these graduates, and many students with a sincere interest in railways have taken non-railway jobs because the salaries were better or the other firms were simply faster and more responsive in the hiring process. "The biggest threats are the industry itself. The industry has to change, it has to modernize, " remarks Lautala. Overall, Lautala sees a stable future for the Michigan Tech program, with minimal growth, "We are no longer dependent on railroad financing for the core of the program."

The education systems vary in structure from nation to nation, and it is hard to make fixed comparisons between

⟩ Feature Article: Railway Education for the 21st Century, continued.

the programs. Table 3 summarizes the variety and volume of railway education each program offers. The first three columns are an attempt to measure the volume of railway specific coursework offered at each institution, and "attempt" is as good as it gets, because the course credit measuring system varies greatly. The course count is, as best possible, scaled to a "standard" course, which in both the United States and Scandinavia means a course that meets for about 3 hours of formal lecture a week. However, it is further complicated by differences such as the length of the term. In Denmark, the term is 13 weeks, and a course is 5 ECTS (European Credit Transfer System), but in Norway and Sweden, the term is 15 weeks, and a standard course is 7.5 ECTS. Birmingham is different because much of its program is designed for part time and visiting students, and so courses are offered in intensive week-long modules. So, these figures should not be judged too closely.

Program application dates are also hard to compare, and interested students should check the details directly. The dates listed are the earliest cutoffs for foreign students. Many programs have later application dates for European Union or home country students. Nearly all the programs offer a degree with a railway focus, the only ex-

Summer School Camp with Two R's: Rail and Road

Since 2010, Michigan Tech has offered a one week summer camp, the "Rail and Intermodal Transportation Summer Youth Program". Thanks to industry sponsorship, most students receive a 50% scholarship for the camp fees. The week is action packed with visits to facilities across the iron and copper mine ranges of the upper Midwest, including dispatch centers for BNSF, locomotive servicing facilities of the Lake Superior and Ishpeming, a rotary dumper at a power plant, and a truck simulator at Halvor Lines trucking. The program attracts students from all over the United States.

Director Pasi Lautala says the student body at Michigan Tech is a good match to the railroad industry, because its students are very hands on, engineering focused, and outdoors oriented, "Railroad people need to drive big trucks and shovel snow." Further, Michigan Tech cannot compete with major universities in popular subjects, so the railroad education line is a niche subject that allows Michigan Tech to stand out and compete nationally.

ception being the University of Southampton. All of the respondents, except Colorado State, offer a PhD with a railway focus, although availability can be sparse from year to year. At our own DTU, PhD positions are dependent on project financing, and are not consistently open for applications every year.

While Birmingham is proud of their intake from around the world, the University of South Carolina has taken a different approach, and offers their program online. South Carolina calls their online program "APOGEE", and is proud to say that it was ranked by U.S. News and World Report as one of the "Best Online Programs Graduate Education 2013". Penn State Altoona claims its Rail Transportation Engineering (RTE) program to be the "home to the first and only ABET-accredited RTE program in the U.S." ABET is the Accreditation Board for Engineering and Technology. Sapienza at the University of Rome is the one to watch though. They offer a Bachelor, MSc, and PhD degree, with the MSc degree offered in English. Sapienza also offers a one year post-graduate degree, in Italian, that has a 13 to 1, applicant to admitted, ratio.

> *"The marketing and getting in front of students never ends." Pasi Lautala*

Clearly, these programs are doing something right, and the future can only be brighter with such strong job prospects. Many of the programs report that their students are easily employed before or shortly after graduation. At our own DTU, it is very common for students to have job offers before graduation. However, many nations, including our own Denmark, are facing a generational cliff, where many railway staff are approaching retirement age. The sum total of the graduates in this survey does not scratch the surface of the projected thousands of jobs in railway construction and management. There remains plenty of opportunity, and work to be done, in railway education.

Table 3: Courses, programs, and students enrolled

University	Courses Non-Degree	Courses Undergraduate	Courses Graduate	Application Date Non-Degree	Application Date Undergraduate	Application Date Graduate	Degrees in English Non-Degree	Degrees in English Undergraduate	Degrees in English Graduate	Students Graduated Annual Non-Degree	Students Graduated Annual Undergraduate	Students Graduated Annual Graduate	PhD 5 yr. count	Rwy. Coop
Beijing Jiaotong University		30	15			Jun			E		150	20	100	Y
Colorado State University - Pueblo			4			Jun			E			4	0	Y
Delft University of Technology		2	11			Jan			E	5	12	6		Y
KTH Royal Institute of Technology			15			Jan			E		10	20		
Michigan Technological University		3	3					E			6	2	1	
Norwegian University of Science and Technology	2	1	10			Mar			E	30		10	0	Y
University of Belgrade		28	15+		May	Aug					20	5	7	Y
University of Birmingham	10	12	25	Any	Apr	Jul Oct	E	E	E	22	15	40	40	Y
University of Illinois at Urbana-Champaign	1	11	11				E	E	E	10	25	10	4	Y
University of Leeds			3			Apr			E			40	8	
Penn State Altoona		8			Apr			E				6		Y
Technical University of Denmark		1	5			Jan			E		20	8	4	Y
Sapienza, University of Rome	12	3	6			Apr			E		30	66	15	Y
University of South Carolina	5	3	8	May Sep	May Sep	May Sep	E	E	E	2	10	2	3	Y
University of Southampton		1	1			Jun						5		

❯ RAS Extends a Big "Thank You" to its 2017 Sponsors!

RAS is proud to advance the application of operations research and analytics to railroad problems. We rely heavily on the dedication of our tireless volunteers and especially the support of our generous sponsors. The sponsor donations pay for the annual dinner, session related costs, prize pool for the problem competition, prize pool for the student paper competition, as well as administrative costs. Thanks to our sponsors' efforts we have had a landmark fundraising year in 2017, raising $14,500! Without this help we never would have been able to facilitate the exciting new events and sessions we are debuting at this years INFORMS. Please take time while at INFORMS this year to reach out to our sponsor representatives and thank them personally.

Amtrak. The National Railroad Passenger Corporation, more widely known as Amtrak is the largest inter-city passenger rail operator in North America. More than thirty one million passengers travelled on Amtrak in FY 2017. Amtrak provides medium- and long-distance intercity service in the United States and serves more than 500 destinations in 46 states and three Canadian provinces, operating more than 300 trains each day over 21,300 miles (34,000 km) of track. Amtrak is proud to be recognized as a leader in the transportation industry and a vital link to the nation's transportation system for the more than 500 communities that it serves. Amtrak is dedicated to innovation, safety, customers and employees to consistently promote customer loyalty and quality–driven operation.

BNSF Railway is one of North America's leading freight transportation companies. BNSF operates approximately 32,500 route miles of track in 28 states and also operates in three Canadian provinces. BNSF is one of the top transporters of consumer goods, grain and agricultural products, low-sulfur coal, and industrial goods such as petroleum, chemicals, housing materials, food and beverages. BNSF's shipments help feed, clothe, supply, and power American homes and businesses every day. BNSF and its employees have developed one of the most technologically advanced, and efficient railroads in the industry. We work continuously to improve the value of the safety, service, energy, and environmental benefits we provide to our customers and the communities we serve.

CSX Corporation, together with its subsidiaries based in Jacksonville, Fla., is one of the nation's leading transportation suppliers. The company's rail and intermodal businesses provide rail-based transportation services including traditional rail service and the transport of intermodal containers and trailers. Overall, the CSX Transportation network encompasses about 21,000 route miles of track in 23 states, the District of Columbia and the Canadian provinces of Ontario and Quebec. Our transportation network serves some of the largest population centers in the nation. Nearly two-thirds of Americans live within CSX's service territory. CSX moves a broad portfolio of products across the country in a way that minimizes the effect on the environment, takes traffic off an already congested highway system, and minimizes fuel consumption and transportation costs.

GE Tranportation combines decades of industrial leadership with cutting-edge data science and analytics acumen to create an efficient, productive and reliable digital-rail ecosystem – from shipper to receiver - from ports to intermodal terminals - main line locomotives and railcars - to train yards and operation centers. Fueled by the outcomes our customers strive for each and every day, our Digital Solutions portfolio delivers results only found when you combine our industry experience with advanced software and problem-solving capabilities. Our solutions enable intelligent asset strategies to help optimize the performance of locomotives, railcars, track, and wayside infrastructure, maximize train performance to reduce train delays and improve efficiencies, and reduce congestion on the main lines and improve efficiencies at yards and terminals.

RAS Extends a Big "Thank You" to its 2017 Sponsors!, continued.

Norfolk Southern Corporation is one of the nation's premier transportation companies. Its Norfolk Southern Railway subsidiary operates approximately 19,500 route miles in 22 states and the District of Columbia, serves every major container port in the eastern United States, and provides efficient connections to other rail carriers. Norfolk Southern operates the most extensive intermodal network in the East and is a major transporter of coal, automotive, and industrial products.

Oliver Wyman's Rail Practice is widely recognized as the premier management consultancy to freight and passenger railways. With deep industry expertise, our consulting staff helps clients stay ahead of the competition by working with them on their most difficult problems around strategic growth, operational improvement, and organizational effectiveness. Our team also excels at innovative financial solutions for rail assets and is a global leader in applied operations research and the development of simulation and optimization software tools for the rail industry.

Optym is the market leader in delivering decision automation and optimization solutions for the transportation industry. Our company utilizes an exceptional blend of computer science and operations research techniques to develop software solutions and products, while incorporating deep industry knowledge. We have delivered software solutions to some of the world's most successful corporations in freight rail, airlines, and less than truckload (LTL) carriers, creating significant long-term value to their operations. Optym has deep expertise in developing optimization-based software solutions in all areas of rail planning and scheduling: train scheduling, locomotive planning, crew planning, yard planning, and locomotive shop scheduling. Our clients include some of the world's largest railroad carriers, such as CSX Transportation, Norfolk Southern, BNSF Railways and Canadian Pacific Railway.

Tech Mahindra is a technology partner of choice to the global rail industry offering a range of connected transportation engineering services and solutions. Our engineering services and solutions to the global Transportation industry encompass rail signaling, rolling stock, positive train control implementation, rail infrastructure and communication.

Tiger Analytics is an advanced analytics consulting firm enabling enterprises to generate business value through data. Today, it is a trusted partner to several Fortune 500 companies, who are leaders in their respective industries. Within the railroad industry, it has delivered advanced analytics solutions in forecasting and planning to major providers that have reduced operations and maintenance costs, improved reliability and optimized capital expenditure.

What Motivates a Student Railway Researcher ?

Article by: Thomas Breugem

I am a third year PhD student at the Erasmus School of Economics, under the supervision of Twan Dollevoet and Dennis Huisman. In my research I focus mainly on personnel planning problems, although I always enjoy collaborating with researchers in other areas.

I decided I wanted to become a researcher at quite a young age. As a young student I was intrigued by the famous P vs NP question, which I encountered first right after finishing high school. How could problems that are so easy to describe be so extremely complex? This fascination never left me, and is still the major drive behind my research.

I started working on railway optimization early in my studies. After two internships at Netherlands Railways, one during my bachelor programme and one during my master programme, I decided that a PhD in railway optimization was the perfect next step in my career as a researcher. I have always been drawn to research that is both theoretical and practical, and I feel this is exactly what research in railway optimization offers.

After my PhD I hope to continue doing research. I feel that the academic world has much to offer, and that it is the ideal place to develop yourself, both as a professional and as a person. In the end, I hope to work on inspiring projects, where innovative optimization techniques are combined with practical relevance.

Updates from the 2017 RAS Officers

Chair: April Kuo, **BNSF Railway**; april.kuo@bnsf.com

Vice Chair: Kamalesh Somani, **CSX Technology**; kamalesh_somani@csx.com

Secretary: Shantih Spanton, **CSX Technology**; shantih_spanton@csx.com

Treasurer: Mike Prince, **BNSF Railway**; michael.prince@bnsf.com

Public Relations Officer: Steven Harrod **Technical University of Denmark**; stehar@dtu.dk

Social Media

RAS has numerous was in which members can keep in touch. Our social media accounts provide a forum for members to post and discuss topics. They are also used to communicate RAS information such as the problem solving or paper competitions. If you are not already a member, please join the groups to connect with the other members from academia, railroads and consulting.

INFORMS Connect at http://connect.informs.org/railway-applications/ho

LinkedIn at visit http://www.linkedin.com/groups?gid=2399643

https://www.facebook.com/groups/INFORMSRAS/?ref=bookmarks

New RAS Student Engagement Representative

The 2017 RAS officer's group is excited to announce a new RAS volunteer opportunity specifically available for students: the RAS Student Engagement Representative. The RAS Student Engagement Representative shall be the principle contact between the RAS organization and its current and potential student members. . The representative will be responsible for the following tasks:

- Attend all regularly scheduled officer and related RAS subcommittee meetings.
- Enact and propose strategies to maintain and increase student membership in RAS.
- Identify ways that the RAS organization can support and engage students interested in rail OR.
- Obtaining and maintaining a list of contact information for interested Universities.
- Promote the RAS organization, rail industry and INFORMS organization.
- Promote the student paper competition and problem competition to academic institutions.
- Following up with student participants during and after the student paper competition and problem competition to identify roadblocks, provide assistance, and gather useful feedback.

This committee position is a great way for students to get involved in RAS leadership roles and meet members of the rail community. If you know any interested students (or you are an interested student), please contact the 2017 and 2018 chairs, April and Kamalesh.

RAS Problem Repository

The RAS Problem Repository was created in 2011 to facilitate a platform on which:

1. Real-life railroad application problems are presented along with dataset(s) and solutions publicly available for anyone to research, develop and test solution approaches.

2. Researchers may showcase their results, engage in questions, answers and discussions, and measure the performance of different solution approaches.

You can find the problem description and data files on our website: http://informs.org/Community/RAS/Problem-Repository. We encourage researchers to submit different problems to add to the repository. Please contact RAS officers to upload your problem.

News: Railroader Steve Tucker Awarded Prestigious Fellows Award

Steve Tucker has been in the rail industry since 1998, and was recently awarded a Fellow's award by Engineers Australia at a reception at the Grand Chancellor Hotel in Brisbane (see below).

https://www.linkedin.com/pulse/engineers-australias-newest-fellow-steve-tucker. This award recognizes leaders and long-term achievers in the industry. Tucker notes that the exposure he gained presenting at events such as the INFORMS International Conference allowed him to be recognized as an industry leader and innovator. Tucker recently completed a dynamic simulation of the Central Queensland Coal Network, built using the AnyLogic simulation platform. This railway simulation included the entire 2,600km of railway track, every switch, road, passing-loop and over 1000 individually modelled wagons. Once completed, he presented this work at the INFORMS International Conference in Hawaii.

News: CSX Operations Research moved to CSX Technology in 2017

In 2017 the Operations Research group at CSX moved under the CSX Technology umbrella. As work load and demand for operations research & analytics services increased, the need for rapid on demand access to live systems, data and increased alignment with technology resources made the move a logical step forward. We are excited about transition and welcome the new opportunities it will bring. The Operations Research group was previously part of the CSX Operations group.

Have News to Share?

Published a paper? Published a book? Hiring for full timers or interns? If you have news that you would like to share with RAS members, please let us know. We can help spread the word.
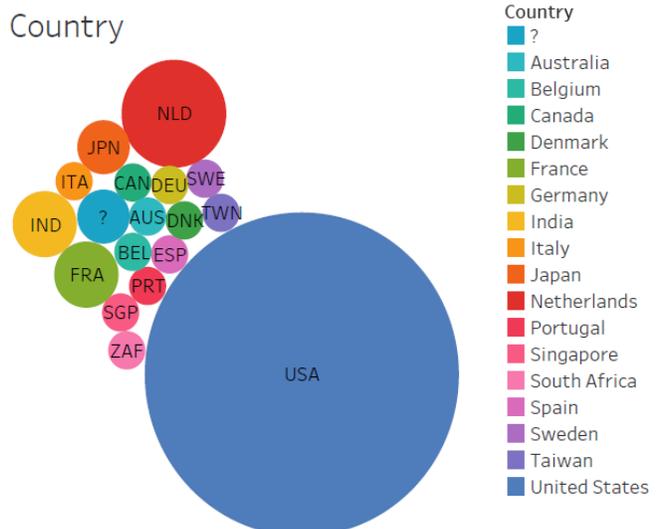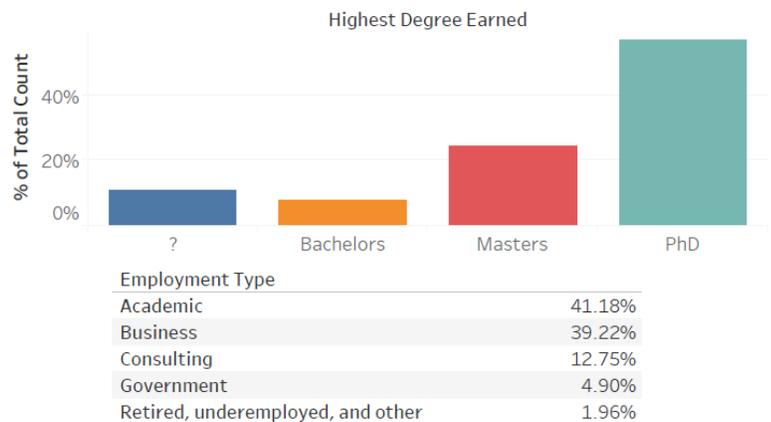
RAS Membership Dues

RAS has two membership levels: student/retired members, and regular membership. Regular members in RAS include railroad officers and staff, academics, consultants, and other with an interest in applying operations research methods to railroad problems. The current rates are as follows: Students and Retired: $5 per year, Regular Members: $25 per year

RAS Membership

RAS membership has declined slightly in 2017 down to a little over 100 members. We strongly encourage students, academicians and business practitioners to join RAS and benefit from many perks of membership. Membership in the group is an exciting opportunity to meet with industry leaders and like-minded professionals, and notifications for the job/internship openings. We have prepared the following membership infographic using membership stats pulled in mid October 2017. It highlights the geographic, employment, and affiliation diversity of the RAS group.

RAS Member Summary 2017

Company Name	Company Name
?	Princeton Consultants, Inc.
AT&T Government Solutions, Inc.	Princeton University
BNSF Railway	QVC, Inc.
CAT Squared	Rey Juan Carlos University
CEA	Rosen Consulting
Clemson University	Rutgers University
Clockwork Solutions	SAS
Collaborative Solutions LLC	Sharma & Associates
Columbia University	Singapore Management University
CSX Transportation Inc	SISCOG
Delft University of Technology	SNCF
Deutsche Bahn AG	Technical University of Denmark
East Tennessee State University	TransNetOpt
Ecole Des Mines de Saint-Etienne	TTX Company
Erasmus University	U of Illinois at Urbana-Champaign
Federal Railroad Administration	Uber Technologies
GE Transportation	Union Pacific
General Electric	University at Buffalo, SUNY
HNTB	University of Bologna
Indian Institute of Management	University of California
Indian Institute of Technology-Kanpur	University of Dayton
Intelligent Railroad Systems	University of Illinois
Jeppesen	University of Illinois Urbana-Champaign
KU Leuven	University of Southern California
Massachusetts Institute of Technology	University of Tennessee-Knoxville
Michigan Technological University	University of Texas-Austin
Movares	University of Tokyo
National Cheng Kung University	University of Utah
Norfolk Southern	University of Wisconsin-Milwaukee
North Carolina State University	Veritec Solutions
Northwestern University	Wayne State University
Oliver Wyman	Wikalytics
OPSI Systems	Xiamen University
Optym	

Highest Degree Earned

Employment Type	
Academic	41.18%
Business	39.22%
Consulting	12.75%
Government	4.90%
Retired, underemployed, and other	1.96%

Country

Country
- ?
- Australia
- Belgium
- Canada
- Denmark
- France
- Germany
- India
- Italy
- Japan
- Netherlands
- Portugal
- Singapore
- South Africa
- Spain
- Sweden
- Taiwan
- United States

RAS Sessions at the 2017 INFORMS Annual Meeting

Cluster Chair:

Nathaniel Richmond **BNSF Railway,** Nathaniel.Richmond@BNSF.com

and Roochi Mishra **BNSF Railway,** Roochi.Mishra@BNSF.com

RAS sessions are held in room 362F unless otherwise noted.

Sunday, October 22

11:00AM	**SB59. 11:00 AM – Education Programs in OR/MS** **Chair: Steven Harrod, Technical University of Denmark** 1. Railway Education Programs at the Technical University of Denmark and Other European Universities, and Related Careers (Steven Harrod, Technical University of Denmark) 2. OR/MS Education in Railways in China (Xy Yin, Beijing Jiaotong University) 3. Railway Operations Education at the University of Illinois At Urbana-Champaign (C. Tyler Dick, UIUC) 4. OR Careers in Railways at BNSF (Pooja Dewan, BNSF Railway)
1:30PM	**SC59. 1:30 PM – RAS Student Paper Awards and Presentations** **Chair: Steven Harrod, Technical University of Denmark** 1. First Place - An Optimization Framework for Fairness-oriented Crew Rostering (Thomas Breugem, Erasmus University Rotterdam) 2. Second Place - Benefits of a dynamic impact zone when dealing with train conflicts (Sofie Van Thielen, KU Leuven) 3. Third Place - Equity-oriented skip-stopping schedule optimization in an oversaturated urban rail transit network (Pan Shang)
4:30PM	**SD59. 4:30 PM – RAS Problem Solving Competition Presentations** **Chair: Yanfeng Ouyang, UIUC** This session is reserved for the finalists of the RAS Problem Solving Competition: "Data Analytics for Railroad Empty-to-Load Peak Kips Prediction." The presenters and their abstracts will be determined the Judging Committee by early October. More information about the Competition is available at http://connect.informs.org/railway-applications/awards/problem-solving-competition.

Monday, October 23

08:00AM

MA59. 8:00 AM – Railroad Machine Learning and Component Failure Analysis

Chair: Qing He – University at Buffalo, SUNY-Buffalo, Roochi Mishra – BNSF Railway

1. Data-driven Railway Track Deterioration Model (Qing He, Amjad Aref, University at Buffalo, The State University of New York, Buffalo)
2. A Machine Learning Approach to Generate Track Surfacing Plan Based On Geometry Car Test Data (Pooja Dewan, BNSF Railway)
3. Bearing Failure Analysis (Landon Smith, BNSF Railway)
4. Prediction of arrival times of freight traffic on US railroads using support vector regression (Daniel Work, William Barbour, University of Illinois, Chicago, IL,)

11:00AM

MB59. 11:00 AM – Railroad OR Applications Showcase

Chair: Kamalesh Somani - CSX

Join us for an interactive look at the substantial use of advanced OR techniques in the railroad industry. Four major North American rail carriers (BNSF, CSX, NS, and Amtrak) will be onsite to give in-depth practical demonstrations of OR tools. Join us to learn how railroads implement robust solutions to complex business problems. The demonstrations will focus on the practical implementation of advanced OR models within companywide systems including the core software and technologies used, large scale data constraints, production level deployment, and business alignment.

1:30PM

MC59. 1:30 PM – Roundtable A- State of Driverless Technology

Chair: Dharma Acharya – GE Transportation

1. The Road to an Automated Transportation Industry (Douglas Mattenburg, J.B. Hunt)
2. State of the Driverless/Smart Driving Technologies (Dharma Acharya, Carl D. Van Dyke, GE Transportation)
3. Benefits of Driverless Technology when Used By Trucking Companies (Bruce Patty, Veritec Solutions)

4:30PM

MD59. 4:30 PM – Roundtable B - Driverless Technology Implications to Freight Railways

Chair: Dharma Acharya, Carl Van Dyke – GE Transportation

1. Rail Renaissance: Responding To The Threat Of Autonomous Trucks (David T. Hunt, Jason Kuehn, Oliver Wyman)
2. Avoiding Irrelevance - A Future State of Railroading (Daniel Plonk, NS)
3. A Possible Railroad Response to Autonomous Trucks: Higher Quality of Service (James Brooks, GE Global Research Center)

Tuesday, October 24

07:30AM

TA59. 7:30 AM - Passenger and High Density Railway Corridor OR/MS

Chair: Shane Wu – Amtrak, Steven Harrod - Technical University of Denmark

1. CO2REOPT: Real-time Train Dispatching On The Iron Ore Line (Lukas Bach, Carlo Mannino, SINTEF)
2. CO2REOPT: Integrated Planning for Multimodal Networks with Stochastic Demand and Customer Service Requirements (Ioannis Fragkos, Joris Wagenaar, Rob A. Zuidwijk, Rotterdam School of Management, Erasmus University)
3. A Rapid Modeling Method for High-speed Railway Terminal Simulation (Yuan Wang, Guangyuan Zhang, Railsmart Technology, Tampa, Southwest Jiaotong University, Chengdu, Sichuan)
4. Passenger Train Food And Beverage Demand Forecasting And Par Optimization (Keivan Ghoseiri, National Railroad Passenger Corporation - Amtrak)

10:30AM

TB59. 10:30 AM – Intermodal Transportation

Chair: Nathaniel Richmond, Mike Prince – BNSF Railway

1. Breaking Deadlocks in Widespan Crane Planning (Steven Tyber, GE Transportation)
2. Intermodal Hub Simulation (Mike D. Prince, BNSF Railway, Fort Worth, TX)
3. Investigating General Intermodal Terminal Capacity Relationships with AnyLogic Simulations (Darkhan Mussanov, Tyler Dick, University of Illinois at Urbana-Champaign)
4. Managing Intermodal Equipment Under Supply and Demand Uncertainties - An Implementation of an Operations Research Tool in a North American Railway (Yudi Pranoto, Clark Cheng, Norfolk Southern Corporation)

12:05PM

TC59. 12:05 PM – Yard Performance Modeling

Chair – Michael Gorman, University of Dayton

1. A Multipurpose Yard Simulation Model (Michael F. Gorman, University of Dayton)
2. Investigating The Relationship Between Volume, Blocking Complexity And Railway Classification Yard Performance With Simulation (Tyler Dick, Nao Nishio, University of Illinois at Urbana-Champaign, Urbana)
3. Yard Planner: A Digital Force Multiplier For Railroad Classification Yards (Jeremiah Dirnberger, GE Transportation)

2:00PM

TD84. 2:00 PM – Poster Session

Chair – Andy Yoon, NS)

Location : GB Prefunction Area

The RAS poster session provides an interactive way to share knowledge and state-of-the-art research in railroad applications. Poster presenters will have the opportunity to show case research or projects that are at early stages of development, and benefit from the interactive critique, suggestions, and encouragement from colleagues working in the area of railroad business analytics and optimization.

2017 Problem Competition

Chair: Yanfeng Ouyang, University of Illinois at Urbana-Champaign; yfouyang@illinois.edu
Problem Owner: ShanShan Wang, and Pooja Dewan, BNSF; ShanShan.Wang@bnsf.com, Pooja.Dewan@bnsf.edu

The 2017 Problem Description: Data Analytics for Railroad Empty-to-Load Peak Kips Prediction

This project asked participants to build a predictive model which can be used to project the peak kips of a currently empty car when it is used under the next loaded status. This implies that the projection will be calculated when the car is empty. This model will help the railroad company exclude the problematic wheels/cars from the next trip.

Peak kips denotes the total vertical force a wheel imposes on the rail. A "kip" is a unit of force that is equal to 1,000 pounds-force, and it can be measured by track-side detectors. The higher the peak kips, the more damage will be imposed to both the wheels and tracks. Railroads use this measure to detect whether there are any defects in either the tracks or the wheels. An alarm will be triggered if the peak kips value is above or equal to 90, and the involved cars need to be set out for inspection and repair (if necessary) either immediately or at the next available repair location. Although immediate action is not required for wheels with peak kips values close to 90, the damage to tracks and wheels might deteriorate (and the peak kips of a defective wheel may further increase) if the defective wheels are not fixed in time. However, setting out a car when it is loaded will cause a lot of loss to railroad company. The shipment might get delayed and the network traffic might suffer from unnecessary disruptions. Therefore, the railroad has an incentive to proactively identify problematic wheels/cars and exclude them from being used for future shipments.

The cash prizes awarded for this year's competition are **First Place: $2000** and **Second Place: $1,000.** Visit the competition web site for additional details: http://connect.informs.org/railway-applications/awards/problem-solving-competition

Special thanks to Oliver Wyman for sponsoring the first place prize!

Finalists (in alphabetical order)

Team OALLIIM:
Tai-Chia Huang, Shiue-Mei Sun, Yun-Hsuan Lu, Department of Industrial & Information Management, National Cheng Kung University, Taiwan

Team TCS:
Harshad Khadilkar, Sudhir Kumar Sinha, Shripad Salsingikar, Tata Consultancy Services, Mumbai, India

Recognition

We thank the committee members for their efforts:

Clark Cheng, Norfolk Southern	Pooja Dewan, BNSF
Jerry Kam, CSX	Xiaopeng Li, University of South Florida
Steven Tyber, GE Transportation	Yanfeng Ouyang, University of Illinois at Urbana-Champaign
Shanshan Wang, BNSF	Aihong Wen, CSX

2017 RAS Student Paper Awards

Chair: Steven Harrod, Technical University of Denmark; stehar@dtu.dk

Railway Applications Section (RAS), a section of the Institute for Operations Research and Management Science (INFORMS), sponsored a student research paper contest on analytics and decision making in railway applications, with a total cash award of $1,750:

First Place: $1,000, Second Place: $500, Third Place: $250.

Special thanks to sponsor Tech Mahindra for funding these awards.

To qualify, the paper must have been written by a student or students enrolled in an academic institution the year ended August 7, 2017.

The paper must demonstrate a subject area of OR/MS that is representative of INFORMS subjects, and may apply to any railway system (freight, passenger, heavy rail, light rail, etc.). The paper must represent original research (not literature reviews) and not have been previously published in a peer-reviewed journal, book, or published conference proceeding. More details on the eligibility criteria, the application procedure and deadlines are available at RAS's website:

http://connect.informs.org/railway-applications/awards/student-paper-award

This year a total of seven papers were submitted. The quality of the submitted papers was in general very outstanding. Authors of the First, Second and Third Place award winning papers will present their papers at the Student Paper Award Session of the INFORMS Annual Meeting in Houston, TX. We encourage all RAS members to attend this session and motivate our young researchers to continue to make great strides in building new models for railroad planning, scheduling and analytical problems. We provide below the abstracts of these papers. Extended abstracts of the awarded papers are available on the RAS website.

We would like to thank the judging committee, who were very helpful in keeping the contest on schedule:

Carl van Dyke, Managing Director, TransNetOpt   Bo Zhou, University of Illinois-Chicago

Javier Faulin, Public University of Navarra   Ato Wangtu, Xiamen University

Yuan Wang, RailSmart Technology   Xuesong Zhou, Arizona State University

The First Place paper has an open invitation for publication in Networks. The paper needs to go through the journal's normal refereeing procedure; however, the paper will receive an expedited refereeing and publication .

2017 RAS Student Paper Awards

An Optimization Framework for Fairness-oriented Crew Rostering

By Thomas Breugem, Erasmus University, Rotterdam, Netherlands

Abstract: We introduce the Fairness-oriented Crew Rostering Problem. In this problem, attractive cyclic rosters have to be constructed, while respecting a pre-specified fairness level. We propose a flexible mathematical formulation, able to exploit problem specific knowledge, and develop an exact Branch-and-Price solution method. We demonstrate the benefit of our approach on practical instances from Netherlands Railways, the largest passenger railway operator in the Netherlands. We are able to construct the explicit trade-off curve between fairness and attractiveness and show that a dichotomous approach can lead to suboptimal results.

Benefits of a dynamic impact zone when dealing with train conflicts

By Sofie Van Thielen, KU Leuven, Leuven, Belgium

Abstract: When two trains want to use the same infrastructure at the same time, dispatchers need to interfere. Their actions are mostly based on experience, however, they are not capable of anticipating the impact of their decision on the network. Therefore, this paper introduces a heuristic that uses offline calculations to create, online, a dynamic impact zone for each conflict. This heuristic needs less than two seconds to determine a solution, taking into account frequently happening other conflicts and expected secondary delays. Experiments on a complex network show more than 67 % improvement in delays compared to basic dispatching strategies.

Equity-oriented skip-stopping schedule optimization in an oversaturated urban rail transit network

By Pan Shang, Tsinghua University, Beijing, China

Abstract: This study proposes a new modeling framework to optimize train skip-stopping pattern for improving system-wide equity performance in an oversaturated urban rail transit network. First, the inequity problem and the first-in-first-out rules in an oversaturated urban rail transit network are analyzed. Then, a passenger-based integer linear programming model is proposed instead of using traditional flow-based formulations to coordinate passengers and trains in a time-discretized high-dimensional space−time−state network, thereby optimizing the train skip-stopping pattern for improving system-wide equity performance. The proposed integer linear programming model can be effectively decomposed to a least-cost subproblem with positive arc costs for individual passengers and a least-cost subproblem with negative arc costs for individual trains under a Lagrangian relaxation framework. In addition, networks with different scales are tested to demonstrate the methodology and computational efficiency of the proposed model and algorithm.

Iron OR – Maximizing Ore Train Capacity and Punctuality

Article by: **Markus Bohlin, Research Institute of Sweden;** markus.bohlin@ri.se

See this project at INFORMS 2017 in Houston at session TA59, Room 362F, 7:30am, Convention Center

The supplies from Europe's largest iron ore mine depends on a single-track railway with low punctuality – but OR is here to help!

The Ofoten railway line in northern Norway is short, only 43 km in total, and with its single-track layout and 7 stations in total would normally be a curiosity of minor consequence. The line is unusual in that it only connects to the rest of the Norwegian rail network via Sweden. However, it also connects LKAB, the largest iron ore supplier in Europe, to its major export port in Narvik, Norway. In fact, 18 million tons of iron ore are shipped annually from Narvik, and 90% of the iron ore produced in the EU is transported on the Ofoten line and its continuation in Sweden. On the Swedish side, the Iron Ore corridor covers another 128 kilometers of single-track railway before reaching LKAB in Kiruna.

The corridor is therefore of vital importance for European industry. However, punctuality on the line was only 70% during the first five months of 2015. As the iron ore production, and hence the amount shipped on the line, is also scheduled to increase significantly in the coming years, prompt action was required.

This is why a team of scientists, in collaboration with LKAB and the Swedish and Norwegian railway infrastructure managers (Trafikverket and Bane NOR), during 2016 applied for funding to solve this and other important logistics problems in Europe. The result was the CO2REOPT project, which promises to provide methods and running prototypes for online dispatching and integrated timetabling based on Operations Research. The project is well underway and the first results are expected during the spring of 2018.

The transportation need on the corridor is expected to increase. Here a number of challenges arise. One of these challenges is the dispatching on the corridor. First, it is a cross-border corridor managed by two independent infrastructure managers with a low degree of real-time collaboration. Second, while the main proportion of the traffic is the LKAB iron ore trains, there is still other intermodal freight trains and passenger trains operating on the corridor. All trains follow a strict schedule, even though the iron ore trains have larger flexibility. Finally, the mountainous terrain puts limitations on at which stations the freight trains can stop to be passed by other trains.
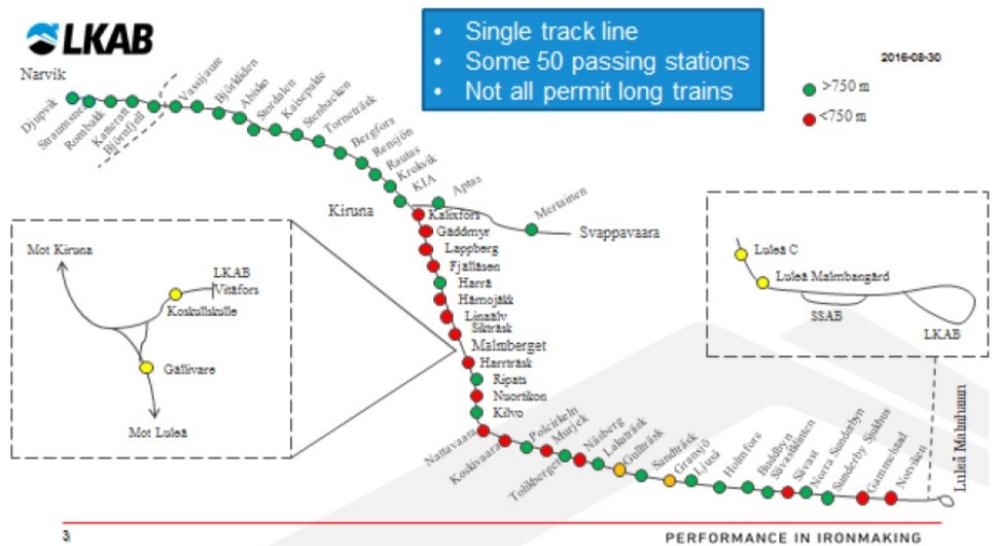
Out of these, in particular establishing decision rules for coordinating dispatching across the border has posed significant challenges. However, OR solutions for most technical challenges have already been developed and can be deployed with little effort once the decision rules have been set. The plan, estimated to be fully realistic by the partnering organizations, is to be ready to implement the first operational prototypes onsite in early 2018.

2017 Distinguished Member Award Winner Pooja Dewan

Article by: Shantih Spanton, CSX; shantih_spanton@csx.com

The success of the RAS organization depends upon two things: the generous support of its sponsors and the contributions of its volunteer leadership. While the volunteer efforts of all our members are valued, certain member contributions go above and beyond the expected, resulting in lasting impact to the organization. The effect of such members give RAS new direction, needed support, and inspire others to contribute. The RAS Distinguished Member Award began in 2012 as a way to recognize member contribution of great impact. This award is not necessarily given every year, and will only be award if nominations of members of noteworthy contributions are obtained. The award committee consists of the current officers, past award winners and past RAS Chairs/Presidents.

The RAS officers committee is pleased to announce the winner of the 2017 RAS Distinguished Member Award: Pooja Dewan.

Pooja has been an integral part of the Operations Research rail community for the past 20 years since the founding of the Operations Research and Advanced Analytics team at BNSF. She currently leads this team as the Chief Data Scientist of BNSF Railway. Pooja has been a RAS member since 1999 and has held numerous officer and volunteer positions with in RAS. Additionally Pooja has been an active organizer and volunteer for the larger INFORMS organization in several capacities.

Pooja has been an active member of INFORMS since early 2000, during which time she became engaged in the RAS community. She was supported and was involved in several key initiatives at their inception including the student paper competition, problem-solving competition, and RAS newsletter. She was the co-organizer of the 2006 Railway Workshop hosted by RAS. This large, high profile workshop event brought together industry and academia around problems related to the rail industry. Another of her key contributions to RAS has been her ability to bring talented, new members and leaders to RAS. She has also been a leader in several other INFORMS events including the INFORMS analytics community, the Edelman Organizing Committee, the Edelman Judging Committee, the INFORMS Analytics Conference Organizing committee. Pooja also served as an Edelman Gala Chair from 2016 to 2017.

During her tenure as a leader of the BNSF OR group, her team has contributed to numerous key initiatives, touching numerous aspects of the company from capital investments, improving labor and train efficiency, asset utilization to capacity expansion. Pooja's passion for operations research and analytics has inspired those she works with and helped to create a culture at BNSF focused on efficiently evaluating how the company plans for the future and executes essential tasks. Pooja's leadership of the BNSF OR team has allowed the team to grow, and she will surely continue to inspire future operations research rail industry leaders, invest in cutting edge technology, and share knowledge across disciplines of all industries and academics.

Please join the RAS 2017 officers committee in warm congratulations of Pooja on reception of this award.

From the Editor's Desk

Steven Harrod, Technical University Denmark, stehar@dtu.dk

Do we have to go back to go forward?

The United States economy and carloadings are recovering, the International Energy Agency projects a tripling of global high speed rail kilometers, and Florida will finally see the opening of a new intercity passenger railway next year. But, HS2 in the UK faces resistance, Amtrak is threatened again, the Danish Togfund faces budget cuts, and CSX is closing hump yards and discontinuing their hub and spoke intermodal service in Ohio. It always seems to be feast and famine in the railway industry, and any economist will tell you that this is a natural outcome of a free market transport system that feels frequent pressure to price at marginal cost and yet must deliver returns to its investors.

The lead story of this month's Trains Magazine says it all, "Operating Ratios: How Low Can They Go?" In short, railways in North America have never been more profitable. But in many cases, they have achieved this by cutting their product offerings back to only the core, most profitable services. How will we grow the economy, and grow railway market share, if there is no investment in new services? Unfortunately, this is not a new question, and it repeats again the historic debate about free enterprise versus communal (government) action. Over the centuries, government has often had to step in when private enterprise did not see a financial return sufficient to justify the risk. Examples of pivotal government commitments are the Erie Canal, the Transcontinental Railroad, and the Interstate Highway System, but there are hundreds more. Especially today, there are numerous investments in branch railway lines at the state level.

This year we are again focused on railway education, but on a more strategic level. How does education and research grow, with stability, in such an environment of instability in railway finance? How should we as an organization, RAS, propose ideas and deliver results that benefit the railway industry, within these constraints? Can a convincing case be made, for investment and planning beyond the next annual report or analysts' call? These are the likely questions we will face, both individually, and as an organization as we plan our activities for next year and seek the support of industry.

A note to readers: I want to give special thanks to Shantih Spanton of CSX, who stepped in at the last moment to write many items and typeset this newsletter. Responsibilities overflowed my desk at press time, including family affected by the Santa Rosa wildfires, and I was not able to fulfill my responsibilities.

— Steven

OPTYM®

Unprecedented Data Mining
By examining your data from a fresh perspective, we help you find new patterns that can improve your scheduling and distribution.
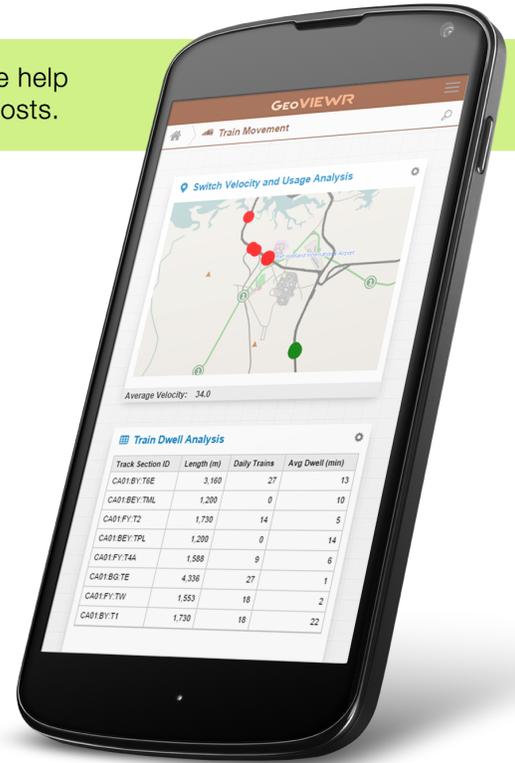
Time-Tested Strategies
Our products have delivered real-world success for railroads, airlines, retail and more, allowing you to plan for your own business with confidence.

An Award-Winning Team
We have a world-renowned technical team that knows how to put optimization in action.

OPTYM.COM

LIVE EFFICIENTLY

Incoming RAS 2018 Officers:

Chair: Kamalesh Somani, CSX

Vice Chair: Shantih Spanton, CSX

Secretary: Nathaniel Richmond, BNSF Railway

Treasurer: Roochi Mishra, BNSF Railway

Public relations officer: Steven Harrod, Technical University of Denmark

Newsletter Staff:

Steven Harrod
Technical University of Denmark

Shantih Spanton
CSX

RAS Business Meeting and Dinner at INFORMS

Business meeting

October 22nd, 2017 6:00PM

RAS dinner

October 22nd, 2017 7:00PM

The Grotto Restaurant, Houston TX