Thank you for a successful 2021 Annual Meeting!!

Kiran Chahar, Norfolk Southern Corp, Public Relations Officer INFOMS-RAS

Despite the continued challenges by the global pandemic, 2021 annual meeting was a success, and that wouldn’t have been possible without the support of many people who put lots of time and energy to make it happen. Starting from INFORMS staff, cluster chairs, international committee members, student liaisons, conference speakers, roundtable’s panelists, competitions’ participants and judges, sponsors, and many others; we want to thank you from the heart and hope you enjoyed all activities organized by RAS during the conference.

We are already planning for INFORMS 2022 so if you are interested in getting involved please don’t hesitate to reach out by email (railwayapplicationssection@gmail.com) or via social media (facebook, linkedIn). Some of the volunteering opportunities are chairing one of our competitions, formulate a problem and provide data for the problem-solving competition, chair the RAS cluster at the annual meeting, organize the roundtable or the interactive session, among others.

Hope you stay safe and healthy during this holiday season.

Wish you all a Happy 2022!!
Invited Article: Railroad Related Deep Learning Text Mining Applications

Trefor Williams, Department of Civil and Environmental Engineering, Rutgers University

tpw@soe.rutgers.edu

Deep learning has emerged as a powerful artificial intelligence tool that can be applied to various types of railroad maintenance and operations issues. Deep learning models are a type of neural network that has more than one hidden layer. These deep neural networks have been found to have superior performance to the original neural network with one hidden layer. Several deep learning models have recently emerged, and these models have very powerful text mining capabilities that include classification problems using text as input, and the ability to automatically answer questions from a text. There are considerable amounts of text data available like maintenance reports, accident records and operational reports that can be mined to gain new insights. This article describes the application of two types of deep learning models to predict maintenance effects on operations and to automatically answer questions about maintenance standards.

The first application describes the results of the application of a Long Short-Term Memory (LSTM) neural network to the analysis of track maintenance log text to predict the effect of maintenance activities on the number of late switching deliveries. The data for the analysis were provided by a U.S. railroad. The data available from the railroad included a daily textual log of the maintenance activities conducted and a separate database that tabulated the daily switching misses. The daily log of maintenance activities consisted of a paragraph description of maintenance activities. The maintenance log data for a three-year period. Railroad management indicated that delays occurred particularly when surfacing was conducted. A switching miss occurs when a car is not delivered on time to a customer. The average total daily switching misses was 33 on days that included surfacing. The average for all days in the study period was 25. This indicates that there is a relationship between heavy maintenance activities and switching operations and that there are patterns contained in the text that may be useful in predicting the effects of maintenance on railroad operations.

The maintenance log entries consisted of pieces of text that are sequences of words, which might have dependencies between them. To learn and use long-term dependencies to classify sequence data, a LSTM Memory deep neural network model was developed. An LSTM network is a type of recurrent neural network (RNN) that can learn long term dependencies between steps of sequence data.). The purpose of the developed model is to predict the level of switching misses that occur on a particular day. The input to the model was only the daily maintenance log text. Potentially there are long term relationships between the type of maintenance work conducted, the location of the work, and switching operations. To improve the accuracy of the neural network model the number of switching misses was converted into a categorical value. The switching misses could be one of three levels, low, medium, or high.

After training the LSTM model was able to predict the level of misses with a 54.79% accuracy using testing data. Figure 1 shows a confusion chart which plots the predicted level of switching misses against with the actual level. Correct predictions are found on the diagonal of the confusion matrix and are colored blue. Examination of the table indicates that high levels of switching misses are predicted with an accuracy of 51.62%. The recall, which is the ratio of correct high levels of switching misses divided by the total number of cases that had high switching misses is 66.67%. This indicated that two-thirds of the cases in the test data where large switching misses
occurred were predicted correctly. The medium level of switching misses was predicted with an accuracy of 52.63%, and low levels of misses were predicted with an accuracy of 45%. It can be seen from the results that the neural network was able to identify high and medium levels of switching misses with moderate accuracy using only the text of the maintenance logs as input. This indicates that there are some patterns in the text that provide an indicator of the effects of maintenance on operations that can automatically be identified by LSTM networks.

A second example of neural network railroad applications uses Transformer networks. They are recently developed deep neural networks that have powerful text mining capabilities. It is possible to train these networks using text from manuals or rule books, and then automatically answer questions. Figures 2 shows some input text from the BNSF design standards for industrial sidings. This text was submitted to a pre-trained BERT network, a type of transformer network. Figure 3 shows that the network automatically generated correct answers to questions. The questions are input by the user.

2.1 Roadbed: Roadbed and ballast section for industrial trackage shall conform to the special roadbed section (see appendix, page A-11), and to the ballast material requirements on page 24.
2.2 Curvature: Maximum degree of curve shall not exceed 9°30' (603.80' radius). All curves are defined using the chord definition. A minimum tangent length of 50 feet must be placed between reversing curves. No turnouts (switches) can be placed in a curve. Mainline turnouts must be placed at least 200 feet from the end of a mainline curve. Industry turnouts within the facility must be placed at least 50 feet from the end of any curve.
2.3 Profile Grade: Track profile grades shall be limited to a maximum of 1.5%.
2.4 Vertical Curves: Vertical curves must be provided at break points in profile grade. The rate of change shall not exceed 2.0 in summits or sags. Vertical curves shall not extend into limits of turnout switch ties. See appendix, pages A-43 and A-44 for BNSF's standard for vertical curves.
2.5 Track: Recommended rail section is 115-lb. or greater. Hardwood ties shall be new 7" X 8" (No. 4) or 7" X 9" (No. 5), 8'-6" long, placed on 21.5" centers with a 6" ballast section. Rail anchorage shall be provided at a minimum rate of 16 anchors per 39' panel. Continuous welded rail (CWR) shall be box-anchored every other tie. Concrete ties can be spaced at 28" center to center with an 8" ballast section. CWR is recommended when using concrete ties. M-8 steel ties (8mm or 5/16" section) can be used in non-unit facility tracks and are spaced at 24" centers with 8" ballast section.

August 2018

Figure 2 Text from BNSF Manual
Question: What is the maximum allowable curvature for an industrial track?  
Answer: 9°30'  
Question: What is the maximum profile grade?  
Answer: 1.5 %

Figure 3 Answers to User Input Questions

The potential for Transformer networks to provide a way to rapidly access information from rule books and manuals in the field is very great. It can be used in the railroad industry to provide access to reference and training materials in the field.

RAS International Committee and Webinars: Continued to be a success story in 2021!

The RAS International Committee was formed at the end of 2019 to increase member engagement and satisfaction. Many thanks to the RAS 2021 International Committee:

Chair: Nikola Bešinović, Delft University of Technology, The Netherlands  
Andrea Arias, BNSF  
Shantih Spanton, CSX  
Yihui Wang, Beijing Jiaotong University, China  
Hadi Karimi, BNSF

The committee was successful in arranging 15 webinars since the beginning of the program. If available, completed talks are posted on the *new* RAS YouTube channel, and the RAS website for your viewing enjoyment.

To join the organizing team, or to suggest topics or speakers, reach out to Nikola Besinovic at N.Besinovic@tudelft.nl.

Thank you 2021 Gold Sponsors!
RAS Member Profile 2021
Kiran Chahar, Public Relations Officer

As of end of 2021, the total number of RAS member was 79, which represents a 21% reduction compared to 2020. 80% of the members are regular, 7% are students, 8% are retired and 5% are community-only members. Out of all members, 60 are from the USA, and the rest from at least 17 countries including: The Netherlands, Canada, China, France, India, among others.
Despite the challenges we faced this year, we had a successful INFORMS 2021 Hybrid meeting, which wouldn’t have been possible without your support, so we deeply thank you for all your commitment and engagement to this wonderful community. We’d love to see you around next year so if you have not renewed your RAS membership, you can do it here, and please also help us spreading the word among your friends and colleagues so we can welcome more people to RAS. Good news is the dues have not changed (see table below) and are FREE for students and retired!!

<table>
<thead>
<tr>
<th>Regular</th>
<th>Student/Retired</th>
<th>Community-Only Regular</th>
<th>Community-Only Student</th>
</tr>
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<tbody>
<tr>
<td>Dues ($)</td>
<td>20</td>
<td>0</td>
<td>30</td>
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</tbody>
</table>

![Thank you 2021 Silver Sponsors!]

RAS Sponsored Sessions – INFORMS 2021

*Alexander Lovett (UP) and Shuai Su, Cluster Chair*

Check out the presentations and recordings available in the [RAS website](#)!!

**Sunday, October 24th**

*Passenger Rail II (Chair: Jiateng Yin; Beijing Jiaotong University, USA)*

- **Rolling Stock Allocation And Timetabling For Rail Transit Network With Multiple Depots**, Fan Pu; Beijing Jiaotong University, China
- **Timetable Optimization For Minimizing Transfer Costs Under Through-operation**, YI ZHENG; PEKING UNIVERSITY, China
- **Dynamic Passenger-centric Railway Traffic Management**, Yongqiu Zhu; ETH Zurich, Switzerland
- **Trains Rescheduling Method During Multi-disturbances Under A Quasi-moving Block System**, Peijuan Xu¹, Francesco Corman²; ¹Chang’an University, China, ²ETH Zurich, Switzerland
• **Train Scheduling Optimization With Virtual Coupled Vehicles For Integrated Commuter Rail And Underground Metro Network**, Simin Chai; Beijing Jiaotong University, China

**RAS Roundtable (Chair/Moderator: Bruce W. Patty; Veritec Solutions, USA)**

• **Improving Rail Share of Intermodal Freight**, Bruce W. Patty; Veritec Solutions, USA
• **Panelist**, Adriene Bailey; Oliver Wyman, USA
• **Panelist**, Michael Leue; Alameda Corridor Transportation Authority, USA

**Monday, October 25th**

**Railroad Maintenance (Chair: Faeze Ghofrani; Penn State Altoona, USA)**

• **Deep Learning For The Detection And Recognition Of Rail Defects In Ultrasound B-scan Images**, Qing He; Southwest Jiaotong University, China
• **Willow Digital Twin for Railway Networks: Lessons and Challenges**, Ali Jamshidi; Willow Inc, Netherlands
• **Use Of Ground Penetrating Radar Measured Track Conditions To Predict Track Geometry Degradation**, Allan M. Zarembski; University of Delaware, USA
• **Inspection Technologies For Reliable Railway Transportation Systems**, Faeze Ghofrani; Pennsylvania State University, USA

**Yards and Terminals (Chair: Roger William Baugher; TrAnalytics, LLC, USA)**

• **Flat Yard Simulation using AnyLogic**, Roger William Baugher; TrAnalytics, LLC, USA
• **Hump Yard Simulation using AnyLogic**, Jiaxi Zhao; University of Illinois at Urbana-Champaign, USA
• **Development of Yard Planning Systems**, Jeremiah Dirnberger; Wabtec Corporation, USA
• **Machine Learning Algorithms for Yard Departure Prediction**, Niloofar Minbashi, Markus Bohlin; KTH Royal Institute of Technology, Sweden
• **Thoughts on Improving Yard Representation in Line Simulation from a Field Perspective**, Tim Robinson; Canadian National Railroad, Canada

**Passenger Rail I (Chairs: Jiateng Yin and D'Ariano Andrea; Italy)**

• **Automatic Train Dispatching: A Real-life Application in the Greater Oslo Region**, Carlo Mannino, Giorgio Sartor, Andreas Nakkerud, Oddvar Kloster, Christian Schulz, Bjornutar Leberget, Giorgio Grani; SINTEF Digital, Norway
• **Effective Pruning Strategies for the Alternative Graph Model**, Marcella Sama¹, Andrea D'Ariano¹, Dario Pacciarelli²; ¹Roma Tre University, Italy, ²Università degli Studi Roma Tre, Italy
• **Train Scheduling Optimization For Commuter-metro Networks: An Improved Job-shop Formulation With Procedence Constraints**, Jiateng Yin; Beijing Jiaotong University, USA
• **Including Stochasticity In Railway Traffic Management Models**, Francesco Corman¹, Alessio Trivella¹, Oskar Eikenbroek²; ¹ETH Zurich, Switzerland, ²University of Twente, Netherlands

**Artificial Intelligence in Railway Transportation (Chair: Nikola Besinovic; Delft University of Technology, Netherlands)**
• **Dealing With Limited Data: Enabling AI In Railways By Transfer Learning**, Lorenzo De Donato¹, Stefano Marrone¹, Valeria Vittorini¹, Francesco Flammini², Claudio Mazzariello³, Frédéric Bernaudin⁴; ¹University of Naples Federico II, Italy, ²Linnaeus University, Sweden, ³Hitachi Rail STS, Italy, ⁴Hitachi Rail STS, France

• **Traffic Delay Predictions in Disrupted Railway Networks using a Graph Neural Network Model**, Christopher Szymula; Technische Universitat Dresden, Germany

• **Artificial Intelligence In Railway Transport: Taxonomy, Regulations And Applications**, Nikola Besinovic; Delft University of Technology, Netherlands

**Tuesday, October 26th**

**Leveraging PTC and Advanced Technologies to increase Rail Capacity** *(Chair: Dharma Acharya; GE Transportation, a Wabtec Corporation, USA)*

• **Capacity and Planning toward a Moving/Virtual Block future**, Ken Kenjale; Wabtec Corporation, USA

• **Comparing the Effectiveness Of Different Train Following Control Algorithms For Freight Trains In Moving Block**, Geordie Roscoe¹, Tyler Dick²; ¹University of Illinois at Urbana-Champaign, USA, ²U of Illinois at Urbana-Champaign, USA

• **Managing Capacity in an Australian Coal Rail Network**, Wayne Johnson; Australia

• **How Positive Train Control Can Help A Railroad Run On Schedule With Precision, Safety, Efficiency, And Profitability And Please Its Customers**, Steven R. Ditmeyer; Transportation Technology and Economics, USA

• **From Moving Block To Virtual Coupling - A Breakthrough In Train Operation**, Hongjie Liu, Ming Chai; Beijing Jiaotong University, China

• **Designing And Rolling Out Movement Planners For European And North American Operations: A Comparison**, Leonardo Lamorgese; Optrail, Italy

**RAS Problem Solving Competition** *(Chair: Hyeong Suk Na; South Dakota School of Mines and Technology)*

• **Arrival Time Estimation for Unit Trains Utilizing Train Matching Techniques**, Geordie Roscoe, Jiaxi Zhao; University of Illinois at Urbana-Champaign, USA

• **Prediction of Estimated Times of Arrival of Freight Trains in US Railroads**, Qing He, Zhen Liu, Qingsong Ma; Southwest Jiaotong University, China

**RAS Student Paper Competition** *(Chair: Faeze Ghofrani; Pennsylvania State University, USA)*

• **The Integrated Rolling Stock Deadhead Routing and Timetabling in Urban Rail Transit Lines**, Dian Wang¹, Andrea D’Ariano², Jun Zhao¹, Qiuyuan Peng³; ¹Southwest Jiaotong University, China, ²Roma Tre University, Italy

• **Effective Train Routing Selection for Real-time Traffic Management: Improved Model and ACO Parallel Computing**, Bianca Pascariu¹, Andrea D’Ariano¹, Marcello Sama³, Dario Pacciarelli¹, Paola Pellegrini², Joaquin Rodriguez²; ¹Roma Tre University, Italy, ²Univ. Lille Nord de France, France

• **Solving the Train Unit Shunting Problem using Multi-Agent Deep Reinforcement Learning with Routing Optimization**, Jacob Trepat Borecka, Nikola Besinovic, Yousef M. Maknoon, Rob M. Goverde, Wan-Jui Lee; Delft University of Technology, Netherlands

**Takeaways from the 2021 RAS Roundtable**

Bruce Patty, Veritec Solutions
Title: Improving Rail Share of Intermodal Freight

This year’s Roundtable focused on opportunities to increase the rail share of Intermodal traffic in the United States. There were three speakers:

1) Bruce Patty, Veritec Solutions – Bruce, who also chaired the session, gave an overview of the importance of international traffic to North American intermodal volumes and how that has evolved over the years.

2) Adriene Bailey, Oliver Wyman – Adriene primarily focused on the results of surveys and interviews done with current and potential intermodal shippers to understand more about how they choose from various transportation options. Results of the surveys were presented along with suggestions for change.

3) Michael Leue, Alameda Corridor Transportation Authority (ACTA) – Michael presented background information on the role of the Alameda Corridor in moving intermodal freight from the ports of Long Beach and Los Angeles onto the networks of the railroads serving Southern California. He also spoke about various projects underway to increase the use of on-dock rail at these ports.

Following the presentation session, there was a session for questions, answers, and dialogue between various participants. Several topics were explored with differing opinions presented.

2021 RAS Problem Solving Competition

Predictive ETA Modeling

Hyeong Suk Na, South Dakota School of Mines & Technology, Competition Chair

Stephen Ecker, Trinity Rail, Problem Owner

Thank you note from the competition chair, Dr. Hyeong Suk Na, “I would like to thank problem owner, Stephen Ecker (Trinity Rail), and the other committee members (Jay Baillargeon, Ian Coleman, Carl Van Dyke, Marc Meketon, Steve Tyber, Daril Vilhena). They have offered their help in all possible ways as a volunteer outside their day-to-day work duties to make this competition a success.”

For this year’s competition, participants were asked to (1) determine whether the RFID data provided to railcar owners and/or shippers can be used to produce a more accurate estimated time-of-arrival (ETA) than the conventional reported ETAs, and (2) when this RFID data is supplemented with GPS event data, whether even greater accuracy can be obtained. There are numerous proven examples within many industries of successful remote monitoring use cases, though it remains to be seen whether rail-related supply chain predictability can be tangibly improved through leveraging GPS location data. On a broader scale, achieving more accurate ETAs will help enhance the attractiveness of the rail transportation mode as a whole, including driving increased supply chain efficiency and actual cost savings for rail shippers. Solving this challenging problem effectively will not only have immediate benefits to freight railroads and their customers but will also enable other important decision problems affecting railroad operations to be addressed.
Competition Criteria:

- Solution quality, Methodology, Quality of presentation, Scalability, Applicability in the railroad industry
- The quality of the final presentation given by finalists at the 2021 INFORMS Annual Meeting

A total of 12 teams registered this year, despite the challenges presented by the pandemic. Congratulations to the winners for their hard work! And a BIG thank you to all the judges and problem owners for their important contribution to the success of this year’s competition.

The slides and recordings of the finalists’ presentations at INFORMS 2021 can be found in the RAS Website.

Congratulations to the winners and many thanks for your contributions!!! The winners of the 2021 Railway Applications Section Student Paper Award are:

**First Prize:** *Arrival Time Estimation for Unit Trains Utilizing Train Matching Techniques*” by Geordie Roscoe and Jaixi Zhao (University of Illinois at Urbana-Champaign)

**Second Prize:** “*Prediction of Estimated Times of Arrival of Freight Trains in US Railroads*” Zhen Liu, Qingsong Ma, and Qing He (Southwest Jiaotong University)

Hyeong Suk Na (Problem Solving Competition Chair) is an Ervin Pietz Assistant Professor of Industrial Engineering at South Dakota School of Mines & Technology. His research interests include the stochastic optimization, artificial intelligence and machine learning, traffic operations and control, emergency management, social influence analysis, network theory, and agent-based simulation modeling. He received a Ph.D. in Industrial Engineering and Operations Research from the Pennsylvania State University in 2019 and an M.S. in Industrial Engineering from Texas A&M University in 2014. He also received a B.S. and an M.Eng. in Industrial and Systems Engineering from Inha University in 2008.

**A perspective and takeaways from the 2021 RAS Problem Solving Competition (Predictive ETA Modeling)**

Carl Van Dyke, TransNetOpt

This year’s problem-solving competition took a different approach to prior ones. Instead of an optimization problem, we instead created an exercise in data analytics and forecasting. All of this was made possible by the provision of an excellent data set by Trinity Rail.
One of the most frequently encountered challenges for railroad customers is tracking and monitoring in-transit products, knowing where the products are, and when they will arrive. While railroads have long provided equipment movement events that tell you where your shipment was last located, little reliable information is provided on when a shipment will arrive. Railroads do attempt to provide arrival estimates for carload traffic through the use of trip plans that are applied to pre-planned or fixed train schedules. For unit trains, less is known, meaning that unit train ETAs are at best “SWAGs” and often not provided at all.

As a result, shippers often try to predict when a shipment will arrive based on a combination of historic performance data for a lane, and the current status reports for a specific shipment. These status reports are based on a combination of manual event reporting by the railroads, and events generated when railcars pass specific RFID reader locations. With the advent of GPS units and a robust cellular network, the opportunity has arisen to supplement this railroad provided event data with additional location reporting using GPS transponders.

This year’s challenge focused on the development of predictive models to forecast the estimated time of arrival (ETA) of unit train and large multi-car shipments at their destinations. We provided a robust database of unit train movements, as reported by a combination of RFID and railroad generated events, supplemented by additional GPS-based location reports. Trinity Rail equipped a number of its tank cars with GPS transponders and collected this data along with the railroad events for a multiple year period. As a result, we had a database of over 600 unit train moves concentrated in three corridors (Alberta to/from Plaines, IL; North Dakota to/from Washington State; and North Dakota to/from Philadelphia). In total, several million sighting events were provided to the competition participants.

The central idea was that looking across all of the shipments in a train or multi-car shipment allows the event data to be combined to provide a richer dataset for the overall train. Furthermore, use of the supplemental GPS data might provide a further improvement in the ETA estimates. Thus, problem participants were asked to create models that used, and did not use, this supplemental GPS data. The vast majority of the data was provided for use in model building and training. We held back the data on a number of the movements so that we could use it to test the models once they were complete. The basic test was to look at the accuracy of the ETAs the models provided against the actual ETAs observed in the field.

Marc Meketon and I took the lead on the final preparation of the data, creation of the problem statement, and answering of questions raised by participants. The data was to some extent “packaged” and “cleaned” for this competition and provided using a standard “csv” format compatible with programs such as Excel or Access. That being said, in many cases the datasets will be too large to be loaded fully into either of the above cited programs. Instead, the entrants likely needed to write custom code to load and manipulate the data in memory, or use other databases such as MySQL, PostgresSQL, etc. We structured the data into three parts: (a) Route Profiles, (b) Shipment Headers, and (c) Shipment Details.

We also noted a variety of “problems” with the data. For example, there could be reports for railcars that were removed from a train or one reason or another, and thus were inconsistent with the overall movement of the train. Not all railcars had the same location reports – some events might be missing, and others might be
spurious. Events could also be out of order due to errors in the timestamps on some records. The GPS data also had its share of issues, including cases where it appeared that the GPS unit might no longer be attached to the railcar. Most of the GPS issues related to location accuracy in that the GPS location were not directly associated to stations along the rail lines.

While we threw out some particularly egregious trains and shipments, we left many of these data “issues” in the database. Such issues always arise in large datasets, and we felt that their inclusion was a fundamental element of the problem. Thus, this year’s competition was an exercise in both forecast modeling, and data analytics.

While we had limited participation in this year’s competition, likely in part due to it not being a traditional optimization model, we did get a few excellent submissions. The problem is clearly a very challenging one, and I think remains somewhat intractable if one desires reasonable accuracy in the production of ETAs. The problem description and data sets are available on-line through the RAS website, and I hope some of you will consider taking a look at the problem set and maybe try to “solve” it. Our industry is definitely handicapped by its perceived unreliability, and ideas for how to address this issue can only benefit the railroads going forward.

Carl Van Dyke (PSC volunteer) has over 40 years of experience building and applying models and analytic tools to the railroad industry both in North America and globally. He founded MultiModal Applied Systems in 1992, which developed the MultiRail service design tool. MultiModal was acquired by Oliver Wyman in 2006, where Carl served as a Partner through year end 2013. Now semi-retired, he continues to take on consulting engagements, working as a senior advisor to both Oliver Wyman and Princeton Consultants. He is currently advising Cedar AI in the design of their tools and the adaptation of those tools to specific markets. He has also created an Access-based freight railway service design and evaluation model called “Rail Expess.” He is a founding member of RAS, and a past Chair.

Dr. Marc Meketon (PSC volunteer) has many decades of experience in network solutions and OR across a number of industries, including airlines and freight railroads. Past experiences include stints at Bell Labs, US Air, and Conrail. He was heavily involved in revenue management at US Air and participated in the development of the Conrail Network Analysis Model (CNAM). He joined MultiModal Applied Systems in 1997, which was subsequently acquired by Oliver Wyman. He is currently a Vice President at Oliver Wyman. Marc has played key roles in the development of numerous rail-related software solutions including MultiRail, blocking plan optimizers, locomotive planners, traffic processors, and line capacity analysis. Recent engagements have spanned the airline, trucking, and railroad industries, where is continues to focus on the application of optimization, heuristics, and data analytics to industry problems. He is a long time RAS member, frequent contributor, and past newsletter editor.
After a careful two-month assessment process, we finally selected four outstanding winning papers of this year’s Student Paper Contest. The final decisions have been made together with the RAS Chair Steve Tyber. Seven papers were submitted to the contest. Papers were evaluated on 6 criteria: the problem novelty, methodology, results and conclusions, scientific contribution, contribution to practice and composition. All papers received double-blind reviews by multiple reviewers. Overall, judges were quite positive about the solid quality and diverse research topics of all submitted papers. The Railway Applications Section is grateful for the great commitment of the judges: Jiateng Yin and Yihui Wang (BJTU, China), Valentina Cacchiani (U of Bologna, Italy), Dennis Huisman (Erasmus U, Netherlands), Luis Cadarso (RJCU, Spain), Bisheng He (SWJTU, China), Christian Liebchen (ZU, Germany), Andrea Arias (BNSF, USA), and Faeze Ghofrani (PSU, USA). The winners of the 2021 Railway Applications Section Student Paper Award are:

**First Prize:** Bianca Pascariu, Andrea D’Ariano, Marcella Samà, Dario Pacciarelli dario.pasciarelli, Paola Pellegrini, Joaquin Rodriguez, from Roma Tre University (Italy), and Univ. Lille Nord de France (France). “Effective train routing selection for real-time traffic management: improved model and ACO parallel computing”

**Second Prize:** Jacob Trepate Borecka, Nikola Bešinovic, Yousef M. Maknoon, Rob M.P. Goverde, Wan-Jui Lee, from Delft University of Technology (the Netherlands), and Utrecht, The Netherlands (the Netherlands). “Solving the Train Unit Shunting Problem using Multi-Agent Deep Reinforcement Learning with Routing Optimization”

**Third Prize:** Dian Wang, Andrea D’Ariano, Jun Zhao, and Qiyuan Peng, from Southwest Jiaotong University (China), and Roma Tre University (Italy). “Integrated rolling stock deadhead routing and timetabling in urban rail transit lines”

Congratulations to the winners!! Each recipient will receive a cash award of $1,000, first place, $500, second place, and $250, third place. The slides and recordings from their presentations at INFORMS 2021 can be found on the RAS Website.

**Invited article: Wabtec’s Yard Planner is live in Birmingham, Alabama**

*Jeremiah Dirnberger, contact: Jeremiah.dirnberger@wabtec.com*

The industry’s first end-to-end decision support tool for Classification Yard operations achieved a significant milestone this summer when the system went live at the Norfolk Southern Norris Yard in Birmingham, Alabama. The joint development project to create Yard Planner began in 2013 and the system has evolved from being a separate decision support application to the new front-end for yard inventory management. Yard Planner
automatically generates plans as the state of the yard changes and adapts to user modifications to those plans. The system also provides seamless execution of worklists and train-to-track moves. The deployment experienced a high level of positive end user feedback and additional inventory management functions are being added to assist with the change management process.

This collaborative effort between rail operational experts and technologists, end users, operations researchers, and computer scientists has resulted in a robust, flexible and effective planning tool for classification yards. Deployment to the second NS hump yard is starting and Wabtec is working with two short line customers to adapt the system to work in flat yard environments. Yard Planner is a testament to the power of OR combined with an iterative approach actively involving the feedback of the end users. Yard Planner is also a foundational piece of the Highly Automated Yard roadmap that Wabtec is advancing as part of its Freight 2030 vision with Genesee & Wyoming (GWI) and Carnegie Melon University (CMU). For more information on Yard Planner, please contact Jeremiah Dirnberger at Jeremiah.dirnberger@wabtec.com.

Yard Planner in use in the main hump tower at NS' Norris Yard in Birmingham, Alabama, USA

Did you know?

That RAS has multiple contact points on social media?
Dear Community,

I would like to start by expressing my deepest appreciation to each and every one of our RAS members, sponsors, and volunteers. You all are the backbone of this wonderful community, and every activity we have done has been possible thanks to your unconditional support and commitment.

Serving as Vice-Chair this year was such an honor. I really enjoyed working with everyone in the outgoing officers’ team. Steve, Hadi, Jay, and Kiran: thank you for your service to RAS and for working very hard so we can accomplish all our goals.

Behind every single thing we do in RAS, there’s many people who volunteer their time and expertise to make it happen. I would say we are a very privileged community, since an important proportion of our membership actively participate in activities such as the planning for the annual meeting. To our student officer (for the second year) Marko Kapetanović, we appreciate your engagement and dedication, thanks for keeping the RAS website updated and for helping us spreading the word about RAS. To our cluster chairs Alexander Lovett, Shuai Su, and Bruce Patty; in my opinion this year was the most difficult to deal with regarding planning sessions given the hybrid format, yet you managed to overcome every challenge, and the result was a successful annual meeting, so thank you very much for that!

This year we continued to host most of our annual competitions. To Faeze Ghofrani and Yihui Wang, thank you so much for taking the lead on the Student Paper Competition; as usual, I was impressed by the high quality of the submissions. Our appreciation also goes to the judges, participants, and sponsors who made it possible. I would also like to thank Hyeong Suk Na and Jay Baillargeon for co-chairing the Problem-Solving Competition on Predictive ETA Modeling; to Stephen Ecker from Trinity Rail, thank you for serving as problem owner; special thanks to Marc Meketon and Carl Van Dyke for providing full support and guidance for this competition; to the judging team, thank you for providing valuable feedback; thanks to every team that submitted a solution; and to our sponsors once again, thanks for allowing us to award our winners with cash prizes. Congratulations to all the winners!

I would also like to thank Bruce Patty for organizing this year’s executive roundtable. I think you nailed it! We had great presentations on improving rail share of intermodal freight, and as usual, they were followed by a discussion with our guest speakers. Many thanks to Adriene Bailey (Oliver Wyman) and Michael Leue (Alameda Corridor Transportation Authority) for sharing their insights about this very relevant topic.

Last but not least, thank you to the RAS International Committee: Nikola Bešinović, Shantih Spanton, Yihui Wang, and Hadi Karimi, for keeping the RAS Webinar Series going. As of October 2021, we have hosted 14 webinars and all of them have had great participation. Our sincere gratitude goes also to every guest speaker who has presented in these webinars, thank you very much for volunteering your time and sharing your knowledge.
with us. We are planning to continue with this initiative during 2022 and look forward to what will come next. Most of the recordings from these webinars (and presentations from previous annual meetings) are available in the [RAS YouTube channel](https://www.youtube.com) so we invite you to stop by and like our videos!

**Looking ahead**

First, I would like to welcome our 2022 RAS Officers: Nikola Bešinović, Jay Baillargeon, Rajan Varadarajan, and Faeze Ghofrani. I look forward to working with you all and I’m very excited about all the new learnings and the good things that we will accomplish together.

I’m very positive about next year and expect things gradually going back to normal. Hopefully we have a full in-person annual meeting in 2022 so we can bring back activities such as the Interactive and Poster sessions and share a networking dinner together in Indianapolis. We have started conversations again about events like the Rail Planning Conference, and there are some ideas about creating a fund to sponsor student RAS members to attend rail conferences. We will continue to revise and improve our current Bylaws and Policies and Procedures; and will keep working on finding better ways to add value to our members and sponsors, as well as to contribute to the growth of RAS. Lately we have seen an increase in international engagement, and we are very encouraged about it. That’s one of the reasons we created the RAS International Committee last year, and it has been such a success that we believe it may be time for us to transition this committee into formalized positions within the RAS Officers team.

Summarizing: with many exciting things in the works there will be lots of opportunities for volunteering, so if you feel this is the year you want to be more active within RAS, please reach out! We will be very happy to work with you. And if you feel this may not be the year or you are very busy... don’t worry! You can still help by sharing your ideas or feedback, participating in things like surveys, casting your vote in elections, spreading the word about RAS, etc.

Again, many thanks for being part of this amazing community.

**Meet the 2022 RAS Officers!**

*Andrea Arias, incoming chair 2022*

Join us in welcoming the RAS leadership team that will support our incoming chair Andrea Arias on continuing the great job that previous leaders have done in the past for RAS. We want to thank all the people who participated in this year’s election, we appreciate your commitment and willingness for making RAS a better community. Please remember that there are many volunteer opportunities within RAS aside from being an officer, for example chairing one of our competitions or our cluster at the INFORMS Annual Meeting.

Aside from incoming Chair Andrea Arias, who offers her own introduction here in the newsletter, there are two new officers and one “trading up”.
Vice Chair: Nikola Bešinović, Delft University of Technology

Nikola is the current Chair of the RAS International Committee.

Bio/Position Statement: Nikola Bešinović is a Lecturer and Researcher at Department of Transport and Planning, Delft University of Technology, The Netherlands. His research develops optimization and analytics methodologies to promote efficient, reliable, and sustainable transportation systems. His focus is on railway traffic management systems, where he proposes data-driven decision-making approaches to enhance railway operations, train scheduling and driver behavior. He is interested in new resilient transportation concepts, determining critical infrastructure, and impacts of increased transport demand on further technological development of railway systems. Nikola received several scientific awards, including the Young Railway Operations Researcher Award from IAROR, the First Prize at the TRAVISIONS Young Researcher Competition, the Best Student Paper from INFORMS Railway Application Section, and the 3rd IEEE ITS Best Dissertation Award.

Nikola has been an active member of INFORMS RAS since 2015, he served as a chair of the RAS Student Paper Contest, a jury member of the Problem-Solving Competition, a Cluster chair, and organized sessions. Currently, Nikola is a member of the RAS International Committee, and hosts the RAS international webinar series. As Vice Chair, he will support the Chair, continue to strengthen the RAS community, and share the RAS message across all continents. Second, he will provide new knowledge to RAS members through the webinars and propose new communication formats such as workshops and online articles. These would aim to actively involving the existing membership as well as lead to attracting new members. Together with the RAS team, Nikola strives to work towards further establishing RAS as an international top-class railway association.

Secretary: Jay Baillargeon, Federal Railroad Administration

Jay continues his service as Secretary.

Bio/Position Statement: Mr. Jay Baillargeon is a Program Manager for the Federal Railroad Administration’s Office of Research, Development, and Technology and is based at the FRA’s Transportation Technology Center in Pueblo, Colorado. He leads a relatively new research program focused on the enhancement of railroad safety through innovative analytical strategies, including artificial intelligence applications for track-related datasets. Jay currently serves on multiple inter-agency task forces related to data management and artificial intelligence at the U.S. Department of Transportation (DOT), including the DOT’s AI Task Force in response to the Presidential Executive Order on AI. He has more than ten years of experience working in the railway industry and holds a Bachelor of Science in Mathematics and a Master of Science in Industrial and Systems Engineering. He’s been a member of the INFORMS Railway Applications Section for the last two years and, during the 2020 organizational year, served as the Problem-Solving Competition Chair. In addition to INFORMS, he is also a member of the American Railway Engineering and Maintenance-of-Way Association (AREMA) and the Institute of Industrial and Systems Engineers (IISE).

Regarding his experience directly related to the position of Secretary, Jay has served on similar positions both in and outside of the industry, including coordination, planning, and documentation of activities for Association of American Railroads’ (AAR) Strategic Research Initiatives steering committees, such as the Railway Technical Working Committee (RTWC), during his time with the Transportation Technology Center, Inc., or TTCI.
Furthermore, his experiences in secretarial matters extend to similar positions outside of the work environment as Recorder for the Knight of Columbus Council 557 and Assembly 90, a position that is responsible for maintaining accurate documentation of meeting proceedings and action items as well as communication of these to the membership on a regular basis.

For the upcoming organizational year, Jay’s goal is to continue to serve the needs of the RAS by providing accurate and timely information to both officers and membership as well as be a liaison to the officer for various annual activities, including the Problem-Solving Competition and the Distinguished Member Award Selection Committee.

Treasurer: Rajan Varadarajan, Norfolk Southern

Rajan is new to RAS administration.

**Bio/Position Statement:** My name is (Dr.) Rajan Varadarajan. I have been working in various management capacities for nearly 18 years at NS Operations Research. These opportunities helped me learn a lot about the railroad industry, especially from operations research and I/T perspective.

This year I am applying for the position of Treasurer of INFORMS RAS section. This would be a good step for me for gaining more exposure to this nice professional group. The relevant credentials are as follows. I have developed a lot of experience with payroll and invoice logic found in agreement and non-agreement payroll and ERP systems at railroad industry. I have been looking at business intelligence and analytics aspects in these topics for quite a long time. As a result, I understand dollars and cents quite well. My MBA experience has also exposed me to Finance and Accounting subjects that would be quite relevant to this position. As a result, I should be able to handle the duties of the treasurer position such as a) administering and disbursing the RAS Section funds as directed by the Section Chair, b) annual budget preparation for the section, c) keeping clean records of the transactions, and d) preparing and distributing reports of the financial condition of the RAS Section.

Public Relations Officer: Faeze Ghofrani, Pennsylvania State University (Altoona)

Faeze is new to RAS administration.

**Bio/Position Statement:** Faeze Ghofrani is currently an Assistant Teaching Professor of Rail Transportation Engineering at Pennsylvania State University (Altoona). She holds a PhD in Civil Engineering from State University of New York at Buffalo. She has over seven years of research experience in railroad transportation Engineering. Her research vision is to incorporate recent data analytics advances and technologies into a broad range of railroad engineering problems. She has been an active member of INFORMS Railway Application Session (RAS) since 2018. Faeze was a student officer in 2019 and currently, she organizes the RAS Student Paper Competition and serves as RAS “Railroad Maintenance” session chair.

As Public Relations Officer, Faeze would like to strengthen the RAS community by reaching out to new experts, students, researchers, and young professionals from all over the world while maintaining the current members engaged. Also, one of her main goals is to keep the RAS community well
informed and connected through improving RAS website, social media and distributing quality content in the newsletter amongst other initiatives.

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