

Editor's Desk: Challenges for OR in Railroads

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For the past several years, my colleagues and I have been actively engaged in developing operations research techniques for solving several railroad planning and scheduling problems. We have had some successes and some failures, some wins and some losses, some pats on the back and some scathing criticisms. We do not think that we have succeeded yet but have not lost hope either. We are beginning a journey and the goal is still far away — much remains to be done to succeed. But we have learned a lot about what it takes to succeed. We need to overcome several major challenges. I am outlining below some of these challenges and what we can do to overcome them.

Data Quality

The data quality for a railroad company is rather poor. There is bad data, incorrect data, and missing data. Trains start at locations that do not exist in the railroad's node file; railcars move over blocks that are not to be found in the block file; trains move over links missing in the link file; a railcar's trip plan has gaps in the block and train sequences. I sometimes wonder how railroads are functioning so well and making huge profits despite this quality of data. Though railroads may function very well despite bad data, our programs would not function well at all. Programs would just crash. We hope that railroads will invest resources to improve data quality. At the same time, we must build sophisticated routines that will test data quality from all perspectives and report any problems found. We also need routines that will automatically repair some simple data problems or eliminate parts of the data that will have insignificant impact on the solution quality. Improving data quality is one of our main challenges; without good quality data we cannot go too far.

Problem Difficulty

The railroad industry is one of the oldest businesses in the modern world. Older a business, the harder it is to change its business practices. Current railroad business practices impose such constraints that generating a feasible and implementable solution becomes a major technical challenge. Generating a crew rotation plan that honors all crew union rules and FRA regulations isn't just a plain MIP (mixed integer program) that we can solve by CPLEX. Generating a railroad's locomotive operating plan isn't simply an integer multi-commodity flow problem. In both cases, there is much more to it. These two problems are well solved in the airline industry but remain unsolved for railroads. To succeed in the railroad industry, we need to develop algorithms that can handle numerous constraints without breaking down. Implementability is more important than the optimality of the solution. We need to build custom algorithms to solve specific problems. Decomposition techniques, which decompose the original problem into a series of decision problems, seem to work very well for railroad problems. However, how to decompose the problem without compromising much on solution quality is an art rather than a science. We also need our algorithms to be robust and flexible so that additional constraints can be easily added.

Zero-Base vs. Incremental Solutions

Large corporations cannot afford to make big changes in their plans unless there is a crisis, since it causes big disruptions to their normal operations and involves increased risk of failure. However, they are open to small changes that create opportunities for improvements. Small changes create quick benefits and instill confidence among users. Further, by making a series of small changes, larger changes can be made over time. Thus, a solution technique that creates improvements through small changes to operating plans and practices with a specified degree of change will be much more useful for railroads than the technique that creates a zero-base or a clean-slate solution, which may significantly differ from the current solution. We call such algorithms *incremental optimization algorithms*. An incremental optimization algorithm optimizes the problem within the specified degree of freedom of a given solution. Researchers working on railroad optimization problems need to develop incremental algorithms in addition to zero-base algorithms, and such algorithms are much more likely to be used compared to zero-base algorithms.

>> Continued on Page 3



RAS Chairman's Message

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Railroad Industry:

The U.S. railroad industry has been experiencing unprecedented growth in recent years. Many believe that a railroad renaissance is here and will stay for the foreseeable future. According to a study prepared for the Association of American Railroads (AAR) by Cambridge Systematics, Inc., US railroads may be required to handle nearly twice as much volume in 2035 as they do today. This is a conservative estimate since it's based on an assumption that railroads will maintain market share with no growth. However, it is expected that freight rail will increase market share because freight rail transportation reduces highway congestion and is more fuel-efficient and environmentally friendly compared to trucking.

OR in Railroad

Operations research (OR) professionals are facing the same growth challenge. But, fortunately, there are a number of ways to add capacity. The most inexpensive way is to make a railroad run more efficiently and better utilize its assets. Over the years, railroads have adopted various OR models in areas such as car scheduling and distribution, network optimization, train service design, locomotive and railcar fleet planning, crew sizing, and track maintenance scheduling; but, there is much more to be done. It is up to the OR community to seize the opportunity and apply OR models and techniques to help railroads meet the challenge.

Rail Application Section (RAS)

RAS has more than 150 members from all over the world and is financially sound. For more information about RAS, please visit the RAS web site at <http://www.informs-ras.org/>. The web site is hosted and maintained by Innovative Scheduling. Please note that the RAS business meeting is on Sunday, October 12, at 6:15 pm.

2008 Annual Meeting

This year's annual meeting will take place in Washington, DC, from October 12th through 15th. RAS is organizing eight sessions and one joint session, including two roundtable sessions on Sunday, October 12, four sessions on Monday, and three sessions on Tuesday. The topics cover various areas such as locomotive planning, hazardous material routing, rail yard simulation, scheduling, study paper competition, OR theory and practice, and hot topics in railroad. For more information, please contact the cluster chair, Mike Gorman, at the University of Dayton. (Michael.Gorman@udayton.edu).

Roundtable

The theme of this year's roundtable is "Rails to the Capital." The topic is government/railroad relations: infrastructure investment, security, and regulation. Speakers include railroad executives, government officials, and consultants. For more information, please contact the roundtable chair, Steven Harrod at the University of Dayton (Steven.Harrod@udayton.edu).

RAS Dinner

Following the RAS business meeting, we will continue our tradition of having a group dinner on Sunday at one of the fine local restaurants. The dinner is free to RAS members. Details of the dinner venue are given on the last page of the newsletter. Our dinner speaker is Don

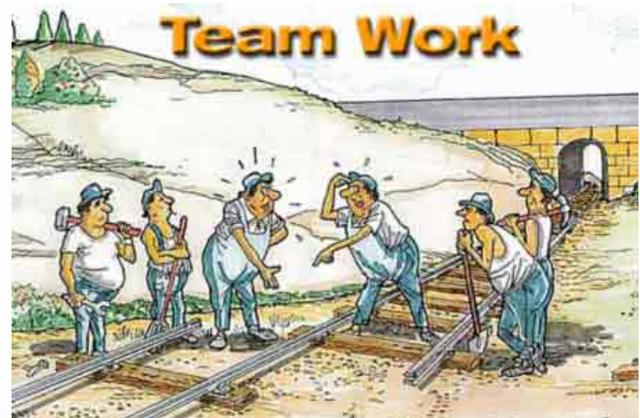
Phillips, an aviation and railroad safety expert and a columnist for the *Trains* magazine.

I look forward to seeing you in Washington, DC.

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Safety Facts

- An eight-car passenger train travelling at 62 mi/h requires about 0.66 miles to stop. When travelling at 81 mi/h, a stopping distance of about 1.13 miles is required.
- The average 150-car freight train travelling at 37 mi/h needs about 0.6 miles to stop. At 62 mi/h, the same freight train needs about 1.5 miles to stop.
- An automobile travelling at 56 mi/h requires about 65 yd to stop.
- An approaching train activates flashing light signals and gates approximately 20 seconds before the train reaches the crossing.
- Approximately 50 per cent of vehicle/train collisions occur at crossings with active warning devices (gates, lights, bells).



Communication Gap >> Real Gaps

Simulating Coal Rail Operations in Australia

Colin Eustace and Paul Corry, Maunsell | AECOM

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Australian coal rail networks are under significant pressure to cope with rapidly increasing throughput in response to global demand. Accounting for approximately 56% of Australia's coal exports, Queensland ports intend to increase system capacity from 165Mtpa in 2006/07 to approximately 261Mtpa over the next three years. Conceptual plans consider as much as 450Mtpa for the longer term. Forecast of additional export terminals at the ports, expansion of existing mining operations and introduction of new mines all add to the anticipated demands on the rail systems. The rail infrastructure and operations must be capable of delivering the tonnages forecast for other components of the logistics chain. For the rail system to deliver the required tonnage, significant changes in infrastructure, rolling stock and operations will be necessary. Discrete event simulation plays an important role in assisting with the development and planning of new rail infrastructure and operations.

The coal rail systems on the east coast of Australia provide common infrastructure for a large number of independently operated mines as well as many different domestic and export coal terminals. Coal train movements are typically unscheduled, driven by varying mine demand, and complex due to the size of the network and rail yards. Priority timetabled passenger and freight train services share much of the network infrastructure. Complex stacking route constraints at export terminals limit concurrent train unloading to specific combinations of product types. There is also a strong coupling between the timing of unloading operations at the export terminals and rail yard operations, which impose different provisioning requirements for different train types. The unique complications and unscheduled nature of coal operations place the challenge of simulating the operations beyond most commercially available rail simulation software, which is generally timetable driven with some localized conflict resolution.

In order to provide a realistic representation of rail operations across the Bowen Basin coal network in Queensland, a rail operations model has been configured using a rail operations simulation platform (RailOPS). RailOPS is developed using the general-purpose simulation programming language SLX. A large number and wide range of freight rail projects have provided the opportunity to develop and test the rail simulation platform.

The simulation platform provides the flexibility and extendibility to construct a detailed and realistic representation of almost any coal or other freight rail operation. The representation of the network infrastructure is taken directly from scaled CAD drawings incorporating all junction work details. All locomotives, wagons and train configurations are modeled explicitly, allowing a realistic representation of the rail operations including shunting operations where necessary. The core of the rail simulation platform is a prioritized section-locking algorithm for conflict avoidance. The approach provides an analogue for the control of signalized track sections and is sufficiently robust such that on-demand train services can run without the requirements for an input train schedule for the model. The section-locking algorithm provides low-level management of train movement. It is possible to overlay high-level logic specific to the constraints and objectives of the system to provide a realistic representation of particular control methodologies when required. The approach incorporates an inherent arrival order priority, but this can be overridden to give priority to particular trains and influence their routing decisions.

The ability to run train services on demand removes the requirement for subjective and burdensome timetable development for configur-

ing simulation scenario runs. This allows the relationship between increasing throughput and system performance to be mapped without the subjective influences of the timetable development practitioner. The performance mapping allows Queensland Rail to plan the staging of infrastructure, rolling stock fleet and operational upgrades to meet contracted levels of performance. Simulation results also allow the identification of the infrastructure upgrades necessary to achieve the required tonnage levels as demands on the system increase.

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Editor's Desk (contd.)

Unscheduled Operations

I think that what makes railroad planning a truly difficult decision problem is that it is partly scheduled and partly unscheduled (or on-demand), and the same set of resources serve both parts. The same set of locomotives pulls both the scheduled and unscheduled trains, and the same crews operate both types of trains. Scheduling resources to optimally meet the needs of both networks is a very complex problem that has eluded operations researchers. Modeling unscheduled operations remains a challenge for us, and I do not see that we can address it satisfactorily anytime soon. Hopefully, railroads will bring more of their operations within the scheduled sector and thus increase modeling of scheduled resources.

Trust in Modeling

Since the inception of railroads, human minds have run them. Thus, a person who has been solving decision problems for the past 20-30 years is reluctant to follow a computer's recommendations. I have observed some lack of trust in computerized decision-making among railroad professionals. They want help and are open to it but aren't sure whether models can be fully trusted for answers. If our models produce answers that they can use and that make their work life easier, the trust will grow. It is thus our responsibility to build models whose solutions are realistic enough to be implementable. If we can also provide some justifications of our solutions, it will further increase their trust in our answers. If our model recommends a certain decision, can we justify that decision? Can we say that the model evaluated more than 1,000 options and found the recommended option to be the best one? We should explore ways to justify a model's answers through sensitivity analysis and convince the user of the power of optimization.

I have observed that in the past few years, railroad managements have shown greater willingness to embrace operations research methodologies. All railroads are hiring operations research professionals and starting new initiatives. As experienced railroad professionals are retiring in mass, management wants to use models to replace some of them and empower the remaining with computerized decision support systems. Carl van Dyke recently said, "optimization is in the air." It is indeed the case. The era of optimization has dawned. It is now our responsibility to build and deploy systems that get used by railroads, create value for them, and generate an excellent rate of return on their investments. Let us all work together and help one another to create such success stories for ourselves, for railroads, and for the discipline of operations research.

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Remarks on the Acceptance of U.S. Government Investment in Railways

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The U.S. railroad industry is poised on the edge of a new era of government-funded new railroad construction and corridor expansion. In the past decade, the success of a number of publicly funded or subsidized rail infrastructure projects has weakened a nearly 100-year aversion to government sponsorship of railroads. The Alameda Corridor linking the Los Angeles connections of BNSF and Union Pacific to the ports of Los Angeles and Long Beach is a prominent example. Eighty-one percent of the 20-mile corridor's \$2.4 billion cost was funded by publicly sponsored bonds or loans.

The mutual acclaim of the Alameda Corridor by all parties contrasts with an earlier, generally frosty relationship between U.S. railroads and the Federal government, and to a lesser extent local governments, reaching back to World War I. Recovering from what is generally viewed as a disastrous period of wartime Federal control, railroads were successively threatened by a Federal campaign for highway construction and its accompanying unregulated motor carriage, liberal support for unionization, and micromanagement by the Interstate Commerce Commission. In this period, the views of U.S. railroads, as expressed by the Association of American Railroads, converged to a dominant policy of non-interference, opposition to regulation, and suspicion of government intentions.

With this prologue, it is not surprising that until recently only railroads in severe distress sought public aid, which in the 1970's was synonymous with the dramatic bankruptcies of Penn Central, the New Haven, the Jersey Central, the Rock Island, and the Milwaukee Road. In each case, aid was provided not to grow the network, but just to keep the network alive. The first round of aid for this purpose was the 3R Act, signed by President Nixon on January 2, 1974, which provided for the sponsorship of Conrail and the restructuring of the Northeast railroad network. The second round came from the 4R Act, signed by President Ford on February 6, 1976. This act provided \$147 million to the Chicago and North-Western for welded rail installation between Chicago and Omaha, among other provisions, but nothing for parallel Rock Island, and implicitly determined that the Rock Island, the Milwaukee Road, and other redundant lines should be abandoned.

One has to reach back to the antebellum era to find government as the dominant participant in railroad development. Many generations of railroad management have been very sensitive to this characterization, because many a child has been raised on history lessons of robber barons and corporate largesse enabled by government land grants to the railroads. The Association of American Railroads was so sensitive to this issue that they distributed "Railroad Land Grants: Paid For in Full" in 1984. In this pamphlet, the total mileage of railroads funded with land grants is calculated as 7% of the U.S. peak rail mileage of 1916, and it is stated emphatically, "Clearly, the great majority of railroad entrepreneurs received no federal assistance."

The focus on land grants, especially Federal land grants, obscures the many other active forms of participation in railroad development by local governments and orchestrated investment endorsed by civic organizations. Railroads frequently obtained financing through loans or bonds underwritten or guaranteed by cities, towns, counties, and sometimes states. The Louisville and Nashville received a subscription of \$1 million from the city of Louisville in 1851, two years before construction actually began. Towns frequently bid their investment in lines far above their "fair share" in order to guarantee that main lines would be routed through their economic center. The L&N main line

was routed through Bowling Green, Kentucky because it raised \$1 million in funding, whereas Glasgow, relegated to branch line status, only raised \$300,000.

In some cases, communities had to take matters into their own hands. For example, take the Norfolk Southern's main line from Cincinnati to Chattanooga. In a twist of irony, this line was constructed by the city of Cincinnati because Ohio law prohibited the direct sponsorship of private corporations with public funds. Beginning with a \$10 million bond issued by the city of Cincinnati in 1869 and continuing with loans from the Ohio legislature in 1876 and 1878, the C.N.O. & T.P. "Rat Hole" division was constructed with over \$18 million of Ohio public sponsorship. It continues today as a property of the city of Cincinnati, leased to Norfolk Southern. A portion of Norfolk Southern's route in North Carolina is also state owned, managed as the North Carolina Railroad, and leased to Norfolk Southern. Taken as a whole, the U.S. railroad network owes far more to public sponsorship than the 7% land grant statistic implies.

This October we will gather once again at INFORMS, and this year's theme is "Rails to the Capital." We will receive presentations from the Federal government, economic consultants, and principals in public/private infrastructure projects at both Norfolk Southern and CSX. Norfolk Southern's project, the Heartland Corridor, is budgeted for \$318 million from state and Federal sources, with Norfolk Southern budgeting \$90 million or more. Not to be outdone, CSX has announced the National Gateway corridor, consisting of lines linking Columbus, Baltimore, Washington, and Wilmington. CSX is seeking approximately \$400 million of public sponsorship for this \$700 million investment. We look forward to seeing you in Washington, DC!

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"quick quotes"

The United States as we know it today is largely the result of mechanical inventions, and in particular of agricultural machinery and the railroad.

- John Moody

There is something about the sound of a train that's very romantic, nostalgic, and hopeful.

- Paul Simon

A railroad is like a lie you have to keep building it to make it stand.

- Mark Twain

RAS Student Paper Awards

Michael F. Gorman, University of Dayton, Michael.Gorman@udayton.edu

RAS (Rail Applications Section), a section of INFORMS (Institute for Operations Research and Management Science), sponsored a student research paper contest on Management Science in Railroad Applications. This contest offers the following awards:

- Cash Awards: \$500 First Place, \$250 Second Place
- Honorable Mention recognition for other top papers

Authors of First Place and Second Place are asked to present the papers at the Student Paper Award Session of the INFORMS Annual Meeting in Washington, DC. RAS covers the conference registration fees for all primary authors who are asked to present their papers.

To qualify, the paper must be written by a student or students enrolled in an academic institution during the 2006-2007 academic year. The paper must relate to the application of Management Science for the improvement or utilization of railroad transportation, and it must represent original research that has not been published elsewhere. More details on eligibility criteria, the application procedure, and deadlines for submission are available at RAS's website: www.informs-ras.org.

We expect that these award-winning papers will be presented in the Student Paper Contest session at the INFORMS 2007 Meeting in Seattle. We give below the abstracts of these papers. 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 and scheduling problems. This year we had submissions from Canada, China, Europe, India and the US on topics including crew scheduling, intermodal facility location, train time tabling, and railcar storage.

First Prize:

- **A Decision Support Framework for Rolling Stock Rescheduling.** Lars Kjær Nielsen, Rotterdam School of Management, Erasmus University Rotterdam, The Netherlands; lnielsen@rsm.nl

Abstract: We present a generic framework for modeling disruptions in railway rolling stock schedules. A disruption is modeled as an online rolling stock rescheduling problem where information on resource availability becomes available as the situation evolves. We propose a rolling horizon approach to decompose the problem and extend an existing model for generic rolling stock scheduling to the real-time case. We perform computational tests on instances constructed from real life cases and discuss their implications.

Second Prize:

- **An Algorithm for Railway Crew Rescheduling.** Daniel Potthoff, Erasmus University Rotterdam, The Netherlands; potthoff@few.eur.nl

Abstract: On the Dutch railway network, there are about 20 disruptions daily. In this paper, we present an algorithm to reschedule the crew when such a disruption occurs. The algorithm is based on column generation techniques combined with Lagrangian heuristics. Since the number of duties is very large in practical instances, we first define a core problem of tractable size that has a high chance of delivering a good rescheduling solution. Then, the algorithm performs a limited number of large neighborhood search steps to improve the solution.

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Palace on Wheels (1982, India): Among world's top-10 luxurious train: outer view and inner View

Using Software Tools to Provide Improved Hazmat Visibility for Freight Railroads

David Hunt, Kevin Foy, and Paul Stephens, Oliver Wyman

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New Political, Commercial, and Social Concerns for Rail-Based Hazmat Shipments

The transport of dangerous goods or hazardous materials is an important part of any industrialized economy. In the United States, more than 1.7 million carloads of hazmats, including explosives, poisonous and radioactive materials, are transported annually by rail. Approximately 105,000 of these carloads are toxic inhalation hazard (TIH) materials, such as chlorine and anhydrous ammonia.

According to the US Department of Transportation, there were 19,734 hazmat incidents in 2007. Rail accounted for 975 incidents, less than 5 percent of the total, while 17,135 incidents were highway related. Given the number of railcars on a single train and the amount of material these cars can hold, rail incidents can be particularly damaging. In Table 1, note that while there were no hazmat related rail fatalities in 2007, the monetary damages were almost equal to highway incidents, which occurred at a rate 11 times that of rail incidents.

Table 1 – US Hazmat Incidents in 2007 by Mode of Transportation

Mode of Transport/Cause	Incidents	Fatalities	Monetary Damages
Air Incidents	1,563	0	\$95,780
Highway Incidents	17,135	13	\$48,584,753
Rail Incidents	975	0	\$47,955,205
Water Incidents	115	0	\$33,394

Source: US Department of Transportation.

Given the origins and destinations of these shipments along with the geometry of the track, it is often necessary to route hazmat shipments through major population centers and through the vicinity of culturally significant or “iconic” structures and environmentally sensitive areas. This issue has become especially important in the U.S. since the September 11, 2001 terrorist attacks, and new U.S. federal regulations specifically address this and other hazmat-related issues.

New US Federal Regulations on Rail-Based Hazardous Materials Transportation

In April 2008, the US Federal Department of Transportation released interim final rules for “Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments.” These rules, detailed in the Federal Register 49 CFR Parts 172 and 174, came into effect on June 1, 2008 and set significant milestones for freight railroads throughout 2008 and 2009.

The rules apply to all rail-borne shipments within the United States, with the most restrictive rules applying to the carriage of three categories of freight: poison inhalation hazard (PIH) materials; Division 1.1, 1.2, or 1.3 explosive materials; and high-level radioactive materials. The new rules also require railroads to respond to certain administrative and operational requirements. Railroads must do the following:

- Analyze current and alternate hazmat network paths while taking into account 27 designated attributes, and collect and retain data to support these route analyses.
- Enhance security plan requirements to address issues including en route storage, delays in transit, delivery notification, and additional inspections.
- Operationally ensure that designated hazmat paths are followed and that new train speed restrictions are observed.
- Comply with new tank car requirements, which call for increased puncture-resistance protection to prevent penetration at 25 mph for side impacts and 30 mph for head-on collisions.
- Communicate hazmat shipping information within one hour of request by the Transportation Security Administration.

Response to the New Hazmat Rules

Response by the Railroads

The general response by the railroads has been to develop solutions to meet expanded network route review regulations, modified to the increased reporting requirements for the government. In 2005, in anticipation of the hazmat rule changes, the Railroad Research Foundation awarded a contract to Information and Infrastructure Technologies, Inc. (IIT) for the development of web-based software to support assessment of network routes based on risk.

This product, called the Rail Corridor Risk Management System (RCRMS), is specifically designed to analyze the risks of routing certain hazmat materials on specific routes, based on the new hazmat rules. The RCRMS contains the necessary data structure and algorithms to enable the railroad users to “score” routes based on their desirability (lowest probability and severity of an accident), based on the commodity, route, and an automated rating using the 27 risk factors listed in the interim rules. However, the RCRMS will not generate or suggest alternate routes; it will only evaluate routes specified by the user.

A Software Approach to Support the New Rules

It is our belief that the rail carriers will need more than the “scoring” of various routes as provided by the shared RCRMS. They will also need tools to manage the following:

- Precise recording of how hazmat shipments were moved in the past, e.g., exact records of routes, the trains carrying the freight, work events, and dwell times along the routes;
- Planning of how future hazmat traffic will be moved at the physical route level; once again, including information on trains, dwell times, and work events;
- Generation and evaluation of possible alternative routes and functionality to compare the routes; and
- Analysis of the effect of new routings on the operating plan – that is, the impact of the proposed alternative routes and “scored” routes on the car blocking and train plan.

The railroads will need efficient software tools to analyze their past, present, and forecasted traffic and network routing options and to develop a screening process before they present possible routing options to the RCRMS. We believe that the Oliver Wyman Traffic Flow Analyzer (“TFA”) and MultiRail® Enterprise Edition (“MR-EE”) systems are capable of managing most of this analysis and of meeting the requirements of the US federal hazardous shipment rules.

The following is a summary of our proposed process steps for the software-based analysis and implementation of U.S. hazmat regulations:

- The historic hazmat shipments (from 12 to 48 months of data) will be identified at the physical routing level. This can be done using TFA, which will record historic waybills, the underlying trains that each waybill used, and the en route work events that took place.
- TFA summarizes this historic data into a set of unique origin-destination pairs (“O-D” pairs), where each O-D pair is broken out by the type of hazardous materials commodity carried and the physical route that was used.
- For new hazmat shipments, the MR-EE software is used to extract the current “official” hazmat routes that are being used by the railroad, which include the block sequences and train service for each extracted O-D pair.
- The railroad must now identify potential alternative routes for the new hazmat traffic movements. To do this, the software will generate a set of “reasonable” alternative routes for each O-D pair, using variations of a “k shortest path” algorithm. These alternative routes, including the proposed block assignments and train services, are then analyzed using MR-EE.
- The TFA and MR-EE software then provide a framework for setting up variables for specifying key attributes among the 27 risk factors in the network database used by these systems. The TFA/MR-EE software uses this subset of the risk analysis factors to further analyze the alternative routes for compliance to the new hazmat rules.
- Based on this combination of the shortest physical paths, blocking plan, train plan, and the user-defined weighting of the 27 risk factors, the TFA and MR-EE software will generate a list of alternative routings for each selected O-D/commodity pairing.
- The selected alternative routings are fed into the external Railroad Research Foundation’s RCRMS for “scoring.”
- Once the user has selected the “best” scored routes from the RCRMS’s outputs, the TFA/MR-EE system can be used to analyze the physical routing so that the railroad can ensure that the route is operationally viable and makes economic sense. The software is also used to “translate” the RCRMS results back into a car block sequence and appropriate train services to ensure that the “correct” hazmat route will be followed by the operating plan for each O-D pair.
- The industry is required to perform a post-shipment analysis of all hazmat movements. This post-shipment analysis, using TFA, will produce reports on the O-D pairs that were observed as well as on the attributes of the routes used in terms of the 27 risk factors. The system will retain selected hazmat routes identified during the TFA-based analysis and will also retain the “scores” of the other routes analyzed by RCRMS and fed back to the TFA.

Conclusion:

Implementation and the Benefits of a Software-Driven Process in Hazmat Route Evaluation

We believe effective management of hazmat shipments requires that planning and operational procedures be integrated with those used for planning the entire railway. The specialized requirements for hazmat shipments should be seamlessly incorporated into the regular operational planning process, and the required data retention and storage should be automatic.

We have proposed that large railways use a system such as the Traffic Flow Analyzer (TFA) and MultiRail-Enterprise Edition (MR-EE) to manage various facets of hazmat transportation and to incorporate this process into their general operational planning and execution processes. We also support the concept of using the TFA and MR-EE to incorporate hazmat planning and route evaluation as a means to provide real-time hazmat car classification instructions to the carrier’s real-time systems. Additionally, non-MultiRail users can leverage the TFA system to integrate hazmat planning, route evaluation, and data retention capabilities directly with their current planning software.

Planning and execution of hazardous materials transportation can be made more efficient and safer using the appropriate software tools. New hazmat transportation rules, such as the US DOT’s interim final rules for “Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments,” create a situation whereby the US Class I railroads must quickly comply with complex and possibly costly regulations. Software-enabled hazmat shipment planning and execution may be the only way for railroads to efficiently and economically conform to the new hazmat rules.

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RAS Sessions at 2008 INFORMS Annual Meeting, Washington, DC

Sunday (October 12): Cluster 52	
1:30 – 3:00 PM	<p>SC60: Panel Discussion: Rails to the Capital Presentations Chair: Steven Harrod, University of Dayton</p> <ul style="list-style-type: none"> Special Policy and Private Capital in Railway Investment (Steven Harrod) Norfolk Southern's Infrastructure Investment to Meet Future Growth (Wayne Mason) Strategies for Public/Private Infrastructure Investment and Management (John Gibson) Government Objectives in Financing Rail Infrastructure (Joyce Rose) Easing Rail Owners' Capital Crunch Using Public-Private Partnerships (Neil Pogorelsky)
4:30 – 6:00 PM	<p>SD60: Rails to the Capital Discussion Chair: Steven Harrod, University of Dayton</p> <ul style="list-style-type: none"> Roundtable Discussion to be Continued
6:15 – 7:00 PM	<p>RAS Business Meeting</p> <ul style="list-style-type: none"> Presentations by RAS Officers.
7:00 – 9:30 PM	<p>RAS Dinner</p> <ul style="list-style-type: none"> Details are given on Page 10 of this Newsletter. Please RSVP to howard.rosen@jeppesen.com by October 6.
Monday (October 13): Cluster 52	
8:00 – 9:30 AM	<p>MA60: Student Rail Research Paper Contest Chair: Michael Gorman, University of Dayton</p> <ul style="list-style-type: none"> A Decision Support Framework for Rolling Stock Rescheduling (Lars Kjær Nielsen) An Algorithm for Railway Crew Rescheduling (Daniel Potthoff, Dennis Huisman, Guy Desaulniers)
11:00 – 12:30 PM	<p>MB60: Generating and Evaluating Railroad Hazardous Materials Routings Chair: Carl Van Dyke, Oliver Wyman</p> <ul style="list-style-type: none"> Transportation Security and Rail Routing (Robert Fronczak) A Comparison of Safety and Security Factors on Alternative Rail Routes (Theodore S. Glickman, Nuala Cowan, Ryan Engstrom, Galen Evans) Strategies for Rail Hazmat Routing Risk Assessment and Management (Michael Swain, Dharma Acharya, Suneil Kuthiala) Hazardous Materials Route Generation and Evaluation (Carl Van Dyke, Dave Hunt, Paul Stephens)
1:30 – 3:00 PM	<p>MC60: Railyard Simulation and Tools for Crew Assignments Chair: Kamalesh Somani, CSX Transportation</p> <ul style="list-style-type: none"> Win-Win on Regular work Assignments for Union and Carrier (Scott Setser) Yard Simulation Optimizer: A Decision Support System for Intermodal Yard Planning (Rob Girardot, Michael Gatto) Extensible Simulation Framework for Railyard Operations (David Ciernoczkowski)
4:30 – 6:00 PM	<p>MD60: Hot Topics in Rail OR Chair: Michael Gorman, University of Dayton</p> <ul style="list-style-type: none"> Disruption Management at Netherlands Railways (Dennis Huisman, Leo Kroon, Gabor Maroti, Lars Nielsen, Daniel Potthoff) Real-time Railcar Scheduling (Shankara Kuppa, David Ciernoczkowski) A Hybrid Algorithm and Compaction Process for Railcar Movement Reconstruction (Ingrid Schultze, John Gray, John Ransom, Chris Sanford)

Tuesday (October 14): Cluster 52

8:00 – 9:30 AM	TA60: Locomotive Optimization: The State-of-the-Art Chair: Michael Gorman, University of Dayton
	<ul style="list-style-type: none"> • Motivations, Uses, and Benefits of Locomotive Models at CSX Transportation (Andy John, Kamallesh Somani) • Locomotive Planning and Real-time Assignment Models at CSX Transportation (Ravindra Ahuja) • Locomotive Optimization for Norfolk Southern using Approximate Dynamic Programming (Warren Powell, Belgacem Bouzaïene-Ayari) • Locomotive Fleet Planning System at Norfolk Southern (Clark Cheng, Belgacem Bouzaïene-Ayari, Junxia Chang, Sourav Das, Ricardo Fiorillo, Warren Powell)
11:00 – 12:30 PM	TB65: Joint Session Scheduling in Service/RAS: Scheduling in Railroads Chair: Anant Balakrishnan, University of Texas at Austin
	<ul style="list-style-type: none"> • Optimal Routing of Locomotives to Shops for Quarterly Maintenances (Ravindra Ahuja, Andy John, Artyom Nahapetyan, Zeynep Sargut) • Passenger Coach Utilization on Indian Railway: Leveraging Standardized Train Composition and Scheduling (G. Raghuram, Narayan Rangaraj, Piyush Verma) • Scheduling Track Maintenance at CSX Transportation (Kamallesh Somani, Seungmo Kang, Xiaopeng Li, Yanfeng Ouyang, Fan Peng) • Planning Supply of Ballast for Maintenance in the Railroad (Shankara Kuppa, Michelle Clark, John Fuller)
1:30 – 3:00 PM	TC60: OR in Rail: Theory and Practice Chair: Michael Gorman, University of Dayton
	<ul style="list-style-type: none"> • Modeling Network Transition Constraints with Hypergraphs (Steven Harrod) • Yield Management in Freight Transportation (Long Gao, Mike Gorman) • Timetabling with TS-OPT (Thomas Schlechte, Ralf Borndorfer) • Optimal Routing of Geometry Cars (Juan Morales, Anant Balakrishnan, Gang Li)

"interview"

Jim wanted a job as a signalman on the railways. At the job interview, the inspector asked him this question: "What would you do if you saw two trains heading for each other on the same track?"
 Jim said: "I would put all signals to danger"

"What if they were going too fast?", asked the inspector.
 Jim said, "I would switch the points for one of the trains."

"What if the lever broke?", asked the inspector.
 "Then I'd dash down the signal box steps waving a red flag", said Jim.

"What if it blew away in the wind?' asked the inspector.
 "Then I'd run back into signal box and phone the next signal box."

"What if the phone was engaged?"
 "Well.....in that case," persevered Jim, " I'd rush down out of the box and use the public emergency phone at the level crossing."

"What would you do if that was vandalized?"
 "Oh well, then I'd run into the village and get my Uncle Harry."

This puzzled the inspector, so he asked, "Why would you do that?"
 "Because he's never seen a train crash!!"

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Free RAS Dinner at INFORMS

We would like to invite all RAS members for a dinner on Sunday (October 12) at the INFORMS Meeting. Please show your commitment to RAS by joining us at the dinner. This dinner will be free for all RAS members. The dinner will take place at 7 PM at the **Lebanese Taverna Restaurant** located at 2641 Connecticut Ave, NW, Washington DC, just one block from Marriott and Omni Hotels; Telephone: (202) 265-8681. Another special attraction of the dinner will be a featured lecture by **Don Phillips**, an aviation and rail safety expert. Lead sponsors: Innovative Scheduling, Jeppesen Rail, Logistics, & Terminals, and Oliver Wyman. Supporting sponsors: CSX Transportation, Norfolk Southern Corporation, and Union Pacific Railroad. Please RSVP to Howard.Rosen@jeppesen.com by October 6. We will try to accommodate you even if you do not RSVP in time but may not guarantee it.



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