RailMAX: A New Generation Train Movement Planning System for Railroads
TABLE OF CONTENTS

1. INTRODUCTION.................................................................1
2. BUSINESS PROBLEM .........................................................3
3. RailMAX OVERVIEW ..........................................................5
4. SIMULATION-GUIDED MEET-PASS OPTIMIZATION ALGORITHM .....6
5. ADDITIONAL CAPABILITIES OF THE OPTIMIZATION ALGORITHM.....8
6. RailMAX DECISION SUPPORT SYSTEM ..................................10
7. RailMAX BENEFITS .........................................................14
8. CAPABILITIES UNDER DEVELOPMENT ..................................15
INTRODUCTION

Railroads are the backbone of passenger and freight transportation in several countries. As economies are growing all over the world, there is also a growing need for more passenger and freight trains. Several rail corridors have reached their peak capacity; additional trains cannot run unless major capital investments are made in infrastructure improvements. Thus, railroads all over the world are looking for ways to run more trains safely and predictably on the available infrastructure.

Planning and scheduling trains, especially freight trains, is a difficult task. While passenger trains have published schedules, some freight railroads do not; many freight trains are on-demand trains, and their schedules change daily. Train planners do not have the luxury of time to optimize train schedules on a daily basis. Frequent disruptions require constant changes to the schedule, and it is beyond human capacity to do this well.

What makes train scheduling so difficult? Trains move on tracks, and tracks have a limited capacity. A typical rail network is a combination of single track, double track, or even multi-track networks. Track speeds vary due to geography and track health, and some tracks are out of service for specific periods due to maintenances. If two trains are moving on a single track segment in opposite directions, then they cannot pass one another. The rail network has sidings, or passing loops, where one train waits while the other train passes by. Creating feasible movements for tens or hundreds of trains on a complex rail network on a daily basis — for instance, deciding what trains wait at which sidings, and for how long — is, mathematically, an extremely hard decision problem. Furthermore, there are thousands of these decisions to be made and each, in turn, affects the outcome of other decisions. This problem needs to be resolved each time any train deviates from its previous schedule. It is this problem, also known as the meet-and-pass optimization problem, which makes train scheduling immensely difficult,
and this decision problem is unique to
the railroad industry.

Currently, train scheduling is done by
experienced Train Controllers (TCs).
A rail network is typically divided into
multiple areas, called control areas,
and each TC plans the movements of
trains in their control area. Each TC
projects the paths of all trains moving
in their area into the future, identifies
future train conflicts, evaluates multiple
options, and makes decisions.
However, human capacity to do
calculations and evaluate options is
limited; thus, a TC may find a good
feasible solution, but not necessarily
an optimal solution. Further, since
we divide the entire rail network into
multiple control areas and each control
area is managed separately, several
inefficiencies are linked to the myopic
nature of decision-making and lack of
communication between different TCs.

Optym has done considerable
research in train scheduling and,
using the latest operations research
and computer science techniques,
has developed algorithms that
can outperform and outsmart
human decision-making, and
create a network-wide optimal train
schedule. These algorithms have
been packaged into an interactive
decision support system which we
call RailMAX. In this White Paper, we
give an overview of RailMAX, explain
its features and capabilities, and
outline how it can assist railroads in
solving several decision problems
related to train scheduling. We believe
that through the use of RailMAX and
changing current processes, rail
network capacity can be increased by
5% - 10% and, simultaneously,
average train velocity can be
increased by 5% - 10%.

We believe that through the use of RailMAX
and changing current processes, rail network
capacity can be increased by 5% - 10% and,
simultaneously, average train velocity can be
increased by 5% - 10%.
BUSINESS PROBLEM

Railroads are looking for solutions to the following business problems:

Creating Train Schedules

Railroads know the number of trains, as well as the origins and destinations of those trains, several days in advance. They need to create detailed train schedules, including departure times at their origins, intermediate stops and times, and arrival times at their destinations. Train schedules need to be disseminated to all stakeholders ahead of time so that they can plan their operations accordingly. Creating schedules beforehand that will be followed on the day of operation is vital to the efficiency of the entire supply-chain network, which includes rail as a component. Train schedules need to be complete; that is, they should consider all possessions and moving objects in the network. Complete train schedules should be executable either by human intervention or automatically throughout the entire network.

Goal-Driven Train Schedules

Trains can move on the network in several ways. We can make different meet-and-pass and meet-and-overtake decisions which result in different train schedules. Different trains can wait at different locations for different periods, and arrive at their destinations at different times. Railroads want goal-driven train schedules where a common goal governs all train movements in the network. The ultimate goal is to meet business targets, satisfy demand, and maximize the usage of assets. This goal can take different forms as the condition of a rail network changes. If rail network capacity is in short supply, then the goal will be to minimize train dwell on tracks. If port capacity is in short supply, the goal will be to maximize the utilization of the port terminal.
Resource Management

A train can be scheduled to depart if all resources such as rail cars, locomotives, crew, material to load, unloading facility, paths, etc. are available. As the departure time approaches, resources with specific ID’s must be committed to the schedules. At this stage, proper information such as departure time, departure location, estimated arrival, etc. must be taken into account to ensure the availability of these resources at the required time. On the day of operation, however, any given resource may not be available; in this case, a recovery plan needs to be generated by the system.

Decision Support

Railroads want decision support capabilities in their train scheduling system. They want the ability to create multiple what-if scenarios for different inputs such as maintenances, different parameter values such as goal setting, different business logic such as train priorities, etc., and to analyse the impact of these changes on network KPIs. Through these what-if analyses, they identify the best scenario and put it into production.

Maintenance Planning

Train movements on tracks cause wear and tear; as a result, track health deteriorates over time. Tracks need to be maintained periodically; maintenance may include several processes such as grinding the track surface, replacing tracks, or changing the concrete below the tracks. For these maintenances, tracks are taken out of service for several hours, impacting train movements. While performing maintenance may cause closures of tracks and immediate loss of profit, postponing maintenance will cause reduced speed of trains, track failures, or derailments. Railroads need to decide which tracks to maintain for what time periods to minimize the impact on train operations.

Visibility and Analytics

Railroads want the ability to create train schedules that correctly predict future train schedules, optimize a specific goal, and adjust train schedules as unplanned events and disruptions occur in the network. Railroads also want the ability to disseminate train schedules to all stakeholders – such as mines, ports, yards, stations, locomotive management, crew management, and maintenance crews – in order to plan their operations accordingly. Railroads also want the ability to analyse past train movements and identify areas of improvements so that better train schedules are created in the future.

Optym’s RailMAX software solution is designed to meet all of these business needs.
RailMAX
OVERVIEW

RailMAX is one integrated system designed to meet all train scheduling related needs of railroads. It has a planning component, a real-time meet-pass optimizer component, as well as a visibility component. Each of these integrated components work seamlessly to provide a unified experience to users. RailMAX has the following major components:

Planning Components
The planning components of RailMAX determine train departure times at their origins and set their destinations while minimizing network congestion and maximizing the utilization of assets. These components also determine how many trains to run while providing sufficient time periods for track maintenances.

Meet-Pass Optimizer Components
The scheduling components of RailMAX generate all decisions related to the movement of trains in the rail network; specifically, meet-and-pass and meet-and-overtake decisions based on train priorities, goals, and train holding decisions. All decisions that are currently made manually by train controllers will be made by this system and executed by train controllers.

Visibility Components
The visibility components include giving the visibility of train plans and schedules to different stakeholders so that they can manage their resources consistently with train movements. RailMAX provides network visibility through both the interactive Electronic Train Graph (ETG) and the Schematic View. In both views, train paths, track possession, speed restrictions, switch clampings, maintenance, etc. are shown.

Integration Components
RailMAX can be integrated with other existing systems in the company. For example:

- **Integration with Train Control System (TCS):** The TCS comprises of actual control of the movement of trains, switches, interlockings, and wayside equipment. TCS receives data from various devices and communicates instructions to them. RailMAX consumes this data to create train movement plans and detailed train schedules. These movement plans and schedules are communicated to the TCS for execution.

- **Integration with Other Systems:** RailMAX can be integrated with other planning systems that are responsible for planning other components in the overall supply-chain; for example, Mine Planning System, Port Planning System, Yard Planning System, Crew Management System, and Locomotive Management System. RailMAX can also report to external reporting systems in required formats.
These are some of the reasons that scheduling trains is a very difficult problem from the mathematical point of view. Optym has done significant research on this decision problem over the last ten years, and has developed an approach which is practical and is suited for both planning and real-time scheduling. Our approach is an application of simulation-guided optimization, a technique we have found to be extremely effective in solving complex optimization problems.

The simulation-guided optimization technique simulates the movement of trains in the rail network. Whenever any decision needs to be made, it enumerates several options, scores them, and recommends the best option. Consider, for example, the track network on the right where several trains are heading towards one another on a single track network with some sidings. The algorithm will simulate the movement of trains in the future. Trains A and B will meet one another first; we need to decide whether train A or train B goes to the siding. The algorithm will create a decision tree with these two possible branches and simulate both options. As we simulate further, train A will meet train C, and then train D; we will have several other options regarding which train waits and which train passes. If we simulate train movements for several hours into the future, there will be thousands of options. Our algorithm will enumerate all of these options, score them with respect to an objective function, and recommend the best set of decisions.

### SIMULATION-GUIDED MEET-PASS OPTIMIZATION ALGORITHM

At the heart of RailMAX is a simulation-guided optimization algorithm that schedules trains moving in opposite directions on a rail network comprising of single, double, or multi-tracks with sidings (or passing loops).

Movement of trains in a rail network is very complex for the following reasons:

- **Tracks with Varying Speeds**
  Tracks have different speeds; thus, trains need to accelerate or decelerate to adjust their speeds.

- **Meet and Pass Planning**
  On single track networks, some trains must wait on siding tracks as other trains pass by.

- **Meet and Overtake Planning**
  Trains have different speeds; slower trains wait on siding tracks as faster trains overtake them.

- **Track Possessions**
  Some track sections are taken out-of-service for maintenance and other reasons, which impact train movements.
The decisions that need to be made when two trains in opposite directions meet are called meet-and-pass decisions. Similar decisions are also made when a higher speed train overtakes a lower speed train moving in the same direction; these are called meet-and-overtake decisions. These decisions need to be made not only for a single track network, but also for a double track network when track maintenance blocks train movements for specific time windows; consequently, the network behaves like a single track network.

Our simulation-guided algorithm uses cutting-edge operations research and computer science techniques, including efficient data structures and parallel computing to speed up the enumeration and evaluation of numerous decisions. The algorithm can enumerate and evaluate tens of thousands of options and recommend the best option within seconds — something the human mind cannot do. Our algorithm can create an optimized schedule for several hundred trains within one minute of computer time.
ADDITIONAL CAPABILITIES OF THE OPTIMIZATION ALGORITHM

RailMAX’s optimization engine has several additional capabilities which enable it to generate implementable solutions honouring various practical constraints.

Maintaining Safe Distances between Trains and Complying with Signaling

Maintaining safe distances between any two trains is one of the most important constraints for scheduling trains. In the fixed signaling system in use at most railroads, only one train can be present between two consecutive signals, called a track segment. If there is a train present in the track segment, then another train moving in the same direction cannot enter that segment. In this case, the following train must stop. When the track segment is open again, the following train can start again. To model train movements correctly and generate accurate train schedules, we must model the deceleration and acceleration profiles of trains, which is a function of train weight, along with the curvature and grade of the track. RailMAX does this modeling.

Multiple Train Types with Different Priorities

A rail network has multiple types of trains with different priorities moving in the network. For example, tracks are often shared between passenger and freight trains, with passenger trains having higher priority than freight trains. Even when the rail network is used only for freight trains, loaded trains are often more important than empty trains. Likewise, loaded trains for a specific customer may carry a higher weight than those for other customers. Another complication for multiple train types is that they may travel at different speeds. For example, empty freight trains are lighter and move faster than loaded freight trains. RailMAX is able to capture multiple train types with different train priorities moving at different speeds and correctly generate meet-and-pass and meet-and-overtake decisions.

Goal-Driven Decision-Making

RailMAX uses a specific goal, which is user-configurable, to evaluate options. For example, our goal could be to minimize the total waiting time of trains, to minimize the waiting time of loaded trains, to maximize the utilization of a port terminal, or to expedite some specific trains needed by some clients. As the user changes the goal, meet-and-pass and meet-and-overtake decisions recommended by the algorithm automatically change to remain consistent with that goal. We call this capability the goal-driven decision-making.
Modeling Track Maintenances

Track maintenances are the biggest source of variability in train movements for several rail networks. Tracks undergo heavy wear and tear due to train movements, and track health deteriorates over time. Poor track health requires train speeds to be reduced; otherwise, trains may be derailed. Track maintenances fall into two categories: planned and unplanned. When generating train schedules several days in advance, planned maintenances can be addressed at that time; however, unplanned maintenances need to be addressed on the day of operation. RailMAX assists rail schedulers and train controllers with both planned and unplanned maintenances. It can create train schedules taking into account planned maintenances; similarly, if tracks are out for unplanned maintenances on the day of operation, it can change train schedules to create room for such maintenances. RailMAX is also capable of incorporating several other maintenances:

- Signal Maintenances
- Switch Maintenances
- Switch Clamping

Modeling End Facility Maintenances

Several railroads transport trains from supply nodes to demand nodes. Loaded trains move from supply nodes to demand nodes, and empty trains return from demand nodes to supply nodes. Examples of such networks are the transportation of iron ore from mines to ports, the transportation of coal from mines to power plants, the transportation of grain from farms to manufacturing plants, etc. In such networks, trains are processed at supply nodes (such as loading operations) and demand nodes (such as unloading operations). This processing is done by heavy equipment that also undergoes planned and unplanned maintenances. RailMAX is capable of modeling maintenances of end facilities; it takes as an input the maintenance schedule of end facilities and plans train schedules around those events.

Movement of Maintenance Equipment

Often, maintenance equipment moves over the rail network; this movement impacts the movement of revenue-generating trains. This equipment movement typically does not have a fixed timetable, but may have arrival deadlines. For example, a planned track maintenance may require specific material and equipment, and both must reach the maintenance site before maintenance can begin. RailMAX is capable of modeling the movement of such trains. RailMAX can move these trains with several intermediate stops at sidings in order to reduce interference with the movement of revenue-generating trains.

Resource Availability and Maintenance

RailMAX considers the availability of resources such as car dumpers, loaders, waiting areas, rolling stocks, etc. While scheduling, RailMAX allocates available resources to trains in a way that minimizes the dwelling of trains. The system also considers the maintenance requirements of rolling stocks. If a set of rail cars are due for maintenance, RailMAX allocates an available maintenance location and schedules required movements to get the rail cars to the maintenance location.
RailMAX not only has cutting-edge optimization algorithms, which constitute its brain, but it also has remarkable decision support system capabilities which make this system invaluable for different user groups to perform their day-to-day functions efficiently. We give next an overview of RailMAX’s decision support system capabilities.

**Data Quality**

The high quality of data is critical for any optimization system. RailMAX has comprehensive data sanity checking and data treatment modules. Whenever RailMAX receives data from a railroad’s systems, it thoroughly checks for missing, incorrect, and inconsistent data; it also identifies and reports data anomalies. It then fills in some missing data, using intelligent business logic, and fixes inconsistencies in the data. The system also checks the sanity of the data provided by the user through user interfaces, e.g., cost parameters, track possessions, and train dwells. Since RailMAX is a multi-user system, multiple users can concurrently change the data and make the data inconsistent or contradictory. RailMAX highlights such anomalies in the data. The data quality and sanity checking modules in RailMAX are also very efficient; they can do all of the data sanity checks and corrections within a few seconds.

**Multi-User System**

RailMAX is a multi-user system, and can be used simultaneously by multiple users. RailMAX has a centralized database of all the data, and this data can be accessed by multiple users. In that sense, it is a client-server application; each user is a client, and the database is hosted on a server shared by all users. RailMAX is a computationally intensive application. Most of the number crunching is done on a set of servers called a computational cluster. All jobs performed by multiple users are queued up to be performed by a cluster of computational nodes, and a job scheduler assigns these jobs equitably among all computational nodes. This capability makes RailMAX a highly scalable system; as the number of users increase and the workload increases, we can increase the number of computational nodes and still provide a fast response time to users.
Multi-Scenario System

RailMAX is also a multi-scenario system, which means a user can create multiple scenarios for different data inputs and parameter settings. The user can copy the live scenario for the train schedule in production and perform what-if analyses for changes that a user may want to consider, such as adding a train, redirecting a train to a different destination, or stopping the train at a location for some time. The user can create such scenarios within minutes, analyse the KPIs of these scenarios, compare any two scenarios, and push a scenario into production. A user can create two types of scenarios: an Operational Scenario which can be pushed into production after analysis, or a Modeling Scenario which is used only for maintenance modeling and cannot be pushed into production. A user can share their scenarios with other users as well.

RailMAX is a decision support system through which the user can see the predicted routes of all trains and monitor all train movements in the rail network. The user can create multiple what-if scenarios, analyse them with respect to multiple KPIs, and push the right scenario into production (e.g., make it live). Here are some of the changes that a user can make, each of which can be done within minutes:

- Add trains, cancel trains, or change trains’ departure times
- Change a train’s destination
- Change maintenance possessions — their locations and times
- Change end-facility maintenance
- Change speed restrictions
- Add switch clamping
- Add travel restrictions on tracks
- Add manual dwell for trains at specific locations

Multiple User Groups

RailMAX is designed to be used by multiple user groups performing different functions related to train operations. We explain some roles and the functions that can be performed in those roles below:

Maintenance Planners

Using RailMAX, maintenance planners can analyse rail maintenances several weeks ahead of time. They can create several scenarios for different numbers and durations of maintenances, assess the impact on the number of trains they can run, and select the best maintenance plan.

Rail Schedulers

Rail schedulers can determine the number of trains to depart on any day, as well as their departure times for the next several days. They can try different options, analyse KPIs for these options, and push the best option into production.

Train Controllers

Train controllers are responsible for the safe running of trains. They are also responsible for creating meet-and-pass or meet-and-overtake plans for trains and directing trains on the rail network. RailMAX makes these decisions through intelligent enumerations of thousands of options and recommends the best option. Train controllers can implement the decisions recommended by RailMAX.

Other Stakeholders

RailMAX can provide train predictions and resource availability outputs to other stakeholders (such as mines, ports, yards, maintenance personnel, crews) in read-only views.
Electronic Train Graph View

RailMAX has an ETG (Electronic Train Graph) that employs the latest technologies. Some of the ETG’s capabilities include:

- **Division into Control Area:** The ETG divides the entire rail network into multiple control areas. The user can see either the overview of the whole network or details of a specific control area.

- **Past and Future Train Movements:** In the ETG, the user can see the movement of all trains for the past 48 hours and future predicted movements of trains for the next week.

- **Different Train Types:** The ETG colors various train types differently to distinguish them from one another. Different train types can be shown or hidden on the ETG based on a user’s preferences.

- **Restrictions (Maintenances, Switch Clamping, Travel Configuration):** The ETG displays all track restrictions, including both the track areas and time durations. Different restrictions are shown in different colors.

- **Speed Restrictions:** The ETG also displays all speed restrictions.

- **Zoom-In and Zoom-Out:** The ETG has zoom-in and zoom-out capabilities through mouse control; the user can fit the computer screen with the right zoom level.

- **Hovers:** All objects in the ETG have hover menus which provide important details.

- **Manual Dwell:** Users can right click on a train path and require the train to dwell at a selected location for a given time period.

- **Overlay Scenarios:** Users can overlay and compare two scenarios.

- **Annotations:** Train ID’s, Loco ID’s and Crew Names are annotated on the ETG.

- **Multi-Monitor Support:** Different pages of RailMAX can be moved to different computer monitors.
User Configurable Inputs and Parameters

RailMAX has several pages where the user can view data through tables and edit the data. There are data tables for train departure times and their loadout, car dumper and product assignments, loadout parameters, car dumper parameters, maintenances, and speed restrictions. There is a general parameter page which contains several user-configurable parameters. All data tables have filtering and sorting capabilities.

Solution Analysis

RailMAX enables detailed solution analysis through various visualizations. A user can view the detailed train solution through data tables and analyse solution quality through various KPIs. RailMAX also shows the inventory of trains at end facilities (e.g., loadouts and car dumpers) through charts. These charts enable us to determine whether end facilities have sufficient trains to process at all times, except when they are being maintained.

Schematic View

RailMAX also has a unique capability to display train movements in the Schematic View. The Schematic View has all of the capabilities of the ETG; however, this view offers a different visualization of the rail network — maintenances, speed restrictions, switch clamping, etc. — and of train movements. The user can edit train and network data in this view as well and, in addition, the user can watch the animation of train movements for some future time period. This view ideally complements the ETG, and together they give the user a deeper understanding of the network and train movements. Schematic View can be used as an effective presentation and communication tool across the organization.
RailMAX BENEFITS

RailMAX meets railroads’ critical train scheduling needs and can assist them on several fronts:

**Increased Train Speed**
Train dwells on line of road is one of the biggest pain points for railroads. This dwell reduces asset utilization, makes crew out-of-service, and increases train cycle time. Using RailMAX, we can reduce train dwell by 5% - 10%, which will increase train speed and asset utilization by the same amount. This will have a huge impact on a railroad’s profitability.

**Increased Rail Capacity**
Most railroads are capacity-constrained in some territories. Use of RailMAX will enable a railroad to run more trains. We believe that the optimization capabilities of RailMAX will enable a railroad to run 5% - 10% extra trains in its capacity-constrained corridors. This will have a huge impact on a railroad’s revenue, in addition to meeting a critical societal need.

**Efficiency of Supply-Chain Network**
RailMAX will enable a railroad to run reliable and predictable train operations which will improve the overall efficiency of the supply-chain network. Rail is typically a link of the supply-chain that impacts several other stakeholders. Reliable and predictable rail operations will enable: (i) yards to line up their resources, (ii) mines to schedule loadouts, (iii) ports to schedule car dumpers and ship loaders, and (iv) maintenance personnel to plan maintenances.

**Consistent Decision-Making**
Currently, decision-making throughout the rail network is decentralized and personnel-dependent. Different individuals have different experience levels and preferences. Any change in business philosophy requires the retraining of personnel. RailMAX encapsulates this human experience into a model, and makes decision-making consistent throughout the network. Further, any change in business philosophy requires only changing the code or user-configurable parameters.

**Improved Track Health**
Creation of maintenance plans, while taking into account train schedules, will enable railroads to run sufficient trains while providing sufficient slots for maintenances. Visibility of predictable train operations will enable maintenance personnel to perform maintenances better. This will result in better overall track health which, in turn, will yield higher network capacity.

**Improved Visibility and Communication**
Using integration and visualization capabilities, RailMAX will be the single source for the estimation of arrivals times of trains at their destinations. All external systems in the organization including yards, end facilities, inventory and resource management will use RailMAX outputs for a complete coordination. RailMAX reports on order management and train scheduling, as well as its intuitive Schematic View, will be the solid framework for coordination and communication across the organization.

**Deviation Management**
The goal of deviation management is to keep a balance between recovery of the baseline schedule and re-optimization of schedules to maximize the throughput of the system. With this capability, RailMAX algorithms will run in three modes: recovery, clean-sheet mode and incremental mode. The system will continuously monitor actual train movements, and if a deviation is detected or predicted, the system will recover or re-optimize the schedule. Small deviations may be handled within the meet-pass optimizer; however, a significant deviation may require re-optimization of the train timetable, including changing train departure times at their origins, or cancelling or redirecting trains.
Improved Meet-and-Pass and Meet-and-Overtake Decisions

Optimization is a journey. It is a continuous improvement process. RailMAX’s algorithm enumerates thousands of options for meet-and-passes and meet-and-overtakes, evaluates them with respect to a scoring function, and recommends the best option. We have numerous ideas to improve the optimization capabilities in RailMAX. We can use high levels of parallel computing (using 25 to 100 parallel processors) and generate solutions within a few seconds. We can use in-memory databases and in-memory data grids to reduce the data read and write times. We are working on these enhancements, and they will be made available to RailMAX users. Greater optimization capabilities will reduce train dwell times, increase their speeds, run more trains with the same infrastructure, and consider more factors such as buffer inventories and resource allocations.

Train Timetable Optimization

In the current version of RailMAX, the user specifies the train departure times at the trains’ origins (that is, the train timetable). Based on these departure times, it creates train movement plans and resulting train schedules. If disruptions happen on the rail network, then the train timetable may become infeasible. Currently, rail schedulers and train controllers are responsible for making changes to the train timetable; that is, canceling trains or changing trains’ departure times. In future releases of RailMAX, it will recommend such decisions. RailMAX will enumerate numerous options for changing train timetables, creating detailed train schedules for each of these options, scoring these options, and recommending the best option. Replacing human decision-making with optimization-driven decision-making will enable a railroad to recover from disruptions faster and have less impact on the network capacity.

Maintenance Time Optimization

Planned and unplanned track maintenances have a significant impact on train operations since train movements cannot take place during maintenances. Hence, track maintenance locations and times should be decided in a manner that has the least impact on train movements. Using the current version of RailMAX, maintenance planners can create scenarios for different maintenance locations/times and, by analyzing the KPIs of these scenarios, make maintenance decisions. In future versions of RailMAX, the system will automatically enumerate various options for maintenance locations/times, evaluate these options, and recommend the best option. This feature will reduce the workload of maintenance planners and enable railroads to perform more maintenances while running the same number of trains.
Management by Exceptions

In future train dispatching systems, algorithms will not only drive train operations throughout the rail network, but will also monitor efficient and safe operations. Different KPIs on a dashboard will monitor network health: green lights will show operations under control, and red lights will show operations that require exception management. Dispatchers will watch dashboards and intercept exceptions. If an operation does not receive the correct resolution in a prescribed amount of time, then alarm notifications will escalate to the next level of authority. Future releases of RailMAX will have dashboards that will display the state of the system from different perspectives to different stakeholders, and raise exceptions or alarms if some KPIs are outside of their acceptable norms. Exceptions will also include sending text messages or making phone calls.

Automatic Route Setting (ARS)

In current train dispatching systems, decision-making is manual and train controllers make most decisions. RailMAX automates this decision-making. Algorithms generate train schedules and train movement routing decisions for the next several hours to several days into the future. These decisions are currently fed into the train control system by train controllers, and trains are routed through the appropriate alignment of switches. RailMAX’s decisions can also be directly communicated to the train control system, making the manual effort unnecessary. The automatic route settings will make the rail network more agile, eliminate human errors, and enable a train controller to control a much larger area than what can be done now.

Moving Blocks

In current dispatching systems, signals control safe distance between trains. Only one train is permitted between two consecutive signal locations, and the distance between consecutive signals determines the number of trains in the network (or the network capacity). If this distance is more than what is needed for safe operations of trains, then we are wasting network capacity. In the moving block system, GPS technology is used to ensure that trains maintain a safe distance; this reduces the average distance between trains. As a result, the network can run more trains. However, moving blocks make train scheduling much more complex since the number of trains in the network increases, and train movement planning needs to be done more often as trains’ movements need to be tracked in near real-time. Computer-driven train scheduling will be critical in order for the moving block technology to work as the incoming data size and complexity of decision-making will preclude unassisted scheduling by planners. Adding moving block technology is part of RailMAX’s roadmap.
ABOUT OPTYM

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.

Optimization is Optym’s passion. Our company is founded by an established academician who is a leading authority in optimization. Our team members have won several prestigious awards for their contributions to the fields of optimization and have published numerous scholarly papers in the field. Our organization employs about 200 professionals in its four global office locations. We take pride in the diversity and technical qualifications of our team whose members come from 20+ countries and of which more than 50% have post-graduate degrees.

Optym has deep expertise in all areas of rail planning and scheduling: train scheduling, locomotive planning and scheduling, crew planning and yard planning. Optym has developed software solutions in each of these areas. We believe that new generation railroad solutions will consider all resources — locomotives, crews, yards and trains — in decision-making; Optym’s background in all areas of rail operations ideally positions it to develop such solutions.

OUR CLIENTS

From the ground to the sky, we’ve worked with some of the biggest names in transportation and logistics.

Southwest  FedEx  SAIA  Walmart

Holland  BNSF  CSX  Toyota

DB Bahn  booz&co.  Canadian Pacific Railway  Norfolk Southern

United Airlines  BHP  New Penn  YRC Freight  Office Depot
As communities grow, so does demand. People consume more goods, use more resources and travel to more destinations. Such growth, however, creates congestion and inefficiency in transportation networks. At Optym, we have made it our mission to bring efficiency to the movement of goods, passengers and services.

Optym is a leading provider of decision automation and optimization software for the global transportation and logistics industry. Our products are used by railroads, airlines, trucking and mining companies throughout the world. Our commitment to both our clients’ success and our own high standards sets us apart as a world-class provider of these solutions.