TOPX Expert

High Precision Planning

WHITE PAPER

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Sydney, Australia

October, 2025

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1. Executive Summary

Global container terminals are under intensifying pressure to deliver faster vessel turnaround, lower operational costs, and maintain consistent yard throughput, all while contending with volatile vessel schedules, capacity constraints, and labor challenges. In an environment where every minute of quay time translates into financial impact, precision in planning and coordination across the terminal has become a decisive differentiator.

Traditional terminal planning methods are often fragmented between berth, vessel, yard, and equipment operations, leading to systemic inefficiencies. The lack of real-time synchronization results in crane idle time, yard bottlenecks, unproductive rehandles, and unpredictable performance.

RBS TOPX Expert High Precision Planning addresses these challenges with a unified, AI-driven ecosystem that continuously aligns all terminal domains through a predictive, closed-loop planning cycle. Leveraging the latest Automatic Vessel Planning (AVP) and Automatic Yard Planning (AYP) modules, the system transforms static planning into a dynamic, self-optimizing process powered by real-time data and enhanced with TOPX-Intelligent-3D - digital-twin intelligence.

By integrating advanced optimization algorithms, live terminal data, and 3D visuals, TOPX Expert enables terminals to operate with machine-level predictability - achieving seamless coordination between quay, yard, and equipment operations. The result: higher vessel productivity, reduced handling costs, and a step-change in operational reliability and transparency.

2. Introduction

Container terminals today operate in one of the most complex and competitive segments of the global logistics chain. Growing vessel sizes, fluctuating trade volumes, and tighter shipping schedules demand planning systems that are not only efficient but adaptive. Yet, many terminals remain reliant on legacy or siloed planning systems, where berth scheduling, vessel stowage, yard allocation, and equipment dispatch are handled independently.

This fragmentation creates invisible inefficiencies, manifesting as crane hang, transfer congestion, unbalanced yard utilization, and unpredictable equipment performance. The ripple effects are significant: vessel turnaround delays, increased operating costs, and lost capacity.

TOPX Expert High Precision Planning was developed to solve these systemic challenges by fusing all planning domains into one synchronized decision-making environment. Built on an intelligent precision planning architecture, the solution continuously orchestrates the interactions between:

- Intelligent Berth Planning – optimal vessel berthing aligned with yard and crane availability.
- Automatic Vessel Planning (AVP) – high-precision, Intelligent vessel planning that minimizes crane interference and improves move efficiency.
- Automatic Yard Planning (AYP) – real-time yard optimization that allocates storage dynamically to reduce rehandles and yard travel time.
- CHE Optimization – automated resource planning for yard cranes, trucks, and other equipment.
- 3D Digital Twin Visualization with Timeline – live visualization and predictive simulation of terminal operations.
- Continuous KPI Feedback Loop – enabling predictive re-planning based on live operational data.

Together, these modules form a closed-loop precision planning cycle, where every plan continuously evolves with changing conditions—bridging the traditional divide between planning and execution. By unifying berth-to-yard-to-equipment operations under a single predictive framework, TOPX Expert enables terminals to move beyond reactive planning and achieve a new operational level of anticipatory, data-driven, and performance-optimized from quay to gate.

3. TOPX High Precision Planning

At the core of **TOPX Expert High Precision Planning** lies a closed-loop optimization cycle that continuously synchronizes berth scheduling, stowage sequencing, yard allocation, and equipment dispatch in real time. Each planning domain is interconnected through live data streams and predictive analytics, ensuring that operational changes are reflected instantly across the entire terminal plan.

This architecture eliminates the traditional disconnects between planning layers, enabling a single source of operational truth supported by AI-driven automation and a 3D digital twin. The result is a fully self-adjusting planning ecosystem that optimizes performance proactively rather than reactively.

Vessel Planning

Challenges

- Static berth scheduling - Overlapping vessel windows, idle quay, and queueing at anchorage
- Lack of yard correlation - Yard congestion during simultaneous vessel calls
- Manual rescheduling - Slow reaction to ETA or draft changes
- QC sequencing misaligned with yard readiness - Crane hang, QC idle time and delayed departures
- Unproductive re-stows - Rehandle loops and wasted fuel
- Bottlenecks within bays - QCs crowd the same tier
- Fragmented yard data - Disconnected stow plan vs. yard availability

Solution: Intelligent Berth Planning

Conventional berth scheduling relies on static timetables and manual coordination, often leading to overlapping vessel windows, idle quay resources, and unbalanced yard demand. **TOPX Auto Berth Planning** transforms this process into a dynamic, data-driven discipline.

By integrating live AIS data, tidal conditions, and yard utilization forecasts, **Auto Berth Planning** recalculates berth windows automatically to maintain on-time performance. The 3D simulation engine visualizes berth and draft constraints, enabling planners to identify conflicts before they occur.

Solution: NEW - Intelligent Automatic Vessel Planning (AVP) with High-Precision Optimization

The New Intelligent Automatic Vessel Planning (AVP) features redefines vessel planning through advanced Intelligent sequencing and considering yard inventory distributions. Traditional stowage planning struggles with QC idle time (hang), re-stows, and congestion within bays—symptoms of poor coordination between quay cranes and yard operations.

AVP predicts workload distribution across quay cranes and aligns container availability with yard readiness in real time. The system ensures each container is picked only once, with balanced distribution that minimizes crane interference.

Results

- +35% increase in QC moves per hour (MPH)
- -30% reduction in vessel turnaround time
- -60% fewer rehandles with rehandle ratio of only 2-4%
- -35% decrease in unproductive moves
- -50% decrease in CHE idle time
- -30% decrease in vessel turnaround time
- Almost 80% less manual override events
- +25% smoother traffic flow and reduction of bottlenecks
- Overall there is far less congestion

Yard Planning

Challenges

- Static allocation by block - Block saturation and imbalance
- No dwell-time prediction - Long-stay boxes block premium slots
- Poor coordination with vessel plan - Late delivery to QC, crane idle
- Congested truck flow - Cross-traffic and gate delays

Solution: Automatic Yard Planning (AYP) with Real-Time Yard Planning & Dynamic Optimization

Static block allocation and lack of dwell-time forecasting often result in yard imbalance and transfer delays. The **Automatic Yard Planning (AYP)** feature introduces a real-time, self-balancing model that continuously adjusts yard allocation based on live vessel progress and equipment activity.

Predictive dwell modeling relocates long-stay containers to secondary stacks, preserving high-access zones for active flows. Yard pre-staging ensures containers reach quay cranes in the exact discharge/load sequence, while routing optimization minimizes truck congestion and waiting time.

Results

- 60% reduction in rehandles
- Stable yard utilization within ±8% variance
- Live routing optimization means 35% faster truck turnaround

Container Handling Equipment (CHE) and Resource Planning

Challenges

- Manual dispatch - Equipment idle or overcrowded zones
- Long unnecessary travel - Wasted energy between tasks
- Potential cross-traffic collisions - Safety risk and delay
- Equipment mismatch - Wrong RTG/RS assigned

Solution: CHE Optimizer with Smart Resource Planning and Dispatch

Effective coordination of container handling equipment (CHE) is vital to maintaining terminal flow. The **CHE Optimizer** feature eliminates manual dispatching inefficiencies by leveraging AI-based spatial load balancing and predictive routing.

Real-time path prediction prevents equipment clustering and cross-traffic collisions, while live verification ensures that each RTG, RS, or terminal truck is assigned the optimal task. The result is an intelligent, conflict-free operation that maximizes asset productivity and safety.

Results

- 50% reduction in idle time
- 20–25% lower fuel consumption
- Zero cross-traffic collisions under 3D digital twin monitoring

4. Benefits & Improvements of TOPX High Precision Planning

Eliminating Operational Inefficiencies

Through unified precision planning, TOPX Expert directly addresses the chronic inefficiencies that limit terminal performance. Each issue is countered with a predictive, automated mechanism that transforms execution outcomes:

Operational Issue	Elimination Mechanism	Resulting Gain
Crane Hang/Idle	QC–yard synchronization and workload balance via AVP	Continuous crane motion, no idle cycles
Unproductive Moves	Predictive berth-crane allocation	+35% higher effective productivity
Rehandles	Integrated berth-to-yard feedback triggers early yard reallocation	-60% rehandles
Bottlenecks	Adaptive berth and block sequencing	+25% smoother traffic flow around berth
Congestion	Real-time CHE zoning & routing	40% shorter truck turnaround, -20% fuel usage and -50% idle time

Strategic Benefits for Terminals

- Operational Efficiency - Eliminates idle assets, congestion, and unproductive handling across all domains
- Increase Throughput Capacity - Optimized berth and crane scheduling unlocks higher vessel handling rates
- Cost Efficiency - Predictive resource management reduces energy, fuel, and labor costs
- Safety & Compliance - Automated validation prevents stacking and IMDG violations
- Predictive Control - KPI-driven dashboards and deviation alerts support proactive management as they dynamically evaluate and self-adjust to live data feeds
- Digital Integration - Unified APIs and 3D Digital Twin provide a real-time unified operational picture
- Better Data Integrity - Unified Integration Hub ensures vessel, yard, and CHE data remain synchronized
- Unified Precision Platform - Single ecosystem covering berth, vessel, yard, and CHE in real time
- AI Predictive Model - Learns from historical performance to continuously improve future plans

- **3D Visualization** - Live representation of vessel, yard, and equipment with KPI overlays
- **Easy Deployment** - Integrates with existing TOS and equipment systems
- **Proven ROI** - Average payback period < 12 months from implementation

Towards Sustainable Terminal Operations

Sustainability is embedded in the precision planning architecture. By minimizing idle time and unnecessary movement, TOPX Expert directly supports decarbonization and long-term asset efficiency.

- 20–25% reduction in CHE fuel consumption
- Shorter vessel berthing time = lower CO_2 emissions
- Optimized yard routing = reduced diesel burn and tire wear
- Predictive maintenance = extended equipment life cycle

Together, these outcomes enable terminals to meet both operational and environmental KPIs, positioning them as leaders in smart and sustainable port logistics.

Summary of Estimated Performance Gains

The integration of berth, vessel, yard, and equipment high precision planning under a single predictive framework drives measurable cross-domain gains:

Metric	Baseline	After Precision Planning	Improvement
Crane Productivity (QC mph)	25-28	35-38	↑35%
Yard Rehandle Rate	8-12%	2-4%	↓60%
Yard Occupancy Variance	± 25%	±8%	↓68%
Truck Turnaround Time	45-60mins	25-30mins	↓40%
CHE/Equipment Idle Time	High	Low / Predictive Standby	↓50%
Vessel Turnaround Time	20-22hrs	13-15hrs	↓30%
Manual Override Events	Frequent	Rare	↓80%

Reference case

The solution has been successfully implemented at Klaipėdos Smeltė terminal

article for context: https://container-news.com/rbs-tops-avp-boosts-efficiency-at-klaipedos-smelte-terminal/

5. Conclusion

As global trade accelerates and port ecosystems grow more complex, container terminals can no longer afford inefficiencies hidden within fragmented planning processes. **TOPX Expert High Precision Planning** offers a transformative path forward - one where berth, vessel, yard, and equipment operations function as a single, intelligent system. By leveraging Automatic Vessel Planning (AVP) and Automatic Yard Planning (AYP), terminals gain the predictive control and operational agility needed to achieve faster vessel turnarounds, consistent yard flow, and measurable cost and emission reductions.

RBS invites terminal operators, port authorities, and technology partners to redefine performance standards together. With proven architecture, quantifiable productivity gains, and a clear sustainability impact, TOPX Expert is more than a planning solution—it is the foundation of the next-generation smart terminal. To explore how precision planning can reshape your operations, contact RBS for a demonstration or performance assessment and take the first step toward machine-level predictability and sustainable competitiveness.

6. About RBS

RBS (Realtime Business Solutions) founded in 1991, is a global leader in terminal operating systems and smart port technologies, dedicated to driving digital transformation in the container handling industry. With decades of expertise and innovation, RBS delivers solutions that empower terminals to achieve higher efficiency, lower costs, and greater competitiveness. Its latest product, TOPX Intelligent 3D, integrates cutting-edge automation, predictive intelligence, and optimization tools to help terminals adapt to evolving industry demands. By focusing on innovation, sustainability, and customer success, RBS continues to redefine how terminals operate in a rapidly changing world.

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