RESEARCH AND APPLICATION OF A FULLY INTELLIGENT, END-TO-END OPERATIONAL SYSTEM FOR SPECIALIZED BULK GRAIN TERMINALS

Guangzhou Port Company Limited

A major global port serving the world.

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01
Group Overview

The Introduction of Guangzhou Port Company Limited

Established through restructuring in 2004 and affiliated with the Guangzhou State-owned Assets Supervision and Administration Commission, Guangzhou Port Company Limited is the leading operator of a comprehensive hub port in South China. In 2025, it handled 610 million tonnes of cargo and 27.388 million TEUs of containers, with assets totaling nearly RMB 67 billion. The Group coordinates its core port operations through its listed subsidiary, Guangzhou Port Company Limited, establishing a network of inland and overseas locations as well as terminals along rivers and coasts—including key projects like the Nansha automated terminal—and maintaining robust sea-rail intermodal transport to form a port layout characterized by "one core, two wings, and multiple supporting points." Simultaneously, the Group expands into diversified industries: its real estate division develops urban landmarks such as Taikoo Wharf and invests in healthcare and elderly care; its aquatic products division operates major specialized markets like Huangsha Aquatic Products Market, integrating the entire industry chain; its business and tourism division focuses on Pearl River cruises and Nansha cruise operations; and it develops port supply chain finance services. Through these efforts, the Group has built an industrial system featuring "one core and multiple diversified sectors," striving to become a world-class port enterprise.

02
Sustainable Development Projects

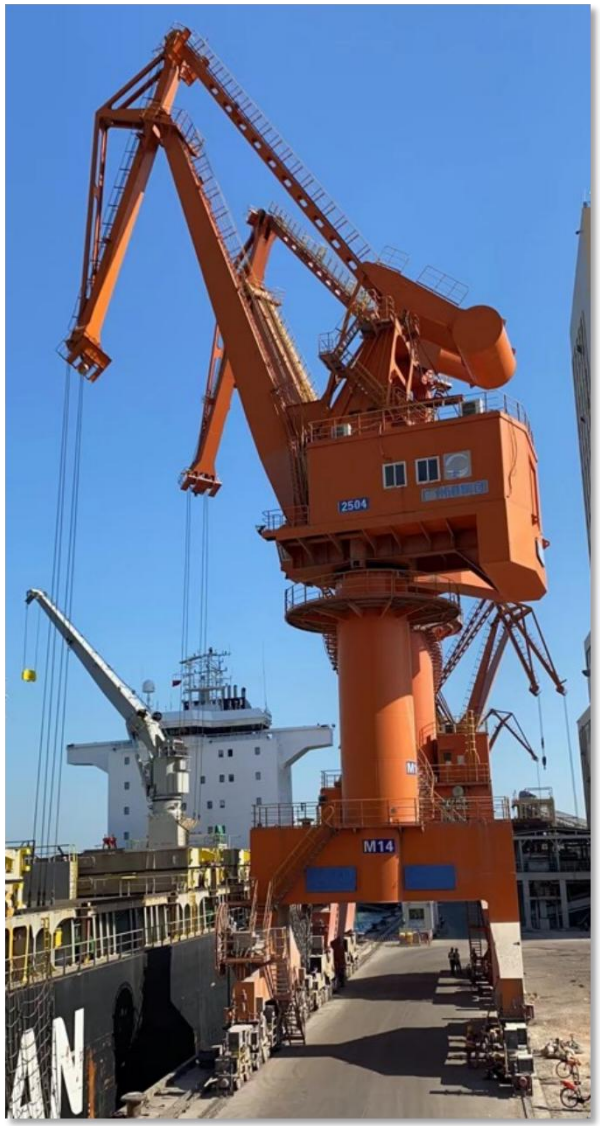
Project Overview

To meet global smart port and industrial intelligent upgrading demands and leverage national pilot programs for building a powerful transport nation, Guangzhou Port Group selected Nansha Grain & General Terminal as a pilot to address traditional bulk grain operation pain points—high labor costs, low automation, high on-site risks and poor overall resource scheduling.

By integrating automatic control, digital twin, robotics, AI and machine vision technologies, the group upgraded loading/unloading machinery (gate cranes, ship unloaders) at Berths 6–8, power distribution equipment and management systems.

This project delivered China’ s first fully automated large-scale bulk grain terminal with multiple industry-first technologies. It realizes full-process smart management, transforms conventional operations and drives high-quality port development.

Pioneered a multi-machine collaboration algorithm for bulk grain unloading; first in the industry to realize fully automated multi-machine (shared hold) operation. Eliminated low efficiency and collision risks, greatly enhancing efficiency and safety.



Automation Upgrade for Bulk Grain Handling Equipment

- Automated 3 portal cranes, 2 buried scraper unloaders and 2 ship loaders, achieving centralized "one-man-multi-machine" operation.
- First in the bulk grain industry: fully automated collaborative operation of multi-type equipment (same hold) and automated coordination between cleaning machinery and ship unloaders.
- Solved challenges: low single-machine efficiency, high multi-machine collision risks, no same-hold operation for cleaning/unloading equipment, and automated loading difficulties for varied barges in the Pearl River.

Application of Substation Unmanned Inspection System

01

Deployed the substation unmanned inspection system.

02

Achieved real-time unmanned substation inspection.

03

First in China’ s port industry: realized unmanned live working of high and low voltage substations.

04

Full-process inspection algorithm developed from human inspection patterns and tasks.

☆ Pioneered an unmanned inspection system for automated bulk grain handling. Solved inspection challenges, improved equipment stability, and guaranteed operation efficiency.

Pioneered an integrated whole-process production management platform for bulk grain terminals, covering full operations. Achieved refined management of equipment, yards, vehicles, barges and production, and comprehensively enhanced port service capabilities.

Development & Application of Intelligent Whole-Process Management System for Bulk Grain Terminals

- Developed an intelligent whole-process management platform for bulk grain operations.
- Realized more intuitive, concise and efficient display and management of complex bulk grain operations via system calculation.

Bulk Grain Unmanned Loading System

Pioneered an unmanned bulk grain loading system with multi-modal fluid coupling self-correcting metering algorithm. Realized unmanned & precise loading, reduced costs and reloading rates, and improved transport efficiency.

- Achieved fully unmanned operation throughout the entire process from silo discharge to truck loading.
- Achieved high-precision dynamic metering loading with an accuracy of ±7‰, reducing reloading rates by over 90%. Bulk grain trucks can “leave immediately after loading” without the need for re-weighing.

03
Conclusion & Prospects

Conclusion & Prospects

Goal: Continue advancing digital/intelligent transformation of bulk grain terminals for smart port development.

Action: Build an integrated management platform for full-process production elements.

Functions: Achieve 100% automated equipment operation, global production factor management, and intelligent scheduling/decision-making.

Deep Dive: Integrate and evolve a full-process intelligent large model in bulk grain production to realize complete operational intelligence.

63%

Reduced labor costs

20%

Overall operational efficiency

5%

Overall operational energy consumption

0

Occupational & Mechanical failure hazards reduced to

THANKS FOR LISTENING!

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