TRENDS IN TERMINAL DESIGN AND OPERATIONS
Outline

- What do we mean by automation?
- What are the current system and equipment choices?
- What is different about planning and designing an automated terminal?
- What are some of the critical civil design issues?
What Do We Mean by Automation?

- Robotic operation
  - The physical movement of the container by the system

- Operational optimization using effective and efficient information technology
  - Receive containers
  - Store containers
  - Retrieve containers
What Do We Mean by Automation?

- The key operational elements that are optimized
  - Service
  - Terminal capacity / throughput
  - Space utilization
  - Terminal traffic
  - Operational cost
    - Fixed
    - Variable
What Do We Mean by Automation?

Port
- Capacity
- Revenue
  - Port ROI
  - Local economic benefit
  - Jobs
- Negative impacts minimized
  - Traffic
  - Emissions

Tenant
- Capacity
- Productivity
  - Vessel
  - Gate
  - Rail
- Cost
  - Lowest total cost per lift
  - Highest revenue potential
Why Automate?

- Predictable capacity & productivity
- Higher limit to optimization
- Predictable return on investment
  - Lower total cost/lift
  - Competitiveness
- Sustainability
  - Emissions
  - Traffic
  - Worker health and safety
What are the current system and equipment choices?
What are the current system and equipment choices?
What are the current system and equipment choices?

Rail mounted yard cranes

End loaded
- Portal RMG
- Overhead Bridge Cranes

Side loaded
- Cantilever RMG
- Overhead Bridge Cranes
What are the current system and equipment choices?

Yard stacking equipment evolution in size

- 6 wide, 1 over 4 high RMG
- 6 wide, 1 over 4 high RTG
- 3 high SC
- Wheeled
What are the current system and equipment choices?

1. Generation
What are the current system and equipment choices?

2. Generation
What are the current system and equipment choices?

3. Generation
What are the current system and equipment choices?

Pilot crane at Antwerp
Guide post for load control
What are the current system and equipment choices?
What are the current system and equipment choices?
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In operation since 1998
1 over 8 high
42 m span
What are the current system and equipment choices?

- Waterside transport
  - Manned
    - Terminal Chassis
    - Bomb Carts
  - Driverless
    - Automated Guided Vehicle [AGV]
    - Automated Straddle/Shuttle Carrier [ASC]
What are the current system and equipment choices?

AGV at CTA

travel speed
3.5

position accuracy +/- 50 mm
What are the current system and equipment choices?

Driverless Straddle Carrier at Patrick Terminal, Australia
What is different about planning and designing an automated terminal?

- **Operations**
  - TOS/Logistics
  - Equipment
  - Maintenance
- **(Top of Pavement)**
  - Pavement
  - Elect/Comm
  - Wharf
- **Infrastructure**

**Manned Equipment**

**Automated Equipment**
What is different about planning and designing an automated terminal?

- **Executive / Steering Committee**
- **Project Manager**
  - Reporting
  - Cost Control
  - Schedule Control
- **Operations**
- **Program Integration Team**
  - Coordinate:
    - Oper – Infra
- **Infrastructure**
  - Wharf
  - Buildings
  - Backlands Elect/Comm
  - Rail
  - Gate

Core team of experts to be kept through the project
What is different about planning and designing an automated terminal?

- A clear understanding and statement of goals is the first requirement for any project, but even more so for an automation project;

  - Project planning horizon (or economic life)
  - Terminal design capacity
  - Performance criteria
    - Berth
    - Road truck receiving and delivery
    - Rail loading
  - Environmental compliance
  - Financial
What is different about planning and designing an automated terminal?

- Set Goals
- Assigned Team

- Terminal Planning
  - Study individual systems
    - Simulation
  - Study interfacing systems
    - Simulation

- Emulation and Terminal testing
  - Simulation

- Operations Training
  - Simulation
What is different about planning and designing an automated terminal?
Composition and selection of core team

- from planning to production
- multidiscipline composition. The perfect composition of this team would include:
  - Operations
  - Equipment
  - Maintenance
  - Infrastructure
  - Finance
  - IT Systems
The planning and design process

Terminal Planning Process

Design & Construction Process

Implementation Process

Core team of experts to be kept through the project

supplementary expertise and resources will be added at critical stages

Tasks and Teams

Progress
What is different about planning and designing an automated terminal?

**Equipment specification**

1. **Fit for the purpose**
   to move / stack containers in an modern large marine terminal

2. **Safe**
   Must comply with national safety standards

3. **Reliable**
   The MMBF is a deliverable and testable item

4. **Fast**
   Operating speed and performance must be specified and demonstrated

5. **Maintainable**
   Designed to be maintainable
   accessability, fault detection and reporting, documentation

6. **Durable**
   Design with headroom
Stacking accuracy (1)

17 m

12 m

40 mm
Stacking accuracy
Stacking accuracy (3)

400 mm

~ 100 mm
Maintenance issues

- No operator or driver on the equipment
  - No ear and eye to hear and see any malfunction
  - No human that can report any malfunction
  - No driver that can work around any malfunction

- Fenced area of operation, difficult to access

- High equipment utilisation
  - work around the clock
  - high investment demands high utilisation and leaves less room for maintenance
- Sophisticated control technology

- The fleet of automatic stacking cranes at CTA contains:
  > 500 tv cameras
  > 120 laser scanner
  > 60 load position sensors
  > several hundreds of sensors, encoders
  > several hundreds of plcs of different size
  > hundreds of computers (pc´s & server)
  > network components

and lots of software:
  operating systems – control software - application software - communication software – firmware – databases - parameters
Maintenance issues

each crane does

> 65,000 moves p.a.

24 hours operation

approx. 1,700 lifting hours p.a.

more than 18,500 km (10,000 miles)
of gantry travel p.a.
Autostacking Crane System
Fotos zum Besuch APMT Portsmouth am 02. Juli 2008
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Terminal Control - Key Requirements

- SPREAD THE WORKLOAD
  AVOID OVERLOADING SOME AREAS AND UNDER-UTILISING OTHERS

- POOL RESOURCES
  MORE PRODUCTIVE UTILISATION OF RESOURCES

- PREDICT & PLAN AHEAD
  OPTIMIZE RESOURCE SCHEDULING

- DECIDE AT THE LATEST POSSIBLE MOMENT
  ALLOW LAST MINUTE CHANGES
What are some of the critical infrastructure design issues?

- Site Geotechnical Condition & Improvements
- Grading & Drainage
  - Stacking areas
  - Crane rails
  - Transfer areas
  - Aisles and travelways
- Electrical & Communication System
- Fire Detection, Protection, and Access
- Security & Safety
- Pavement System
- Infrastructure Expandability
Storage Yard Design

Automated Stacking Cranes (ASC’s)
- 2 ASC’s per Stack
- Integrated Reefers Racks

Electrified ASC’s
Reefer Racks
Transfer Area
Site Geotechnical Condition & Improvements

Options for Crane Rail Foundation
- Crane Rail on Spread Footing
- Crane Rail on Pile Supported Footing
- Adjustable Crane Rail System
ASC Rails
Site Geotechnical Condition & Improvements

- Crane Rail on Concrete Tie
Site Geotechnical Condition & Improvements

- Stacking Area Foundation / Pavement
  - Grade Beam and Gravel
  - Concrete Slab at Corner of the Containers
  - Concrete Pavement
  - Asphalt Pavement
Strict ASC Rail Design Tolerance

Rail Span Tolerance

Longitudinal Track Differential

Allowed Track Slope Alternate Direction Tolerance

Cross Section Differential
Site Grading & Drainage

Pass-through Aisle
Site Grading & Drainage
Site Grading & Drainage

Transfer Area
Electrical & Communication System

- Power Requirements
- Availability and Reliability of Power
- Lighting Requirements
- Communication System Infrastructure
  - Camera System
  - data networks
  - has to be 100% fault tolerant
Other Requirements

- Fire Detection, Protection, and Access
- Security and Safety
- Pavement System
- Infrastructure Expandability
Electrical & Communication System

- Power Requirements
- Availability and Reliability of Power
- Lighting Requirements
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Other Requirements

- Fire Detection, Protection, and Access
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Storage Yard Design – Transfer Areas

Landside Transfer Zone – Reefer Access

- 5 Lanes
- 4 TEU Long

One Maintain
One Working

Landside Transfer Zone – RMG Maintenance Position
Fotos zum Besuch APMT Portsmouth am 02. Juli 2008
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Receiving – Data Collection Portal

- Truck ID used to reference collected data
  - TWIC Card or RFID, etc
- Drive Through OCR
  - Inspection Image Obtained
  - Container Number, Chassis Number
  - Link information to Data Package
Receiving – Transaction Interchange Pedestals

- Data Collected/Verified by remote clerks
  - Empty Containers Checked
  - Equipment Inspected Remotely
  - Container Weight entered
  - Seal Checked

- Yard Instructions Printed
THE END