A Complex and Complicated Railway Project

Alnabru Intermodal Freight Terminal

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About me

• Sam Paul Singh Pawar - 30 years old from Oslo, Norway

• Graduated from MSc RSEI in 2011

• Former underground train/metro driver (4 years)

• Worked 8.5 years at Multiconsult AS (Norway’s 2nd largest consultant company)
  – Currently Team Leader at department for Planning and Infrastructure
  – Railway alignment design, station design, terminal logistics and capacity, system engineering, highway design, traffic safety and capacity assessments
  – Experience with mainline railway, freight railway, light railway, tram and metro
Alnabru Intermodal Freight Terminal

- Inland intermodal terminal
- No port connection
- One of Europe's largest freight terminals of its type
- At its peak it had 600 000 TEU (2008)
- Primarily domestic goods
-Built for shunting and wagon load operations
- Fatal accident in 2010 changed the way it was operated

20ft. Container = 1 TEU
A Complex and Complicated Railway Project

Railway Systems Engineering Comes of Age
21st Anniversary Celebration
University of Birmingham, 4/5 Dec 2015

Location

Railway Systems Engineering Comes of Age
4-5th December 2015, University of Birmingham
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Location

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UNIVERSITY OF BIRMINGHAM
Location

- Alnabru Terminal
- Container Port
- Oslo, Norway

History

- Established 1907 along Norway's first main line (built in 1854 by Robert Stephenson)
- Industrial and agriculture area
- Built for shunting trains and wagon load operations
History

• Today’s track layout design as hump shunting yard (1972)

• Upgraded in 1991 to accommodate container freight operations

• Partly electrified

The project

• Design and feasibility study of Alnabru Intermodal Freight Terminal (Mk 3)
  - Triple the terminal capacity from 430,000 TEU to 1,200,000 TEU pr. year
  - Increase train lengths from average 450m to 600m
    » Be able to handle 750m and 1000m long trains
  - Terminal has to remain fully operational during construction
  - Reduce investment costs from approx. £1.2bn to £400m
  - Design for multiple terminal operators

• All within today’s track layout!!
Terminal Operations - Layout

- Maintenance base, wagon workshop and train control center
- 7 arrival tracks
- 12 loading tracks
- 46 shunting and storage tracks
- 2 loading tracks
- Transfer sheds
- Gate control
- Transfer sheds
- Passenger railway mainline
- 12 loading tracks
- Locomotive workshop
- Component factory
- Bergen
- Kristiansand
- Stavanger
- Sverige
- Tvedheim
- Narvik
- Sverige
- Public Area

Terminal Operations – Freight Handling

- Freight collection
- Freight sorted for destinations
- Gate control
- Unloading by terminal operator
- Short term stack
- Long term stack
- Loading of train
- Public Area
- Terminal Area
- Controlled by JBV
Terminal Operations – Loading and unloading

Reach Stackers vs. Portal Cranes

- Lower investment costs
- Flexible operations
- Curved tracks
- Easy to upgrade
- Area inefficient
- 20 TEU per h.

- High investment costs
- Rigid operations
- Straight tracks
- High number of tracks per m²
- 27.5 TEU per h.
- Environmentally friendly
Examples of Typical Transport Units...

- 20ft. Container = 1 TEU
- 45ft. container
- Pressurized tanks/silos
- 25ft. Swap bodies
- Road trailers
- Thermo trailers

Lift time increased by 80%
Terminal Operations – Train movements

Terminal Operations - shunting

New
Some Project Challenges

Freight Production Flow – Very Peaky

- **Seasonal**
  - 30% Peak
  - 90% average

- **Weekly**
  - 90% volume

- **Daily**
  - 60% volume

- **Hourly**
  - 45% peak
  - 45% average
Railway Systems Engineering & Integration Comes of Age
21st Anniversary Celebration
University of Birmingham, 4/5 Dec 2015

A Complex and Complicated Railway Project

Track Area:
Area: ca. 490 000m²
Length: ca. 2050m
Angle: ca. 135°

Track Area:
Area: ca. 490 000m² – 760 000m²
Length: ca. 2050m – 3400m
Angle: ca. 135°
Road traffic through gate – 1 every 8 sec.

Terminal Operations – Capacity Challenge
Operational Risks

- 3 different types of obsolete signaling systems
- No spare parts available
- Locations without any signaling at all
- Signaling system must be upgraded independently of the main project

- Points are operated locally by hand by operators
- 55 trains arriving and departing per day
- 650 shunting movements per day
- Heating system only on new switches
Operational Risks – Snow and Ice Build-up

- Packs up underneath wagons
- Brake freezes
- Wheel flats
- Manually removed or carefully with digger
- De-icing system
- Only preventative
- Location
- Accessibility
- Costs

Operational Issues
Gradient Issues

- 1.90%
- 1.60%
- 1.10%
- 2.50%
- 98m
- 104m
- 93m
- 3.00%
- 120m

Ground conditions – quick clay area
Switch Design & Alignment

Stricter technical regulations

- Switches
  - Requires standard switches “off-shelf”
  - No “switch in switch”
  - No curved switches
  - No symmetrical switches

- Alignment
  - No gradient changes allowed within switches
  - Standard requirement 300m radius
  - Minimum allowed 190m radius
  - High risk of derailment due to string behavior of empties

Concepts

- Concepts to make principal decision for further detailing
  - Concept zero – to be able to operate (signaling)
  - Concepts level 3 – major adjustments
  - Concepts level 4 – total redesign to reach targets
- However, detailed designed necessary to confirm concept
Concept 0 - Details

Concept 3.6 - Details
Thank you for your attention!

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