ORR Best Practice Study

Visit to Denmark

17 September to 21 September 2007

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1	Feb 2008	Final Draft to Hosts	Final Draft
2	March 2008	Incorporates comments from hosts	Final
3	March 2008	Changes to Network Rail challenges to match summary report	Final

System Map (courtesy of Banedanmark)

GLOSSARY

ATC	Automatic train control system
BAH	Booz Allen Hamilton
BDK	Banedanmark, Infrastructure manager, also known as Railnet, and formerly known as Banestyrelsen
BSL	A subsidiary company to consultants Lloyds Register
CRM	Customer relationship management
DCDK	Copenhagen Central Station National and Regional Train Control Centre,
DIC-S	Drifts og Informations Central S-tog. Copenhagen Central Station control centre for suburban services.
DKK	Danish Kroner (approx DKK10 = £1, September 2007)
DSB	Danske Statsbaner (Danish state railways)
EIM	European Infrastructure Managers Group
GIS	Geographical Information System
LCC	(Whole) Life Cycle Costing
MTTR	Mean time to recovery
OHL	Overhead line equipment
PAS 55	British Standards Publicly Available Specification for asset management
R-Bane or R-Tog	R-Train: Regional train services
S-Bane or S-Tog	S-Train: Suburban train services
SAP	Systems Application Process (proprietary asset management software product)

Executive Summary

The visit to Denmark was arranged around four full days of meetings, interviews and site visits with the infrastructure manager, Banedanmark, and its maintenance contracting division, Entreprise, between 17 and 21 September 2007. A final presentation and wrap up meeting was held on the morning of the last day.

Banedanmark (BDK or Rail Net Denmark) is a state owned enterprise, which reports directly to the Ministry of Transport. Entreprise is set up as a self-managing subsidiary of Banedanmark with the intention of privatisation in due course. Denmark's railways have recently experienced poor performance from increasing levels of infrastructure unreliability reaching a peak in the summer of 2006. An ambitious recovery plan has been developed with full government funding to 2014 and is being enthusiastically implemented to restore confidence in the rail industry with priority given to the busiest routes first.

Extensive work was evident on lines in the Copenhagen area with new track, new stations and interchanges, and indeed Copenhagen presents a superbly integrated transport system. Reliability on the network as a whole is improving and some of the joint working evident in the Control centres was based on practices adopted by Network Rail. Much of the infrastructure unreliability stems from the signalling system but Banedanmark has adopted a strategy of life extension until a clearly defined ERTMS level 2 system has been developed and can start to be rolled out from 2014 with completion before 2020. This will be done in a single project across the entire network. Analysis by Banedanmark indicated 21% lower life cycle costs than existing maintenance and renewal practices.

In contrast to Network Rail, Banedanmark is in the process of contracting out all maintenance, using very small and closely specified contracts. Banedanmark retains the responsibility for specifying what work has to be done and when. Productive time in possessions is much higher than the UK and leads again to questions over UK practice. A highly coordinated planning strategy for maintenance work was presented.

Notwithstanding the different governance arrangements there are good practices, which clearly should be considered for the UK network. From the wide range of discussions held during this visit over twenty issues were identified to inform the SBP challenge process with Network Rail. Most were technical issues such as productivity in possessions, quality of work and use of plant, but good management practices such as quantified prioritisation of work and open internal benchmarking practices were also identified. The management style observed was also open and inclusive.

Acknowledgements

Many members of Banedanmark and Entreprise contributed to the success of this visit, a full list of whom may be found in Appendix C of this report. Our questions were patiently and thoroughly answered and any language difficulties overcome with good humour. All contributors gave up valuable time to assist us for which we are most grateful. We wish to express particular thanks to Henrich Holterman, who accompanied us throughout and made the practical arrangements for our meetings and site visits. His background knowledge of the Danish railway industry and governance arrangements added valuable insight during our formal and informal discussions.

1. Purpose

As part of its preparatory work for the 2008 Periodic Review, particularly to inform the challenge process of Network Rail's Strategic Business Plan, ORR has undertaken a world best practice study of other railway infrastructure owners and managers by making technical visits to 6 European countries, to Australia, and to the USA and Canada. Denmark was the third European country visited. These visits were expected to gather examples of best practice in terms of railway engineering, asset management, maintenance and renewal.

Denmark was selected because it was known that it had experienced a period of infrastructure unreliability in recent years. ORR expected that a number of good practices and strategies recently put in place to overcome previous difficulties could be used to challenge Network Rail together with the consequences of poor maintenance and renewal strategies. However, it was recognised that the Danish railway system is much smaller than the UK and at a different stage in its privatisation process and therefore not all strategies and lessons learnt would be relevant to the UK experience. Where appropriate, the Danish experiences, policies and practices will be used to inform the Periodic Review.

2. Introduction

The main body of this report comprises notes of the key features and lessons learnt from a series of meetings with representatives of Banedanmark, the maintenance group Entreprise, and various site visits in the period17th and 21st September 2007. For reference, a schedule of meetings and visits, in the order they occurred between 17th and 21st September 2007 inclusive, is to found in Appendix A. Ad hoc and informal coversations also took place with the CEO of Banedanmark, Mr Jesper Hansen, and with Mr Bartal Kass, a director of DSB.

The results of our interviews are summarised and key conclusions drawn. Where issues are relevant to ORR's PR08 process they have been highlighted by a text box and summarised in the findings section.

The ORR team comprised Mervyn Carter (Civil Engineering Adviser), Andrew Wallace (Track Adviser) and Frank Zschoche (consultant from BSL Management Consultants, a wholly owned subsidiary of Lloyds Register).

3. Background

The Danish railway network is approximately one tenth the size of the UK network, and is largely dominated by its internal passenger services. There are also important international links to both Sweden and Germany.

There has been significant restructuring of the railway industry in Denmark in recent years, partly to ensure compliance with European directives. However Denmark is at an earlier stage than the UK in its overall strategy. There is very close involvement of the Danish Ministry of Transport in the railway with government responsibility for co-ordination, monitoring and regulation. The National Safety Authority (Trafikstyrelsen) has some parallels with ORR but primarily on the safety side. Economic issues are largely handled by the Transport Ministry.

The infrastructure manager is Banedanmark, (BDK), which is a state owned enterprise under the Ministry of Transport. A strong management link exists between BDK and the government. The Minister appoints the majority of the Board (rail unions appoint two members) who in turn appoints the Chief Executive Officer.

The system has faced major challenges in the last few years caused by past underinvestment resulting in significant unreliability. This became particularly evident in 2006. BDK conducted an extensive review of the state of the infrastructure and utilised a number of international consultants in the process (including BSL, BAH and McKinsey). The analysis included a number of options with risks and consequences for each and prioritised the proposals based on sections of the network that carry the largest numbers of passengers and trains. The network was divided in to 3 sections based on use (ref 4 Appendix B). As a result of this analysis the government has given secured funding with cross party support for the period 2007 to 2014 including an additional DKK 4 billion (approx £400M). This funding is intended to secure the required renewal of the principal infrastructure assets and minimise train delays from infrastructure failures. Challenging targets have been set to improve punctuality.

Restructuring and a further privatisation process is under way and the railway industry remains very focused on restoring its public reputation.

Key facts and figures of the Danish railway compared to UK

Measure	Denmark	UK	Units	Ratio	Notes on UK data
Track	3,240	31,483	km	1:9.7	
Switches	4,409	20,383	No.	1:4.6	
Signals	7,079	64,000	SEU	1:9	
Bridges	2,302	40,000	No.	1:17	
Tunnels	-	335	km	-	
Stations	381	2500	No.		
Trains daily	2,700	17,400	daily	1:6.4	Approx passenger only
Kilometres daily		1,352,051	daily		incl passenger & freight
passengers daily	432,000	3,100,000	daily		passenger journeys daily
tons of cargo daily	20,000	297,000	daily		total freight lifted

In summary, the principal rail markets are:

Passenger

a) An urban metro serving Copenhagen and the immediate surroundings.

b) Inter-city services within Denmark.

c) Regional railways within Denmark.

d) International services to Sweden and Germany.

The main railway operator, DSB, provides 80% of all passenger services including regional, suburban, and international traffic into Sweden and Germany. It was established as an independent public company in 1999. Other secondary operators include Arriva Trains.

Freight

e) Railion and CFL Cargo are the only operators, and there is little freight traffic.

4. Meeting Notes

The following summarise the key points that arose from a series of meetings and organised site visits in the period 17 – 21 September 2007. These discussions were extensive and inevitably it has been necessary to edit the narrative to retain only those points most significant to understanding the current railway in Denmark or those points with a potential relevance to the UK. The order of some meetings has been adjusted where this aids the narrative.

4.1 A Historical Perspective of the Danish Rail Sector

Key Points:

- 1991: the railway company in Denmark was Danske Statsbaner (DSB); with 13 locally operating railway undertakings each with a very low market share. DSB was part of the ministry and acted like a political entity.
- 1994: DSB was transformed into a state company with political agreements to separate the various business streams such as buses and ferries from DSB.
- 1995: DSB installed a Board of Directors with some decision-making ability but with final authority under the Ministry.
- 1996: establishment of one central safety inspectorate.
- 1997: train operating companies and infrastructure were separated and Railnet Denmark was created (now known as Banedanmark (BDK)). There were large infrastructure improvements, such as across the Great Belt; introducing a new area for passenger transportation; and DSB managed to stabilize its market share.
- 1999: full liberalisation of freight access, and in 2000 passenger passenger services were included as well. There has been some subsequent growth of freight operators. S-Bane is an independent entity but owned by DSB. There is a cross party agreement that all new passengers services shall be tendered in the future.
- 2001: DSB sold its freight division to Railion, which is now the major operator. BDK´s consulting engineers were sold to Atkins.
- 2003: investigation of track access led to a political traffic agreement covering the period 2005 to 2014.
- 2004: a serious derailment resulted in a different safety culture/awareness and caused a more structured and systematic approach to track inspection and evaluation.
- 15% of Regional passenger services to be tendered; 2003: Arriva won tender.
- Merger of safety authorities across modes in Trafikstyrelsen (strategic advice, tendering, traffic planning, safety related issues, reporting etc.).
- Trafikstyrelsen manages safety for both infrastructure (BDK) and operations (DSB and private operators).

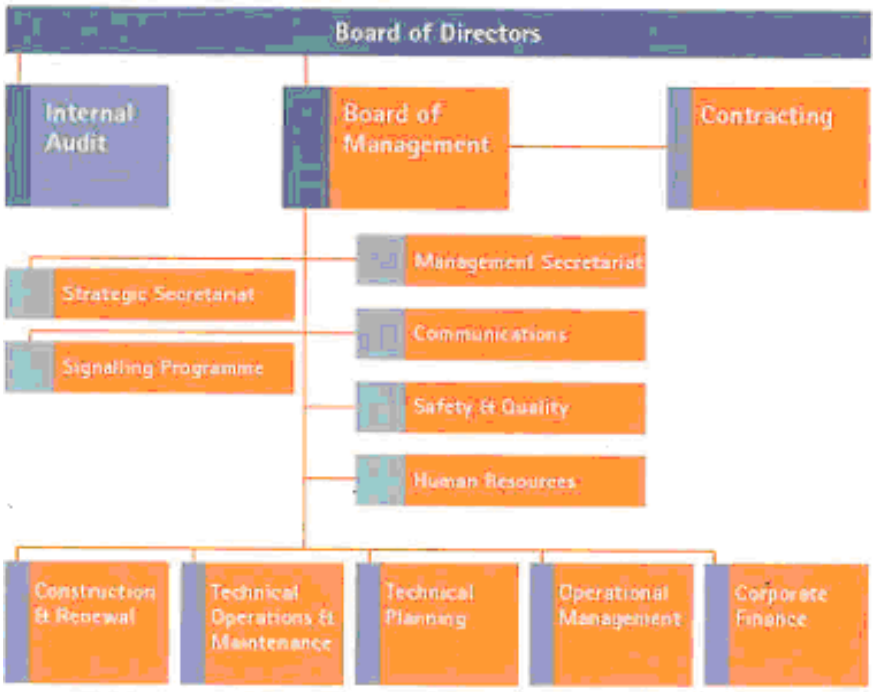
- Privatisation of DSB under investigation.

4.2 Introduction to the Current Danish Rail Sector

Key points:

- The infrastructure manager, Banedanmark (BDK),was established in 1997 by separating it from Danske Statsbaner (DSB), for two main reasons:
  - the implementation of the EU directive requiring non discriminatory access to the rail network
  - the separation of functions within DSB such as bus transportation, freight, infrastructure, trains, etc. in order to break up global funding, and to create more transparency in all of these functions
- BDK is funded solely by the government. This issue has been discussed extensively within Denmark, primarily due to the conflict between spending money on maintenance to assure a sustainable network versus spending on more prestigious new projects.
- The efficiency improvement target since 1997 has been set at 2% per year on the basIs that greater efficiency leads to more available money for investment.
- Trafikstyrelsen, the safety authority, has a similar role to that of safety regulation within ORR, being in charge of regulatory affairs, safety and safety aspects of the preparation of investment projects.
- The current passenger train punctuality target is 94%, increasing to 97% by 2015. The target for the metropolitan network is 94.8%. Service punctuality is the priority goal.

4.3 Organisation of Banedanmark



Banedanmark – Organisation Chart

Key Points:

New Organisation

- BDK is an independent state organisation under the auspices of the Ministry of Transport. The Minister has a right to overrule BDK board decisions. The organisation holds an annual general meeting.
- BDK´s principal tasks are the allocation of capacity to the train operating companies, traffic management, and the management of all maintenance and renewal activities.
- The contracting division (see chart) is a subsidiary company 'Entreprise'. Entreprise functions as a separate part of the organization and carries out tasks in maintenance plus renewals works won in open tender.
- Performance contract:
  - The performance contract for BDK was structured around the 2006 agreement on traffic, and is split into three target groups.
  - First level: increase punctuality, reduce the maintenance backlog, and realise strategic projects. These are mandatory requirements for the funding agreement with government.
  - Second level, management and control of targets: These targets are not mandatory and therefore don't have to be met to fulfil the contract. They

include for example establishing reporting to the government and improving the asset management system.

- Third level, reporting milestones as internal points of reference: For example half yearly status on sickness absences. These targets are set by BDK and are reported to the Ministry.

- A safety report is submitted to Trafikstyrelsen separately.

4.4 Strategic Development

Key Points:

- In 2005 BDK prepared its strategic focus for the forthcoming years (not unlike Network Rail's Strategic Business Plan). As a result of this process, it was decided to focus on the existing network and core business with challenges such as:
  - increased performance.
  - elimination of maintenance and renewal backlog (service life derived and operational performance derived).
  - asset management.
  - meeting stakeholders high expectations.
- This led to three key areas of action: internal processes, asset management and performance.
- Banedanmark identified four main processes:
  - Traffic control.
  - Maintenance.
  - Renewals.
  - Asset management (as a cross cutting process).
- The overall vision that was created included three concepts, covering inspections, the prioritisation and execution of works with renewals planned to follow.
- Maintenance is outsourced completely, including failure management and inspection activity.
- A strong centralised maintenance prioritisation system results in standardised processes and decision criteria instead of decentralised, local decision making.
- In the future, prioritisation will be based on objectives and a common set of criteria. Providing knowledge is shared with HQ allowing a logical reasoning process to be applied overall, the budget is expected to remain the same.
- Every month there is a priority meeting on proposed large scale maintenance and renewals with the asset owners of track, signalling, OHL etc. As a result, a list of measures is produced with red, yellow, green prioritisation. The planning horizon for maintenance results from a

prioritised list is given to the contractors 15 months in advance. However, this process has not yet commenced for renewals.

- The booking horizon for track access is supposed to be three months.

Issue ref.	ORR Issues for PR08
1	BDK use an Excel based prioritisation tool that takes into account the effect of not doing the work on train performance, cost of doing the work, number of passengers effected (excluding delay). Also, a very clear hierarchy of routes has been agreed with stakeholders, to ensure consistent prioritisation of works. How does NR prioritise maintenance and renewal jobs across different assets for specific routes?

4.5 Agreement for Banedanmark 2007-2014

Key Points:

- The traffic agreement was originally set up in 2003. However, in 2005 BDK identified an under-funding situation.
- BDK was asked to create a robust planning basis around the following four scenarios:
    - high level of traffic quality and reduction of the backlog
    - continue with the same level of funding as in 2003
    - best possible level of traffic output by 2014 and reduction of the backlog
    - two intermediate scenarios
- Consideration was given to prioritisation with limited resources a follows:
    - prioritisation on the numbers of trains
    - prioritisation on the numbers of passengers (which if considered alone would be too advantageous for densely populated areas)
    - as result BDK came up with three separate line categories
- This concept was backed by the politicians and did not cause any adverse public reaction. The government chose the largest package (scenario 4), increasing budgets by 33% and aiming to reduce the backlog to zero by 2014. The first priority is initially on the S-Bane (suburban services) and main inter-regional line.
- The renewal programme for 2007 – 2014 was modelled (for example complete renewals, sleepers and rails, sleepers only, ballast cleaning etc)
- The maintenance backlog was the major cause of unreliability, and BDK is still struggling to determine if they are spending the money in the right places. It was considered to be mainly a track issue. The relative

spending in track between renewals and maintenance is 50:50 and is expected to remain that way.

- Maintenance tracking is carried out in different ways. A degradation model was developed for the long term planning based on utilisation and age and how the asset has subsequently been renewed, maintained and used. LCC models were developed for transmission systems, bridges and power supply: i.e. to determine the average lifespan of the assets.
- As an aside it was pointed out that there is apparently no engagement of Network Rail in EIM perceived by BDK. BDK noted this was disappointing as they wished to share ideas as widely as possible

Issue ref.	ORR Issues for PR08
2	BDK finds attendance at the European Infrastructure Managers' (EIM) Group to be very useful to identify and spread best practice. BDK commented that Network Rail is one of the few European infrastructure managers that apparently do not attend the EIM. What is Network Rail's response to this challenge?

4.6 Financing

Key Points:

- Almost all financial support comes from state budgets. Although there are track access charges, they play a minor role. Track access charge revenues (DKK 700M) are used to cover 70% of the cost of two large bridges.
- Funding is broken down into:-
  - o new infrastructure (DKK 300M = £30M)
  - o reinvestment and maintenance (DKK 2BN = £200M)
  - o administration and planning (DKK 500M = £50M)
- Re-allocation between each segment is not possible, but can be done between reinvestment and maintenance
- Funding is fixed until 2014 but can be moved between years within a certain bandwidth (5% underspending, 9% overspending)
- Different inflation indices are used and are being discussed. In Denmark the current consumer price index is 2% with the construction price index 4%

4.7 Prioritisation

(Reference materials: "Process for planning and maintenance", Appendix B)

Key Points:

- Decisions concerning maintenance and renewal are made at a central level: although there is a financial distinction between renewal and maintenance there is not an optimal decision making process based on LCC (as for example in the Netherlands).
- A track model decision support tool is used. If at replacement the rail life is 7 years longer than the life of the ballast/sleepers, then the rail is re-used.
- There are approximately two large projects per year carried out in a blockade during summer holidays. Track renewals on long weekends and holidays are carried out in possessions. (full line closures are preferred but not a realistic option on main lines).
- Prioritisation is carried out for track and signalling. To support this, criteria were set up to reflect the overall objectives (punctuality, safety, and efficiency).
- An excel database has been developed to support the prioritisation process. This provides structured answers to the consequences of not doing the activity now or the likely impact on traffic.

4.8 Safety in the field

(Reference material: safety report – Appendix B ref 17)

Key points:

- The safety department is in charge of establishing the safety rules, investigating incidents, as well as educating and training the staff. The department comprises a team of 12 people, mostly headquarters staff.
- The safety department is responsible for all educational activities. They train all trainers and carry out refresher courses once or twice a year for staff, categorised as follows:
    - work team leaders of small groups
    - work team leaders of large groups
    - lookouts
    - drivers of maintenance machines
    - There is multi-tasking across these groups

- All staff have to attend a one day introduction course.
- There is an average time of approximately 20 min each at the beginning and end of possessions in order to set-up a safe working system and to hand back to operations.
- Trafikstyrelsen normally carries out formal external audits once a year. Trafikstyrelsen also investigates incidents.
- There are a number of safety targets affecting work such as SPADs, train/buffer collisions, accidents at level crossings, and derailments, etc.

Issue ref.	ORR Issues for PR08
3	In Denmark, the average possession takeup or hand back time is 20minutes, often including electrical isolations. What best practice lessons can Network Rail learn from European practice in this regard? Has Network Rail reviewed Danish processes for achieving or improving on those times?

4.9 Signalling programme

(Reference material: 'Banedanmark Signalling Projects', Appendix B)

Key points:

- The signalling equipment in Denmark is very old (20% is more than 40 years old), covering different technologies from various suppliers forming a patchwork system. The existing signalling system contributes massively to infrastructure delays.
- BDK does not use axle counters.
- BDK is facing a skills and knowledge shortage since experienced engineers are retiring and replacements are difficult to find.
- Instead of replacing the system area by area, BDK has chosen a whole system strategy (a "big bang" approach).
- BDK considers it makes sense to renew and replace the existing systems with one system because this is expected to be beneficial, not only in terms of purchasing power and economies of scale, but also because of the elimination of interfaces, which reduces system costs considerably.
- There will be more time for ERTMS to mature before it is introduced in Denmark from 2014. Currently BDK considers that there is no real European standard, only one based on interoperability.
- On the mainline, all telecoms will be updated to GSM-R, as this is already financed and Denmark is rolling out a nationwide digital radio communication standard.

Issue ref.	ORR Issues for PR08
4	BDK is planning to roll out ERTMS in a way that minimises costs, particularly of interfaces, for their system. How have ERTMS plans elsewhere informed the development of Network Rail's own implementation plans?
5	BDK has found no benefit from using axle counters. What justification can Network Rail demonstrate for continuing to replace track circuits with axle counters, particularly given Network Rail's need for 4 hours 'wheels free' time at the end of some possessions?

4.10 Asset Management

(Reference material: 'Asset Management' Appendix B)

Key points:

- The project to set up an asset management system is part of BDK's management contract and has been audited and reported to the Ministry several times. The degree and benefit of information exchange has also been demonstrated.
- BDK is aware of and is considering using the PAS 55 update when the assessment process is complete.
- The Geographical Information System (GIS) is based on an Oracle database. All assets were geographically localised since this information had not been recorded. The challenge has been to harmonise the various systems of localisation and to transfer it to a node model.
- The asset register is a central database that provides static information to other applications. BDK´s philosophy is to link different applications to each other and facilitate the access through a portal.
- BDK is starting to monitor the utilisation of the system. A lot of cultural change, as well as education and training, is necessary to improve usage.
- External parties can access the system as well (as 'consultant status').

Issue ref.	ORR Issues for PR08
6	BDK monitors usage and effectiveness of asset management tools. Does Network Rail monitor use of web portals by frontline staff to make sure they are being fully utilised to improve performance?

4.11 Track

(Reference material: 'Engineering standards', Appendix B)

Key Points:

- The basis for modelling was determined by BSL 5 years ago. The model was based on structure age and utilisation (tonnage). It resulted in four scenarios, and was used as a basis for long term planning.
- Track is manually inspected once a year, a measurement train runs four times a year and trolleys run six times per year (every 8 weeks) for visual inspections.
- Track-side lubricators and train borne systems are both in use. Trackside lubricators are used mainly on the S-Bane.
- For switches and crossings BDK have carried out spot renewal over many years.
- Possession times are typically 3.5-4 hours for smaller activities. For longer activities such as rail grinding, work is planned one year ahead, in consultation with the operators, to arrange up to 8 hours of track access.
- Maintenance is always carried out at night and renewal is carried out at weekends.
- 97-98% of the rail is continuously welded.
- Until 4 to 5 years ago BDK carried out complete renewals. Since then, component replacement based upon residual lifetime has become more common (driven also by increasing steel prices). The choice also depends on the allowable disruption to traffic.

Issue ref.	ORR Issues for PR08
7	BDK inspects track by foot patrol once a year and by trolley every 8 weeks. Network Rail's equivalent frequencies appear high by comparison. How is Network Rail using such comparisons in its inspection strategy?

4.12 Maintenance and renewal

(Reference material: charts on maintenance & renewal levels, organisational structure, presentation on new maintenance structure, Appendix B)

Key points:

- There is a steep increase in maintenance and renewal levels until 2008 to reduce the existing backlog and improve punctuality.
- Track is “10 years older than the European average” (Danish rail age estimated at approximately 24 years in 2001).
  - Efficiency of renewals has been increased due to longer possessions (e.g. closures for 2 months). Large renewals are carried out in summer.
- Technical Operations & Maintenance
  - Contracts are split into asset types by regions, which doesn’t match the internal organisation as there are responsibilities for an asset group across various regions.
  - Each of the asset managers ensures that standards match the condition of the assets.
  - In total there are 220 people, 35 approximately in track, split between 80% technicians and 20% engineers. In signalling the majority are engineers.
- BDK is in full control of contractors´ activities using 100% functional contracts.

MAINTENANCE BUDGET BREAKDOWN		
in Mio DKR	Volume	External contractors
Regional contracts	500	50
Cross country tracks (e.g. grinding)	120	60
Cross country signalling	50	
Forestry/cleaning station	130	
IT	65	
Wages TO&M	100	
Total	965	110

- New maintenance concepts:
  - the new concept for maintenance contracts during 2009 – 2018 will be a new contract group with 10 contractors representing the five asset types
  - 30 pre-qualified contractors were consulted about introducing new contracts and their views sought
  - the bidding process for the first contract will start next year, and a tender will be sent out every three months

- the working scenario is to extend the scope by reducing the number of regions (higher critical mass). Contracts will cover tracks, signals and power supply at a value between 10M and 20M Euros
- supply of signalling technicians on the open market is critical and BDK tries to promote the education of technicians by contractors (they have 13)
- BDK noted it was in a process of creating a market by starting an open dialogue
- by the end of 2009, all maintenance should have gone through this bidding process
- it is an objective to manage maintenance levels and standards better in relation to the quality demands of the operators, e.g. by differentiating the levels of MTTR (mean time to recovery)

- A 'Failure Consequence' model predicts the affected trains on the line where a failure occurs, as well as the secondary delays caused on the other lines. This helps to determine what reaction time and time to repair is needed. This is being modelled now.

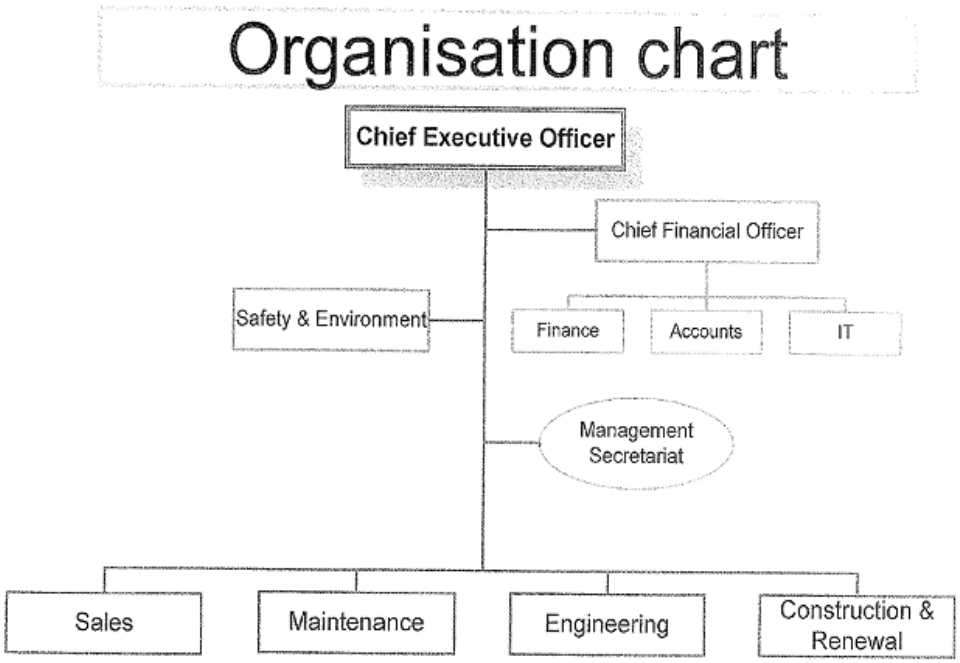
Issue ref.	ORR Issues for PR08
8	BDK uses a failure consequence model to predict direct and secondary delays. How does Network Rail model delays and assign criticality levels to different assets at different locations?

4.13 Visit to Entreprise works at Roskilde

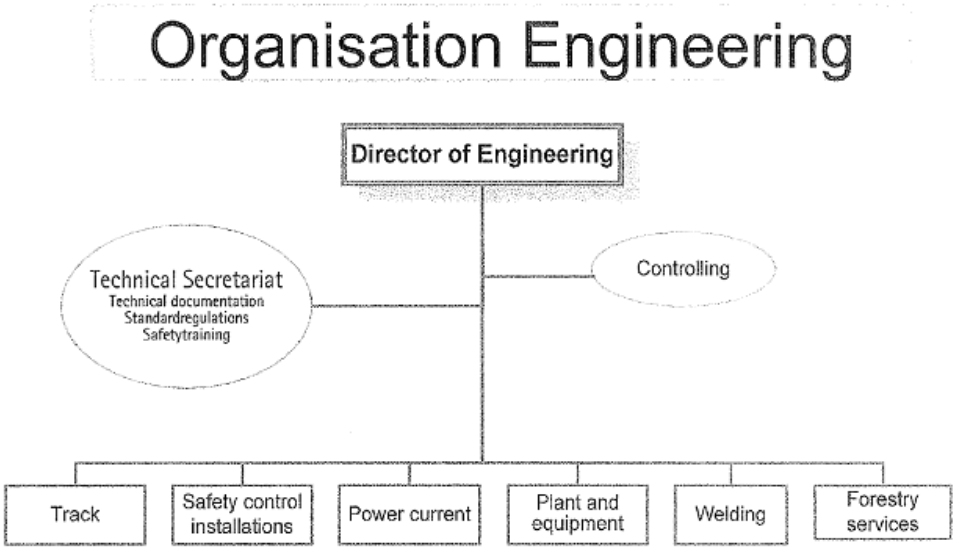
(Reference material: Entreprise briefing pack, corporate brochure and organisation charts, information on plant and machinery in use, Appendix B)
The visit comprised a presentation and discussion followed by a tour of the offices and works.

Key points:

- Organisation charts



Entreprise –Overall Organisation Chart



Entreprise Engineering Organisation Chart

- Organisation:
  - Enterprise's primary goals are to be privatised; to be competitive and to expand into other countries, focusing on Nordic states first
- Machinery:
  - includes tamping and ballast cleaning equipment, a dynamic track stabiliser, regulators, MPV, a track renewal train, and high output machinery
- Workshop:
  - the workshop has central responsibility for all rail maintenance machinery in Denmark
  - in total there are two workshops, a third one has been outsourced to DSB due to overcapacity, but is still working for Enterprise
  - there is an urgent need for additional staff and Enterprise has started to train staff (this takes about 3 years for signalling)
  - planning will be centralized (he current horizon is 10 days, with a target of 3 months in the near future, and 12 months in the longer term)
  - Contract volumes are £8 – 12 m GBP and considered to be sufficiently large. Entreprise considers contract periods need to be at least 4 to 5 years, and preferably 8 to 10 years. Entreprise has won the bids so far since market entry barriers for others were high and heavy investments were needed.

4.14 Visit to Entreprise offices at Hellerup

Key points:

- Organisation and assets
  - The suburban (S-Bane) system consists of 171 km of double track, electrified at 750 V dc, and 25 kV on the mainlines. Line speed in the suburban area is 120 km/h max and the typical frequency is 10 trains per 20 minutes. It was noted that S-Bane has no level crossings.
  - Traffic Load on the S-Bane is about 30m gross ton km per year.
  - Sleepers are mainly monobloc concrete with Pandrol fastclips, and rail will have been completely upgraded to UIC 60 within the next 2 years.
  - This contracting group works on all the asset types (track, signalling, power supplies, and catenary).
  - 90% of the work is done in midweek night possessions.
- Maintenance
  - Entreprise can train its own signalling people within 18 months if they are pre-qualified as electricians; similarly on catenary on work.
- Drainage has not been addressed in the past and is now being renewed when it carries out track renewals.

- Signalling is the most critical asset and makes up 50% of the infrastructure failures. Entreprise expects the proportion of signalling failures to rise to 75% when (other) renewals are completed.
- Wheel/rail management:
  - At a particular location, BDK had to change UIC 60 rails every 6 months due to poor wheels, now they last about 8 years due to DSB improvements in wheel management.
  - DSB uses wheel flat /profile detection devices and data goes straight to the DSB depot.
- Possessions:
  - After the last train has run, preparing the site for a possession takes about 10 to 20 minutes including isolation; It was noted that in Denmark detonators were abandoned 80 years ago and the UK was considered to be very old fashioned in this respect.
  - On-track work groups have a radio equipped lookout 400 m away from the maintenance team, to act as advance lookout.
- Switches and crossings:
  - Most switches are greased every two weeks and stretcher bars are not used; Siemens type 1957 point machines are very reliable. The suburban network has 500 point machines and 3-4 teams inspect once a year, (critical ones are inspected every 2 weeks). All points are electrically heated. Some point motors operate very frequently in peak times.
  - New Alcatel point machines with a hydraulic operating system are considered poor. They are now testing point machines built into the sleeper (Siemens and Bombardier).
  - S&C ballast renewals: Entreprise part vacuum 3 or 4 bearers for 3 points per night during 4 hour possessions in the same station. A machine is hired from RailCare in Sweden and a speed restriction is set up for the week. It takes 7 days to complete 3 or 4 switches, comprising ballast and timber bearer replacement.
  - The Vacuum requires 2-3 people and has a pressure of 10 tons; It can be used to excavate up to 200m of drainage trench down to 1.3 metres without damaging cables; it is also used for excavating the foundation of masts down to 5 metres.
  - Leaf fall rail head cleaner: this equipment uses a mix of water and calcium at 300 bar/70°C, and runs for 20 hours a day over seven weeks at a speed of 30km/h in selected zones. Entreprise were not impressed with NR's more complicated machines for this job.

Issue ref.	ORR Issues for PR08
9	Entreprise can accelerate the training of signallers and OLE staff to 18 months if they are recruited from other electrically based trades. Is Network Rail considering accelerated training of staff recruited from other electrically based trades?

10	As a result of previous neglect, Entreprise now routinely replaces drainage when track is renewed. How is Network Rail addressing a similar history of drainage in Britain ?
11	In Denmark out-of round wheel alerts are integrated with operators and defective trains are directed straight to the depot. Significant rail life extension has resulted in critical locations. Has Network Rail considered better systems than Wheelchex? Gotcha/Quo Vadis for example)
12	Entreprise uses radio communication from advance lookouts to improve workforce safety in red zones. Has Network Rail considered the use of radio based communication for advanced lookouts? If not, why not?
13	Entreprise is very clear on its most reliable point machines. Is Network Rail following best European practice in selecting and maintaining its machines?
14	Entreprise makes innovative use of leased rail vacuum machines to excavate trenches and simple foundations as well as S&C re-ballasting. What applications does Network Rail consider are appropriate for this type of equipment in Britain?
15	Entreprise uses simple and reliable leaf fall removal equipment and considers the British approach to be unnecessarily complex. How does Network Rail respond to this?

4.15 Visit to National and Regional Train Control Centre at Copenhagen Central Station

The following key points were made in a power point presentation:

- The dispatchers of Banedanmark, DSB, and Railion are all working in one room with one general manager for all operations in the centre, representing the interests of all stakeholders.
- The primary function is to guarantee regular traffic and carry out trouble shooting in the case of breakdowns.
- Passenger information has been centralised.
- Standard operational procedures for several train paths.
- The development of standard business processes. For example there is an evaluation at 10.00hrs of morning traffic, an evaluation of afternoon traffic at 13.00hrs and an evaluation of night traffic at 19.00hrs.
- There is a detailed review of disruptive events, how they are handled and how processes can be improved.
- Introduction of KPIs; there will be bonus agreements with the employees in the future.

Issue ref.	ORR Issues for PR08
16	Banedanmark (BDK) has found centralised and combined operations centres to be very effective. What consideration is Network Rail giving to centralising various network control operations?

4.16 Visit to the S-Train Control Centre, at Copenhagen Central Station

Key points:

- In the past there were 38 control centres for the S-Bane, which have been centralised over the last 15 years. The new Copenhagen Control Centre (DIC-S = Drifts og Informations Central S-tog) was created a year ago and there are now five control areas supervised by one coordinator (with two assistants in the rush hour) all employed by BDK.
- Four DSB workstations in the control centre are dedicated to passenger information. These cover 84 stations and also communicate with teletext, TV, radio and revenue protection teams.
- Delays of 2min 30secs and more have to be reported and explained. There are about 700 codes for failures, differentiated by train, infrastructure, or external related failures.
- The length of tracks managed is 432 km (268 miles) with 1,228 trains each weekday, 946 trains on Saturday, and 802 trains on Sunday. There are 22,520 stops on a weekday with a dwell time of between 10 sec and 1 min. 260,000 to 300,000 passengers are carried per day. It was noted that trains arrive or depart every 30 sec in central Copenhagen.
- To facilitate continuous improvement, human errors can be recorded onto a nationwide database (Synergi), which is used intensively. It has been considered by the airports as well and creates a real learning culture and helps to optimises processes.

Issue ref.	ORR Issues for PR08
17	BDK has a 'Synergi' system / database to encourage its operations and signalling staff to record errors and create a open learning culture which improves performance. Does Network Rail have a similar system in operation?

4.17 Database for prioritisation of engineering work

(Reference Material: two charts on the prioritisation model, Appendix B)

Key points:

- Database
  - Used to enter all maintenance, renewal, failure recovery, and study activities per asset group. BDK registers all activities but prioritises larger jobs only.
  - Reference to a region and a contract to identify the unit price from the contract (just labour).
  - Object IDs correspond to the asset register, but there is no link (planned).
  - It is possible to enter options and consequences including a likelihood (what happens if the activity is not carried out? could be higher cost, TSR, extra work etc).
  - A critical date is entered after which a consequence will be effective.
  - Once it has been entered it is sent to the inbox of the team leader for approval (workflow).
  - It will then be prioritised by the team leaders.
  - A peer review approach is in place to ensure as much objectivity as possible.
  - The model calculates a numeric value by multiplying an urgency factor, a consequence factor and a location factor.
  - Traffic importance consists of timetable relevance, line category and criticality of the component.
  - The model will be transferred from Excel in to the database and contains for example numbers of passengers/train.

4.18 Train ride on S-Bane (metro) and from Copenhagen to Humlebaek

By changing services a number of times throughout the afternoon, this site visit covered a variety of services and infrastructure. We travelled some 35km within the Copenhagen city area, surrounding suburbs and country and included S-Tog, Metro, R-Tog and international services. Good examples of coordinated multi-modal interchanges were evident together with the adverse consequences of delays caused by services originating in Sweden. The following principal points were noted during the journeys.

- In the metropolitan area there has been heavy investment in new infrastructure including new lines and connections, opening of former freight lines for passenger use and new stations. Transport in the urban area is well integrated with easy interchange between R-Bane, S-Bane, the Metro and bus at nodal points such as Norreport and Orestad.
- Further out of Copenhagen, station facilities were more traditional but well maintained and with the recent addition of lifts and ramps for disabled access.
- In the urban area most observed track has been renewed very recently, within the last six years.
- The ORR team were shown some old track at Humlebaek Station, the key points of which were:
    - rail 1972 – visually ok, but defect history unknown.
    - sleepers were a mix of twin-block, fast clip monobloc concrete and some timber sleepers; condition of the twin-block steel ties was reportedly very poor (but covered in ballast).
    - ballast was in very poor condition with heavy vegetation. Track had poor alignment and top level.
- Traffic at this site was 80,000 trains p.a. both directions (say a maximum of 19 million gross tonnes/track p.a.) Probably circa 25EMGTPA.
- This is slightly longer than Network Rail service life averages for a similar line:
    - Denmark rail life typically 35 years (c.f. NR 30-40years).
    - Denmark concrete sleepers typically 35 years (c.f. NR 35-40yrs but monoblock not twin block).
    - Denmark ballast 35years (c.f. NR 25-40 years).
- Passenger information screens were excellent showing trains in real time on a line map. These were colour-coded to show services on time and those delayed.

4.19 Traffic Control/punctuality

(Reference Material: 'The Process of Traffic Operations', Appendix B)

Key points

- RFC/FC are BDKs signalling boxes (approximately 29 including 4 bridge operators), DCDK is the central control centre in Copenhagen.
- About 0.8% of recovery time has been built into the timetable to improve punctuality. Journey times have been increased. A train is considered to be delayed after 6 minutes. In 2008/2009 this will be reduced to 5 minutes.
- In the past BDK wanted to keep up the punctuality by cancelling a train. In contrast the operators were incentivised by the government to keep the trains running (causing a conflict of interest). This is now resolved in the DCDK.
- BDK analyses network and staff performance in a number of ways, for example the average number of delayed trains per incident and by employee over two years. Employees´ qualifications and other factors have been considered. Dispatchers that formerly had been working in smaller signalling boxes had a poorer performance than those from larger control centres. Age has not had an influence on individual performance. The aim of this analysis is to improve this specific performance per employee.

Issue ref.	ORR Issues for PR08
18	BDK has a system to identify signaller caused delay and benchmarks different signal control centres and operators. This is used to identify signallers for further training and improve train performance by benchmarking. Does NR have an equivalent system? and, if not, is it considering adopting one?

5 Findings

The issues identified during this investigation which will be considered for challenging Network Rail, as part of the Periodic Review, are highlighted in the boxed comments in the text above. These are grouped into main topic areas below. The reference numbers used in the text boxes in Section 4 are shown in brackets.

Organisational structure

1. Banedanmark (BDK) has found centralised and combined operations centres to be very effective. What consideration is Network Rail giving to centralising various network control operations? (16)

Asset Management

1. BDK uses an Excel based prioritisation tool that takes into account the effect of not doing the work on train performance, cost of doing the work, number of passengers effected (excluding delay). Also, a very clear hierarchy of routes has been agreed with stakeholders, to ensure consistent prioritisation of works. How does NR prioritise maintenance and renewal jobs across different assets for specific routes? (1)
2. BDK monitors usage and effectiveness of asset management tools. Does Network Rail monitor use of web portals by frontline staff to make sure they are being fully utilised to improve performance? (6)
3. BDK uses a failure consequence model to predict direct and secondary delays. How does Network Rail model delays and assign criticality levels to different assets at different locations? (8)

Asset Inspections

1. BDK inspects track by foot patrol once a year and by trolley every 8 weeks. Network Rail's equivalent frequencies appear high by comparison. How is Network Rail using such comparisons in its inspection strategy? (7)

Capability, Maintainability, Reliability

1. Entreprise is very clear on its most reliable point machines. Is Network Rail following best European practice in selecting and maintaining its machines? (13)
2. As a result of previous neglect, Entreprise now routinely replaces drainage when track is renewed. How is Network Rail addressing a similar history of drainage in Britain ? (10)

Engineering Access

1. In Denmark, the average possession takeup or hand back time is 20minutes, often including electrical isolations. What best practice lessons

can Network Rail learn from European practice in this regard? Has Network Rail reviewed Danish processes for achieving or improving on those times? (3)

3. Entreprise uses radio communication from advance lookouts to improve workforce safety in red zones. Has Network Rail considered the use of radio based communication for advanced lookouts? If not, why not? (12)

Engineering Innovation

1. BDK is planning to roll out ERTMS in a way that minimises costs, particularly of interfaces, for their system. How have ERTMS plans elsewhere informed the development of Network Rail's own implementation plans? (4)

3. BDK has found no benefit from using axle counters. What justification can Network Rail demonstrate for continuing to replace track circuits with axle counters, particularly given Network Rail's need for 4 hours 'wheels free' time at the end of some possessions? (5)

Research & Development

1. BDK finds attendance at the European Infrastructure Managers' (EIM) Group to be very useful to identify and spread best practice. BDK commented that Network Rail is one of the few European infrastructure managers that apparently do not attend the EIM. What is Network Rail's response to this challenge? (2)

Wheel/Rail Interface

1. In Denmark out-of round wheel alerts are integrated with operators and defective trains are directed straight to the depot. Significant rail life extension has resulted at critical locations. What consideration has Network Rail given to alternative systems to its own Wheelchex? (Gotcha/Quo Vadis for example). (11)

Modern Engineering Plant

1. Entreprise makes innovative use of leased rail vacuum machines to excavate trenches and simple foundations as well as S&C re-ballasting. What applications does Network Rail consider are appropriate for this type of equipment in Britain? (14)

2. Entreprise uses simple and reliable leaf fall removal equipment and considers the British approach to be unnecessarily complex. How does Network Rail respond to this? (15)

Skills and Technology

1. Entreprise can accelerate the training of signallers and OLE staff to 18 months if they are recruited from other electrically based trades. Is Network Rail considering accelerated training of staff recruited from other electrically based trades? (9)

Staffing

1. BDK has a 'Synergi' system / database to encourage its operations and signalling staff to record errors and create a open learning culture which

improves performance. Does Network Rail have a similar system in operation? (17)

2. BDK has a system to identify signaller caused delay and benchmarks different signal control centres and operators. This is used to identify signallers for further training and improve train performance by benchmarking. Does NR have an equivalent system? and, if not, is it considering adopting one? (18)

APPENDIX A - SCHEDULE OF MEETINGS

(in order of occurrence)

Date	Subject	Presenters	Text ref
17 Sep	Introduction to the current Danish Rail Sector	Kirsten Berthelsen	4.2
17 Sep	Organisation of Banedanmark	Kenneth Juul Andersen	4.3
17 Sep	A Historical perspective of the Danish Rail Sector	Henrik Holtermann	4.1
17 Sep	Strategic Development	Per Lindholm Larsen	4.4
17 Sep	Agreement for Railnet 2007-2014	Claus Rehfeld Moshoj	4.5
17 Sep	Financing	Rasmus Darling	4.6
17 Sep	Prioritisation	Sören Boysen	4.7
18 Sep	Safety in the field	Allan Corneliussen	4.8
18 Sep	Signalling programme	Morton Sondergaard	4.9
18 Sep	Asset Management	Henrik Timm	4.10
18 Sep	Track	Bo Nielson and Lars Bo Forstig	4.11
18 Sep	Maintenance and renewal	Anne-Marie Petersen and Morton Ostgaard	4.12
19 Sep	Visit to Entreprise works at Roskilde	Jörgen Schoubye and Soren Horn Petersen	4.13
19 Sep	Visit to Entreprise offices at Hellerup	Poul Lykke Pedersen	4.14
20 Sep	Visit to National and Regional Train Control Centre, Central Station	Mogens Bjerregaard	4.15
20 Sep	Visit at the S-Train Control Centre, Central Station	Sascha Hauvn	4.16
20 Sep	Database for prioritisation of engineering work	Andreas C. Lund	4.17
20 Sep	Train ride on S-Bahn (metro) and from Copenhagen to Humlebaek (35km)	Henrik Holterman	4.18
21 Sep	Traffic Control/punctuality	Lasse Toylsbjerg-Petersen	4.19

APPENDIX B - SCHEDULE OF DOCUMENTS RECEIVED

Ref	Date	Item	From
1	17 Sep	Banedanmark organagram	Kenneth Andersen
2	17 Sep	Government KPI plan (A0 sheet)	Ditto
3	17 Sep	Banedanmark – key data	Per Lindholm Larsen
4	17 Sep	Background briefing, history and forward strategy	Claus Rehfeld Moshoj
5	17 Sep	Financing presentation 5 stage implementation plan (A4 sheet)	Rasmus Darling
6	17 Sep	Process for planning and maintenance	Soren Boysen
7	18 Sep	Banedanmark Signalling Programme (presentation) Comparison of different strategies (A4 sheet) Comparison of reliability from different strategies	Morten Sondargaard
8	18 Sep	Asset Management (presentation)	Henrik Timm
9	18 Sep	Overview of actual and normal condition resulting from the benchmark (Atkins note) Engineering Rules (Atkins note)	Bo Nielsen Lars Forsting
10	18 Sep	Organisation of Rail Net Denmark (focussing on maintenance) Activity level Maintenance and Renewal (A4 graph) Maintenance Contracts 2009 –20018 (presentation)	Morten Ostgaard Anne-Marie Petersen
11	19 Sep	Entreprise presentation notes	Jorgen Schouby Jorgensen
12	19 Sep	Entreprise A3 brochure ‘Excellence on track’	
13	20 Sep	Track Model (prioritisation)	Andreas C Lund
14	20 Sep	Netredegorelse 2008 (Network annual statement)	Banedanmark
15	20 Sep	Stray KPI sheets	Kenneth Andersen
16	21 Sep	The process of Traffic Operations (presentation)	Lasse Toylsberg-Petersen
17	21 Sep	Driftsuheld 2006 (Safety statistics)	Banedanmark

APPENDIX C – Contributors from the Danish Railway Industry

The following staff from Banedanmark, Entreprise, and other organisations freely gave up their time to assist the authors of this study and without their help and valuable contributions the study could not have taken place. In alphabetical order:-

Name	Organisation	Title
Kenneth Juul Andersen	Banedanmark	Head of Section
Kirsten Hestbaek Berthelsen	Banedanmark	Head of Management Staff
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Soren Boysen	Banedanmark	Head of Technical Planning
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Lars Bo Forsting	Banedanmark	Manager
Erik Girke	Banedanmark	
Jesper Hansen	Banedanmark	Chief Executive Officer
Henrik Holtermann	Banedanmark	Senior Councillor
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Morten Sondergaard	Banedanmark	Programme Director
Henrik Tim	Banedanmark	Project Manager Asset Management Systems
Lasse Toylsbjerg-Petersen	Banedanmark	

APPENDIX D – PHOTOGRAPHS

Photo 1

Hellerup Station and two S-Bahn surburban trains

Photo 2

Copenhagen Central Station

Photo 3

Outer surburban station, new CEN60 track in foreground

Photo 4

New interchange station (2 surburban lines one metro line)

Photo 5

Hellerup Station, showing S&C adjacent to platform and the necessary platform cut-back.

Photo 6

Old CWR track on timber sleepers, poor ballast. Planned for renewal this year

Photo 7

S&C at Hellerup, showing common European design that avoids the need for stretcher bars

Photo 8

Scissors crossover at Hellerup, relatively new

Photo 9

Passenger information display at a suburban station, showing position and direction of trains on the route

Photo 10

Mix of track ages at Osterport station

Photo 11

New high level Station at Ny Ellebjerg, showing CEN60 track with derailment protection