

-SQA-SCOTTISH QUALIFICATIONS AUTHORITY

HIGHER NATIONAL UNIT SPECIFICATION

GENERAL INFORMATION

-Unit number-	D9A9 04
-Unit title-	THE RAILWAY INDUSTRY: INTRODUCTION AN
-Superclass category-	VF
-Date of publication- (month and year)	AUGUST 2002
-Originating centre for unit-	SQA

-DESCRIPTION-

GENERAL COMPETENCE FOR UNIT: Explaining the complex and multi-disciplinary nature of railways, how they have evolved, how they work, and the economics of designing, building, maintaining and renewing them, and applying operational factors in timetabling.

This to be to a level commensurate with the role of Technician Engineers as defined by the Engineering Council.

OUTCOMES:

1. explain basic railway economics and apply appraisal techniques;
2. explain the development of railways through history;
3. explain and apply the key factors in operations and safety;
4. explain the principles of maintenance and performance;
5. explain the applications of renewal and installation technology.

CREDIT VALUE: 1 HN Credit.

ACCESS STATEMENT: Access to this unit is at the discretion of the centre. The unit will be of value to those candidates employed in the railway industry but equally to those with an interest in railways.

Additional copies of this unit can be obtained from:

The Committee and Administration Unit, SQA, Hanover House, 24 Douglas Street, Glasgow G2 7NQ, (Tel: 0141-242 2168).

At the time of publication the cost is £2.50 per unit (minimum order £5.00).

HIGHER NATIONAL UNIT SPECIFICATION**STATEMENT OF STANDARDS**

Unit number: D9A9 04

Unit title: THE RAILWAY INDUSTRY: AN INTRODUCTION

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME

1. EXPLAIN BASIC RAILWAY ECONOMICS AND APPLY APPRAISAL TECHNIQUES

PERFORMANCE CRITERIA

- (a) The differences between finance and economics are correctly explained.
- (b) Investment appraisal techniques are correctly applied.
- (c) The principles of cost-benefit analysis are correctly explained.
- (d) Asset utilization/performance is correctly explained.

RANGE STATEMENT

Economic terminology and theory: goods; utilities and specialization in economic development.

Appraisal techniques: financial (discounted cash flow; net present value and internal rates of return) and social cost benefit (value of time, safety etc).

Railway Costing: fixed; variable; short; long.

Performance: utilization; benchmarks; modeling.

EVIDENCE REQUIREMENTS

Written and/or oral evidence of the candidate's understanding of the four areas of railway economics covered by the performance criteria detailed above.

The candidates should demonstrate an understanding of one of the following:

- How public funding is justified through social / economic cost benefit analysis.
- How railway organisations cost their activities.
- How the timing of investment impacts on project life cycle costs.
- How railway organisations measure performance.
- The candidates should also complete a worked example using one of the appraisal techniques.

OUTCOME**2. EXPLAIN THE DEVELOPMENT OF RAILWAYS THROUGH HISTORY****PERFORMANCE CRITERIA**

- (a) The factors behind the historical and geographical contexts, which have shaped railways and the limitations these place on future developments are correctly explained.
- (b) Major technological trends in railways, past, present and future, in the UK and world-wide, are correctly identified and explained.
- (c) Railway terminology is used correctly.
- (d) Management structures and models are correctly explained and compared.

RANGE STATEMENT

Historical and geographical contexts: industrial and land-use changes; traction v topography; freight distribution; emergence of road transport; freedom of movement.

Technological trends: mass production; mechanical plant; steam, diesel electric traction; signaling sophistication.

Terminology: acronyms; pictures/diagrams of major equipment.

Management models: single/multiple organisation; wheel/rail; public/private.

EVIDENCE REQUIREMENTS

Written and/or oral evidence of the candidate's understanding of the development of railways and the factors affecting such development.

An understanding of history and geographical contexts and technological trends may be evidenced by the candidate preparing an essay/report on the key issues which have shaped and driven railways.

The use of correct terminology may be evidenced by the candidate correctly identifying types of equipment, their major function; and their acronym if applicable. This could be orally by viewing slides, or by multiple choice type questions.

An understanding of management models may be evidenced by written or oral explanation of: the politics and policies of the time/country; the strengths/weaknesses of, for example, the command and control structure of British Rail or the free market regulated framework of the privatized structure.

OUTCOME

- 3. EXPLAIN AND APPLY THE KEY FACTORS IN OPERATIONS AND SAFETY.**

PERFORMANCE CRITERIA

- (a) The evolution of operating and control systems is correctly explained.
- (b) The basic components and approaches to railway control systems are identified and explained.
- (c) The allocation and optimisation of capacity, together with means of improvement are correctly explained.
- (d) Timetabling exercises are correctly completed to achieve optimum capacity.
- (e) The approach to, and impact of, engineering possessions and temporary speed restrictions are correctly explained.

RANGE STATEMENT

Operating systems: historical lessons; changes in traffic; legislation.

Control systems: block systems; interlockings; warning systems; moving block.

Capacity: mixed speeds; impact of gradients; pathing conflicts; station stops.

Possessions: planning process; impact on construction techniques; impact on operation; publications and notices.

EVIDENCE REQUIREMENTS

Written and/or oral evidence of the candidate's understanding of the key factors in operation and safety.

The candidate should demonstrate an understanding of how the railway industry adopted changes in operations and safety practice to suit changes in business, often as a result of incident/accident.

The candidate should complete a timetabling exercise with different train types/speeds and stopping patterns and optimize capacity by means of manual train planning graphs over a given length and period, with given signaling headways.

The candidate should demonstrate an understanding of the need for planning to maximize output and minimise disruption for engineering works and how this impacts on timetables.

OUTCOME**4. EXPLAIN THE PRINCIPLES OF MAINTENANCE AND PERFORMANCE****PERFORMANCE CRITERIA**

- (a) Track maintenance requirements are correctly identified and the importance of maintenance in each area correctly explained.
- (b) The various methods of manual and automated maintenance techniques and processes are correctly described.
- (c) The principles of maintenance management are correctly explained.
- (d) The maintenance/renewal optimisation process in relation to performance is correctly explained.

RANGE STATEMENT

Maintenance requirements areas: componentry; line and level; drainage; fastenings; joints; lubrication; performance regimes.

Methods: manual/mechanical; patrolling/inspection.

Maintenance management: track standards; plant; labour; materials; rapid response.

Maintenance/renewals: life expiry; budgets; cascading.

EVIDENCE REQUIREMENTS

Written and/or oral evidence of the candidate's understanding of the principles of maintenance and the effect of maintenance / renewal on performance.

The candidate should be able to explain the principal requirements of track maintenance.

The candidate should be able to explain which methods are used for each area.

OUTCOME**5. EXPLAIN THE APPLICATIONS OF RENEWAL AND INSTALLATION TECHNOLOGY****PERFORMANCE CRITERIA**

- (a) The types of renewal and installation are correctly identified.
- (b) The types of available technology are correctly identified and compared.
- (c) The difference between possession working and greenfield working is correctly explained.

RANGE STATEMENT

Types of renewal/installation: re-ballast; re-model; re-rail; complete renewal (plain line and S & C); CWR and jointed; drotting; new build.

Types of technology: manual; ballast cleaners; track relaying machines; track laying machines; high capacity cranes.

Possession working/green field working: access difficulties; short-time use/24 hour use; rail based/road based.

EVIDENCE REQUIREMENTS

Written and/or oral evidence of the candidate's understanding of types of renewal/installation, the available technology and the difference between possession and greenfield working.

From visual presentations, the candidate should be able to identify types of renewal/installation and technology. The candidate should also be able to compare types of technology and their applications.

MERIT STATEMENT: To gain a pass in this unit, a candidate must meet the standards set out in the outcomes, performance criteria, range statements and evidence requirements.

To achieve a merit in this unit, a candidate must demonstrate a superior or more sophisticated level of performance. In this unit this might be shown in the following ways:

- (a) submitting written material demonstrating a knowledge beyond that presented through the course material;
- (b) submitting all work on time and in a well-presented fashion;
- (c) contributing to discussions in the classroom at a level which helps to stimulate additional debate;
- (d) adding to this debate through knowledge gained by experience or additional research.

ASSESSMENT

In order to achieve this unit, candidates are required to present sufficient evidence that they have met all the performance criteria for each outcome within the range specified. Details of these requirements are given for each outcome. The assessment instruments used should follow the general guidance offered by the Scottish Qualifications Authority (SQA) assessment model and an integrative approach to assessment is encouraged. (See references at the end of support notes).

Accurate records should be made of the assessment instruments used showing how evidence is generated for each outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

SPECIAL NEEDS

Proposals to modify outcomes, range statements or agreed assessment arrangements should be discussed in the first place with the external verifier.

© Copyright SQA 2003

Please note that this publication may be reproduced in whole or in part for educational purposes provided that:

- (i) no profit is derived from the reproduction;
- (ii) if reproduced in part, the source is acknowledged.

HIGHER NATIONAL UNIT SPECIFICATION**SUPPORT NOTES**

Unit number: D9A9 04

Unit title: THE RAILWAY INDUSTRY: AN INTRODUCTION

SUPPORT NOTES: This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

NOTIONAL DESIGN LENGTH: SQA allocates a notional design length to a unit on the basis of time estimated for achievement of the stated standards by a candidate whose starting point is as described in the access statement. The notional design length for this unit is 40 hours. The use of notional design length for programme design and timetabling is advisory only.

PURPOSE This unit introduced candidates to the history and evolution of railways and provides an understanding of railways in the context of the work candidates might do in permanent way design and practice.

CONTENT/CONTEXT The candidate should achieve the level of competence of someone who is in the position of responsibility in a design office/client office/contractor office/site, in understanding the background to railway work to enable them to understand that railways, in all aspects, are complex multi-disciplinary systems. As such, performance is only optimised by those with an understanding of this, who can then tailor their inputs accordingly.

Whilst the unit is primarily aimed at candidates who will practice in the UK, care should be taken to look at world-wide practice to help candidates understand the “why” before the “what”. Indeed the focus of this unit is on the “why”.

Corresponding to Outcomes 1 to 5:

Outcome 1

This outcome should provide the candidate with an understanding of basic railway economics. There has long been a perception that UK Railway Engineers wish to “gold-plate”, bringing them into conflict with accountants who have been running railways, who have equally been accused of first-cost conscious short term economics. The outcome of this conflict has been a contributory factor in the demise of Railtrack: Engineers and Accountants failing to grasp the need to provide, maintain and renew railway infrastructure assets through optimizing whole-life costs. This outcome sets out to engender a better understanding of whole life costs from the on-set of an engineer’s basic training. With the scale of investment now envisaged in the industry this will be vital if value for money is to be provided.

Outcome 2

This outcome should provide the candidate with an understanding of why railways are as they are; their role in the socio/economic development of a country, and the evolution of basic components and terminology through time. This will also cover pertinent current legislation shaping railway administrations. This will allow candidates to understand how lessons have been learned and continue to be learned.

Outcome 3

This outcome should provide the candidate with a basic understanding of how railways work. The relationship between operations and infrastructure is a complex and vital one. Those practitioners who are able to understand this develop the best solutions and interact in a more informed way with other disciplines. Along with outcomes 1 and 2, this will help candidates understand at a high level why they do things, before learning what to do technically.

Outcome 4

This outcome should provide the candidate with an understanding of the relationship between maintenance and performance. Increasingly in railways the customer is seeking performance first and foremost. This will help the candidate understand the needs of his customer : the passenger or the freight carrier, even if he is some layers removed from them. Again a previous criticism of railway engineers has been their lack of customer focus. Warranted or not, this approach will help to avoid such criticism in the future.

In performance and maintenance the candidate will demonstrate an understanding of the key relationships. Clearly there are many examples where this has gone wrong: gauge corner cracking in the UK; poor supervision of contractors; setting the wrong benchmarks i.e. pure performance with little technical benchmarking to ensure asset standards. There are also examples of where it was right: e.g. the tailoring of standards to traffic levels brought about in the UK by sectorisation in the late 80's and early 90's, which was responsible for saving some routes. These types of example should be understood by the candidate in order that he can demonstrate that there is always a balance between cost and performance. This is likely to be in written evidence.

Outcome 5

As an adjunct to outcome 4, this outcome will help the candidate to understand basic track renewal methods and technology.

APPROACHES TO GENERATING EVIDENCE Most of this unit will be completed through lectures and candidate research, through reading and workplace discussion/learning (if appropriate).

The teaching should encourage additional reading and research wherever possible, particularly for those not working in the railway industry. There is a wealth of published information available.

ASSESSMENT PROCEDURES Centres may use the instruments of assessment which are considered by tutors/trainers to be the most appropriate. Examples of instruments which could be used as follows:

Outcome 1

As it stands, this does not comply with the evidence requirements. In addition to completing a short question paper covering railway economics and cost-benefit analysis, candidates could be required to complete a short assignment requiring the use of an investment appraisal technique.

Outcome 2

This outcome would be best assessed by an open-book written submission in which candidates could demonstrate their understanding of the taught material and also the depth and breadth of their reading and research.

Outcome 3

This outcome would be best assessed by a short question paper on history of operations and safety and possessions. A timetabling assignment could also be set, with different train types/speeds and stopping patterns. Candidates could be asked to optimize capacity by means of manual train planning graphs over a given length and period, with given signaling headways.

Outcome 4

This outcome would be best assessed by a short question paper on the principles of maintenance requirements, techniques and management.

Outcome 5

In renewals and installation, the candidate should be able to demonstrate an understanding of types of technology and approaches available and when to apply them. The candidate should understand how a head office/infrastructure controller would typically determine rolling programmes of maintenance to keep the track at the desired level.

A short question paper could be used to assess understanding of technology, including visual presentations to assess candidates' ability to identify types of technology.

PROGRESSION This unit forms part of the framework of the HNC in Civil Engineering. Each unit is a separate part of the framework for the award and although units need not necessarily be taken in a prescribed order, there is a logical sequence to the acquisition of the skills and knowledge concerned.

It is suggested that this unit be undertaken as a foundation for further railways related units.

Reading material

A vast array of reading material exists in this field and candidates will find texts readily available in libraries, in the workplace and on the internet. Assistance will also be available from the Permanent Way Institution, the Institution of Railway

Signalling Engineers, the Institution of Railway Operators and the Railway Civil Engineers Association, and from Railway Group and Railtrack Line Standards.

A brief reading list is provided below.

- 1) Planning Passenger Railways, Published 1992 edited by Nigel Harris and Ernest W Godward
- 2) Danger Signals, Published 1987, Author Stanley Hall
- 3) BR Signalling Handbook, Published 1987, Author Stanley Hall.
- 4) CENELEC Technical Standards prEN51026 Railway Applications- The Specification and Demonstration of Reliability, Availability, Maintainability and Safety RAMS
- 5) HMRI Safety Principles and Guidance
- 6) HMRI Annual Safety Statistics
- 7) Permanent Way Institute – British Railway Track – Design, Construction and Maintenance Edition 6 1993 (New version now emerging in sections)
- 8) A guide to the approval of Railway Works, Plant and equipment ISBN 0717607410
- 9) The privatisation of British Rail, published 1997, authors Nigel G Harris and Ernest Godward

REFERENCES

1. Guide to unit writing, SQA, 1993 (Code: A018).
2. Guide to assessment, SQA, 1993 (Code: B005).
3. Guide to certification, SQA, 1996 (Code: F025).
4. Notes for unit writers, SQA, 1995 (Code: A041).

For details of other SQA publications, please contact staff in the Sales and Despatch section (Tel: 0141-242 2168) who can supply you with a copy of the publication list (Code: X037).

© Copyright SQA 2003

Please note that this publication may be reproduced in whole or in part for educational purposes provided that:

- (i) no profit is derived from the reproduction;
- (ii) if reproduced in part, the source is acknowledged.