

ONLINE NON-DESTRUCTIVE EXAMINATION QUALIFICATION FOR MARINE SURVEYORS

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SYNOPSIS

Lloyd's Register carries out internal Non-Destructive Examination (NDE) qualification of all their marine surveyors. To remain qualified, the surveyors are required to re-qualify at five yearly intervals.

TWI and Lloyd's Register have developed an Internet based examination system that automatically notifies Lloyd's Register surveyors by email in advance of their impending re-qualification date. Surveyors are instructed to log into the online examination system (along with their exam invigilator) and complete the obligatory examination.

Before attempting their exam, surveyors can access a practice version, which allows them to familiarise themselves with the software functions. They also take an eyesight test, the results of which are entered by their exam invigilator.

The examination comprises three multi-choice modules (surface crack detection, ultrasonic and radiographic) and a radiographic interpretation module. The latter displays a series of 10 weld radiographs that must be correctly interpreted with respect to film quality, weld quality and acceptability.

Each of the four exam modules must be completed within one hour. Examination questions are randomly selected from a number of categories to ensure that each 'randomly generated' exam covers the required syllabus. Examinations are marked automatically and the exam result presented immediately after completion of the exam.

If a surveyor fails to meet the required standard, following a month's revision period they are automatically entered for a re-sit examination. Failure of two re-sit exams would result in losing their qualification and the provision of the necessary re-training.

Training managers have access to the software to view surveyors who need to re-qualify. The software also allows the Lloyd's Register exam administrator to review specific exams and to perform statistical analysis on exam results. This information can then be used to identify misleading questions, or areas of surveyor weakness, that may require targeted training.

BACKGROUND

As part of their internal training programme, Lloyd's Register operates a mandatory qualification scheme in the subject of non-destructive examination (NDE) for all their marine field force surveyors (approximately 900 worldwide). To remain in the scheme, surveyors must go through a re-qualification procedure every five years.

Prior to implementation of this 'internet based' package, Lloyd's Register operated a paper-based re-qualification examination system issued from a central location in London. This required personnel to be identified and exam packages to be assembled and sent worldwide by courier to the appropriate Lloyd's Register office. The package consisted of an eyesight test, multi-choice examination papers (surface crack detection, ultrasonics and radiography) and a set of radiographs for the radiographic interpretation examination. The examinee and supervisor were allowed 4-6 weeks to complete and return the examination package to London.

On receipt back in London, the exam administrator (Level 3 NDE Specialist) manually checked the eyesight results and marked the three multi-choice and radiographic interpretation papers. A pass result would require a certificate to be created and sent out to the examinee. Those who fail the exam would receive tailored feedback on areas of strengths and weaknesses. The actions required included immediate re-sit if the failure was minor, further revision and re-sit, or arranging an eye test with an optician.

LIMITATIONS OF PAPER BASED SYSTEM

Lloyd's Register needs to ensure all its field force surveyors are appropriately qualified to undertake survey work where non-destructive examination techniques are used as part of the inspection process.

The existing examination content was judged to be satisfactory but a number of process problems were identified:

- The system relied on line managers identifying surveyors in need of re-qualification and applying to London for an exam package. This presented a number of people related problems, for example, the need to maintain up to date records and make timely applications to maintain qualified status.
- There were a limited number of exams that could take place at any one time due to the number of radiographic interpretation packages available (50 packs were available, reducing to 40 when a training course was running). This constrained the number of applicants that could be processed simultaneously, especially if exam packages were not returned promptly.
- Productive time for surveyors completing exams represented only 4 hours in the period a package was away from London, due to transit time, pack out pack in etc. In practice, the packages were returned outside the 4-6 week period and in some cases could be up to 6 months late.

- Backlogs would often occur due to the limited number packs available and the time constraints listed above. Therefore, even where the manager had anticipated the need for staff re-qualification at a particular time, the system could not always cope in a timely manner.
- The radiographic interpretation element of the exam package (master sets) cost in excess of £500 to produce. Courier costs worldwide were excessive, up to £25 each way depending upon the destination.
- Avoidable administration costs, including that of printing, assembly of each package and reproduction of lost exam packages. Each package took 1hr of admin time to assemble, around 1 hour for the NDE specialist to mark each package and a further half an hour of admin time to collate results and issue the certificate.

The whole process was a significant burden in terms of man-hours.

AIMS OF IMPROVED SYSTEM

The limitations of the paper-based system highlighted a need for a new quality assured system that would provide improved management control of the re-qualification process. Prior to specifying this new system, the following essential requirements were identified:

- A standardised global system of re-qualification.
- Reliability, cost-effectiveness and a reduction in man-hours required.
- An increased flexibility for potential examinees.
- Consolidated training records.
- A reduced turn around time for the examination process.
- An increased number of exams that can be handled concurrently.

These requirements were further developed into a product brief for an online examination system, which would automatically notify surveyors by email of their impending re-qualification date. TWI was commissioned to undertake the software development work and collaborated with Lloyd's Register to produce a fully operating system.

SYSTEM DEVELOPMENT

An iterative process converted the product brief to a detailed specification through close collaboration between TWI and Lloyd's Register. Detailed discussions resulted in a system that maximised the impact of automation on the NDE re-qualification process.

TWI designed extensive testing and implementation plans in partnership with Lloyd's Register before commencing software development. This ensured the streamlined introduction of the new system into Lloyd's Register.

FIELD TRIALS

Pilot versions of the software were initially tested in Lloyd's Register's London office, before commencing worldwide field-testing. This testing confirmed compatibility of the new software with the global Lloyd's Register IT infrastructure. As well as picking up minor computer bugs and operating problems, these trials highlighted the need for refinements to the specification. TWI implemented the required modifications prior to full roll out.

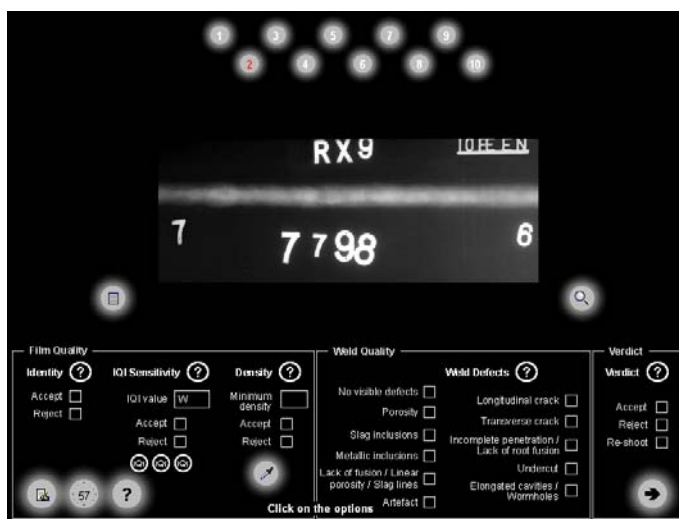
TECHNICAL AND USER FEATURES

The system automatically notifies surveyors by email 3 months in advance of their impending re-qualification date. Surveyors are instructed to log into and complete the online examination system. The password controlled access to the system makes various functions available depending on the level of authorisation:

Student log in functions

- Verification of personal details, including changing passwords and work location, if required.
- Nomination of an invigilator.
- Facility to view their exam history.
- Facility to view online certificates (original and latest re-qualification).

Before attempting their exam, the student will nominate an invigilator to oversee the process. The invigilator will receive the student's exam password and instructions for conducting the eyesight test. Surveyors can access a practice version of the exam to familiarise themselves with the software functions.



(fig. 1: Radiographic interpretation question)

When ready, the student sits an exam consisting of 3 multi-choice modules (surface crack detection, ultrasonic and radiographic) and a radiographic interpretation module (Fig 1).

The radiographic interpretation module displays a series of 10 weld radiographs that must be correctly interpreted with respect to film quality, weld quality and acceptability.

The modules are marked automatically by the system and the result displayed on-screen immediately after completion of the whole exam. If the surveyor has passed, the system automatically generates a certificate, which may be printed if required. The system then automatically manages the re-qualification process such that the individual is reminded in 5 years time to sit the exam.

If the surveyor has failed the examination, the system automatically manages the re-sit process, i.e. confirms by email that further revision is required and which modules will require a re-sit. A further email is automatically sent after 1 month, advising that they can re-sit the modules they previously failed.

Invigilator log in functions

By logging into the system, the invigilator has the ability to:

- Search, but not modify students and view qualification status.
- Print the eyesight chart for student's exam.

This allows office managers across the world to monitor their surveyors' qualification records.

Exam Administrator log in functions

An exam administrator, when logging into the system, can access the full range of functions:

- Create a student
- Add /amend/deactivate questions (*fig 2*)
- Add /amend/deactivate invigilators
- Access a monthly activity summary, giving a rolling month snap shot of who has taken which exams and when.
- Access a listing of those approaching their current re-qualification expiry date (3 months in advance).
- Access a listing of approved invigilators, who are responsible for over-seeing the individual's exam.

Question ID 385 - Duplicate

Click [Submit] to create as new question

Exam : Surface Crack Detection

Category : 1

Question : If a copper conductor is placed through a ferrous cylinder and a current is passed through the conductor

Answer : Options :

- 1. the same intensity and as in the conductor
- 2. greater than in the conductor
- 3. less than in the conductor
- 4. the same regardless of its proximity to the cylinder wall
- 5. depends upon the conductor diameter

Image : (e.g filename.jpg)

Image Data Fields :

1		2	
3		4	
5		6	

[Menu] [Back to Search Results] [Submit]

(Fig 2: Editing an examination question)

- Access statistical analyses of how successful examinees have been in answering each question in the database. The full database can be reviewed or any subset for a particular date range.

- View a marked version of each student's exams, allowing review and identification of individual training needs.
- Search (by email address, office or region) to review the qualification status of anyone or a group of people in the company. The full database can be searched or any subset for a particular date range.
- View an individual's examination history.
- View the emails sent to a student, confirming their stage in the re-qualification process.
- Bring forward students to re-sit exams (over-riding the automatic 1 month re-sit period) in exceptional circumstances, e.g. minor error resulting in failure.

The system also notifies the administrator with a daily email, which logs the activity around the world, i.e. the various emails sent out from the system, in the order they are sent out and to whom.

AUTOMATED MARKING

Marking and distribution of the examination scores is an automated two-stage process:

- **Stage 1**
Upon completion of each module the examination system will automate scoring. Scoring mechanisms are embedded within the software mirroring the scoring procedures set by the Lloyd's Register NDE Specialists. All examination questions and responses are stored on the system database making it possible to recall an examination at later dates.
- **Stage 2**
Once the student has completed all the examination modules the system will select this student and forward, via email, the exam results to the student and their invigilator.

If the student has passed the examination, the certificate revision numbers are updated in the database and made available for viewing and printing.

Failure of an examination will prompt the system to forward re-sit procedures to both invigilator and student. The system administrator is notified of any re-sit cycle operating, and has the ability to override this cycle at any stage if required.

RANDOMISED QUESTIONS

Upon starting an exam the system will select a random collection of questions from a large data store. Each question is categorised allowing an even spread of questions to be presented for each examination, thus ensuring all subject areas in the syllabus have been covered.

RADIOGRAPHIC IMAGES

Radiographic images are created using digital imaging equipment and are derived from original radiographs of test specimens.

Extensive trials have helped devise a method of producing images of high quality and acceptable file size. This has ensured that downloading time is not adversely affected.

The film density can also be checked via a density measurement tool to ensure it complies with recognised standards.



(Fig 3: Viewing a radiograph)

Within a radiographic question, a student can view and magnify the radiograph to a level deemed equivalent to that possible by the naked eye. (Fig 3)

EXAM SECURITY

Developed using Authorware, the examination system provides a robust secure package in which examination modules are delivered and immediately removed as soon as the connection between the student PC and Lloyds server has been destroyed.

Activities of students and invigilators are tracked and the system will automatically block any users if improper activity has been detected. The re-qualification system will automate all of this information and relay it to the system administrator, who will act accordingly.

MAINTENANCE

In the event of any network errors a team of server engineers provide support and rapid response to any problem.

Any patches or updates required for the NDE re-qualification system can be handled passed on quickly and effortlessly throughout the development, administration and support teams.

BENEFITS

The benefits achieved by moving away from a paper-based system to an internet-based system have by far exceeded those anticipated from the requirements identified in the initial scoping exercise:

- A new auditable system that provides improved management control of the re-qualification process across the world.

- The records held in the examination system can be reviewed and used to make improvements. For example, statistical analyses can identify ambiguous questions requiring amendment and areas of weaknesses within the system.
- The automated nature of the system has eliminated delays associated with requesting a package, waiting for delivery, returning the package, time for marking, reporting of results and issuing certificates. The results are available immediately after completing the exam.
- As the system allows an increased number of exams to be handled concurrently, the backlogs associated with the paper-based system have been eliminated.
- Once the surveyor has been notified of the need to sit the exam, he/she can plan with their local invigilator when to complete the exam.
- The system has reduced internal administration costs and eliminated courier costs. It is estimated that implementation of the system has increased manning efficiency by 0.5 man-years.
- The centralised database within the examination package has removed the need for the local office managers to maintain their own training records. They can monitor the qualification status of their surveyors online whenever necessary.
- Since records are maintained in a consistent manner right across the organisation, the ability to audit the process is improved.
- The random selection of examination questions makes it difficult for the surveyor to predict which questions will be in their examination.
- The various access levels give robust security for the examination system.

USER RESPONSE

Due to a highly effective implementation procedure, the new system has been integrated successfully with minimal disruption to the day-to-day operations of Lloyd's Register.

Whilst only being in the early stages of operation the NDE re-qualification system has been well received by both the Lloyd's Register NDE specialists and surveyors.

FUTURE DEVELOPMENT AND EXPANSION

The re-qualification software has been developed in such a way that any additions and amendments to examination questions can be implemented effortlessly and integrated instantaneously into an online exam.

Any changes to exam scoring mechanisms can be passed on to the TWI software development team and quickly integrated into the working system.

Linking this software with future online training systems will allow Lloyd's Register to operate fully automated training and examination services.

CONCLUSIONS

- The TWI software development team has had a long successful working relationship with Lloyd's Register, which proved vital when undertaking a project of this scale.
- Effective collaboration between Lloyd's Register and TWI ensured the project developed into a highly sophisticated product, tested and scrutinised at each milestone.
- Lloyd's Register now has an internet-based automated examination system, which identifies surveyors requiring re-qualification and manages the whole examination process.
- The initial period of use has shown that the benefits of an internet-based system have by far exceeded those identified in the initial scoping exercise.
- It has also provided the opportunity to show possible enhancements to the system and highlight the prospect of expanding this system into other areas of training and examination services within Lloyd's Register.