We Know How To Improve Inspection Reliability - Why Don't We Do It?

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Abstract. The PANI projects, sponsored by the UK's Health & Safety Executive, were completed and reported in 2007. However, when NDT vendor companies were subsequently surveyed in 2010 it was found that only a small number had taken steps to change the way they operated in the light of the findings from these projects. In addition, few respondents could see how the results from the PANI projects were relevant to other NDT Techniques.

This paper summarises the results of the PANI projects with respect to the impact of the organisation on the reliability of inspections covering the inspection process and the role of the client. The results of the survey are presented which highlights the best media for communicating results. The relevance of the human factors lessons from these manual ultrasonic investigations to the application of other NDE techniques is emphasised.

1. Introduction

The PANI (Google - PANI NDT) programme began in 1997 in an attempt to quantify the performance of manual ultrasonic operators outside the nuclear industry. Along with its successor document, they gave an insight into how improvements can be made to increase reliability in manual ultrasonics in NDT. The third document in this series showed the influence of human factors. One of the main risks identified which threatens inspection reliability is improper organisation of NDT. Often the chain of customer, vendor and operator is a source of unreliability.

Together with the online guideline documents for NDT and other reliability studies around the world, information on how to improve inspection reliability is readily available but a survey performed in 2010 found only a few companies had changed the way they operate based on this information. In addition, few respondents could see how the results from the PANI projects were relevant to other NDT techniques. So in response to this a decision was made to produce a short, concise summary document covering the main results from the three PANI documents, in the hope that it will raise awareness of the PANI projects and help NDT companies improve inspection reliability through changes to their organisation, processes and personnel.

2. About the document

The aim of the document is to disseminate as widely as possible information on NDT reliability so that end users can benefit.

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The PANI 1, 2, 3 and guideline documents totals over 600 pages with their appendices. The summary document has only 19 pages of report content, so the document can be read quickly and produced in different format types such as a pocket sized handbook.

The document examines the findings, conclusions and recommendations of the 3 PANI projects. It also highlights their relevance to other areas of NDT, particularly visual inspection which is a major technique applied in the Nuclear Chemical Industry.

Finally, the findings from an industry survey and a literature review are presented to show if improvements based on the PANI documents have been successfully implemented in industry and to establish what else could be done for the future.

3. Organisation impact assessment on inspection reliability

As well as confronting the human factors issues in NDT reliability, PANI 3 also performed an assessment on the organisation and the process of NDT. The assessment of the organisation of NDT was conducted through eliciting information from operators and NDT vendor companies and reviews of previous reliability studies and other initiatives to improve NDT reliability.

A literature review performed in PANI 3 identified that unreliability is not due to a single factor, but a combination of factors associated with the task, the individual and the organisation. A recommendation from the review was that work should be performed to identify the level of support required for NDT operators from an organisational point of view.

This had already started by asking operators in a workshop environment to describe their actual and idealised process for manual ultrasonic inspection programmes of work.

The ideal process from the operator's point of view, irrespective of the employment contract environment, is one where the preparation for the inspection is undertaken by the management of the NDT organisation. All the relevant information is then passed to the operator on mobilisation. Apart from undertaking site preparation such as inductions and permits to work, the operator just concentrates on the main task of conducting the inspection and producing a report. The NDT organisation then takes over to technically review and formally issue the report.

To highlight the discrepancy between actual and ideal inspection process two examples from the PANI 3 workshop are presented below in Figure 1 and Figure 2.

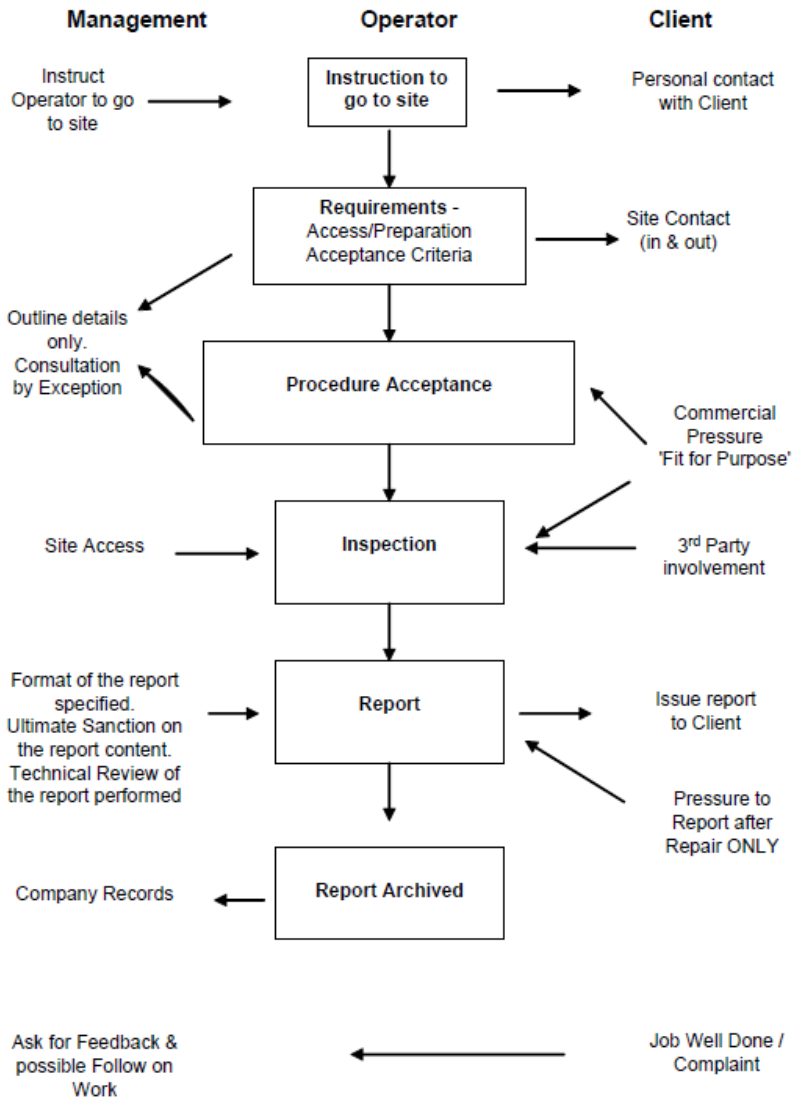

Figure 1 Example from one group showing an actual process for a typical jobbing inspection and the interactions between the three main parties

If the process from Figure 1 is the usual scenario for an inspection, it is without doubt that the operator is inundated with tasks to perform before the inspection itself is performed.

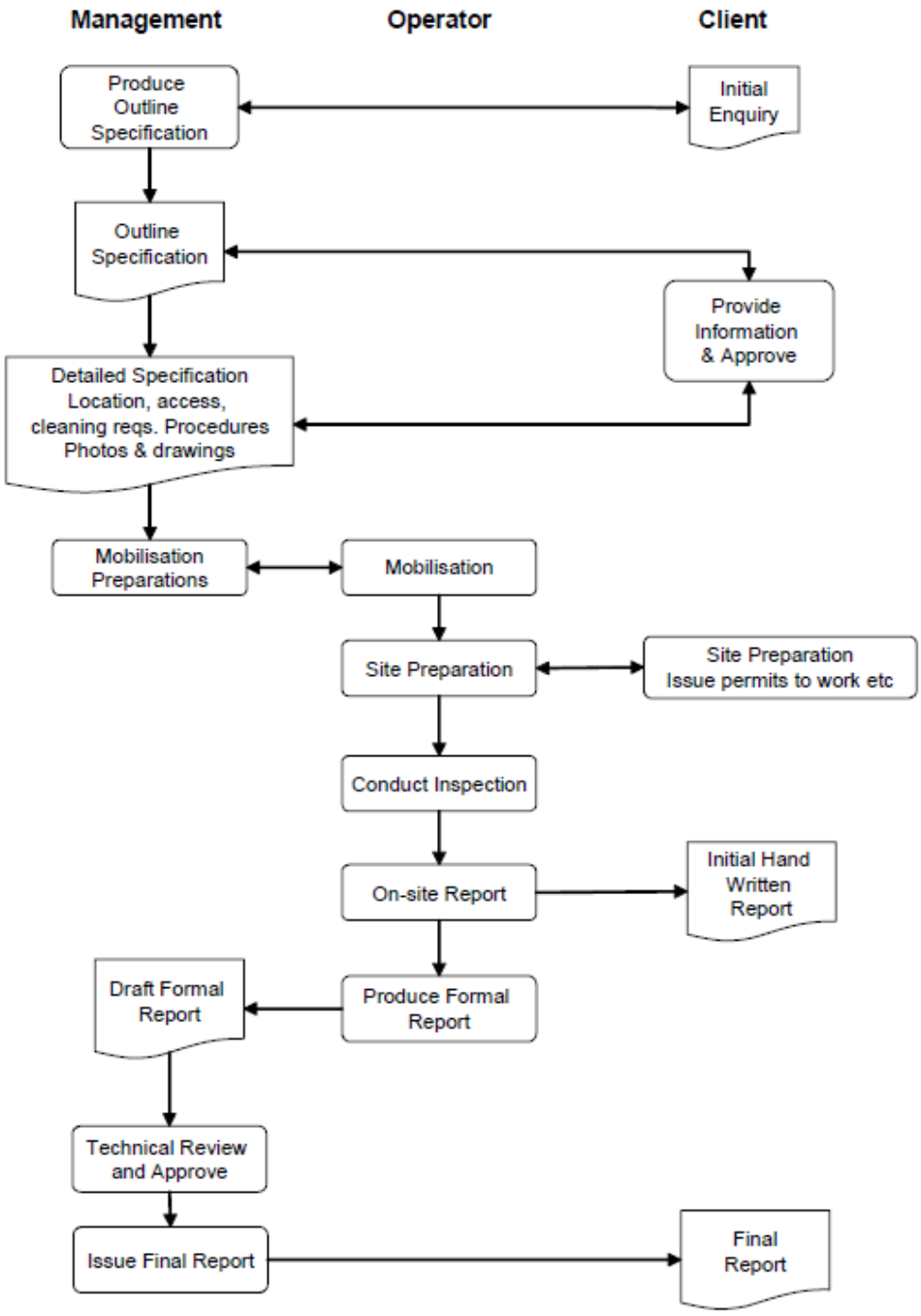

Figure 2 Example of an ideal process for a typical jobbing inspection

A more evenly distributed flow of work is evident in Figure 2 giving the operator the opportunity to concentrate on the inspection itself.

A general workshop discussion held after this process session identified the areas of concern, including time pressures, monetary pressure, training, equipment, environment preparation and supplied information.

To include the views of other links in the chain, visits were made to an NDT training facility and also to an operational NDT unit.

Areas for improvement were identified in both organisations. From the training organisation it was noted that -

- Better policing of the whole NDT process through QA and auditing. The aerospace industry has made improvements in this area through the NADCAP scheme.

- More time for training with different levels of syllabus – even the operators sometimes wish they had more time for their training.

From the operational NDT unit, the following areas for improvement were identified -

- Reduction in the re-qualification burden to reduce costs and demands on time.
- Better policing of the NDT process to ensure correct application.

Following the operator workshop, discussions, visits and the literature review, two conclusions and two recommendations were produced out of the PANI 3 study relating to the organisation of NDT.

The two conclusions were -

- The output from the operator's workshop showed that an operator's ideal inspection process is one where:
    - The preparation for the inspection in terms of access, safety and plant surface condition is performed by the client or NDT organisation, as appropriate, in advance.
    - Suitable documentation including risk assessments, inspection procedures, standards, acceptance standards, access and cleaning requirements, drawings and photos and equipment inventory are provided.
    - Adequate time is allowed for the inspection.
- This allows the operator to concentrate simply on carrying out the inspection. The NDT organisation should ensure that the operator is aware of the extent of their responsibilities.
- Feedback from contributors to the project indicated that an organisational culture can predominate in which inspection is regarded simply as a statutory or contractual necessity rather than as a valuable process which can help avoid plant failures. This can lead to problems with lack of information, inadequate preparation, poor access and working conditions, unreasonable time pressures and poor remuneration. Also, operators are aware of, and influenced by, the pressure to report a clean bill of health considering the costs and time delays to the operation of plant if a defect is found.

The recommendations based on these conclusions were -

- Apart from carrying out the inspection itself, the role of operators in an inspection should be limited to verifying the adequacy of the arrangements for safety, access and plant condition. The preparation for the inspection and the provision of an adequate and appropriate inspection procedure is the responsibility of the client and/or NDT organisation as appropriate.
- All organisations should promote a culture in which NDT is valued as a key input to the safe and cost-effective operation of plant. Organisations must facilitate the necessary preparation prior to NDT and also provide on-site facilities for the inspection, in particular they must allow adequate time for the inspection to be completed safely, accurately and reliability. A Code of Conduct for Industrial Plant Owners has been proposed to assist in the process (provided in the new summary document)

After the workshop individuals were contacted directly to gather the opinion on what the highest risks are to an NDT operator. The main risks that came from these conversations were -

- Lack of information received from the client which leads to -
    - Unrealistic expectations
    - Time delays
    - Use of the wrong equipment
    - Use of the wrong personnel
    - Impact on personnel (blame/stress etc)

- Poor Preparation of the area including -
    - Surface Finish requiring more attention
    - Area is too hot and quickly induces fatigue
    - Poor or no access (scaffolding not available etc)
- Commercial pressures

4. 2010 survey results

To gather views on what companies were doing to implement changes to improve reliability a survey was sent to 51 companies. The companies selected for the survey were identified via the following three routes:

- Internet search - small to medium companies
- PANI committee members
- BINDT associated members

Amazingly, although most of the participants were aware of PANI, only 56% had a good understanding of the outcomes and results, the rest had a more general awareness.

Even more interesting, the percentage of the total participants that had actually read each of the documents was -

- PANI 1 - 25%
- PANI 2 - 20%
- PANI 3 (which is available online) - 18%

Out of the total participants approximately 6% had made changes to the way clients operate through the successful use of the PANI documents. From the response to the survey and client, vendor and operator involvement in the reliability studies it is clear that together we want to improve reliability but what is not clear is how to do it. So one of the questions asked in survey is shown in Figure 3 “How do you keep up to date with developments in NDT?”.

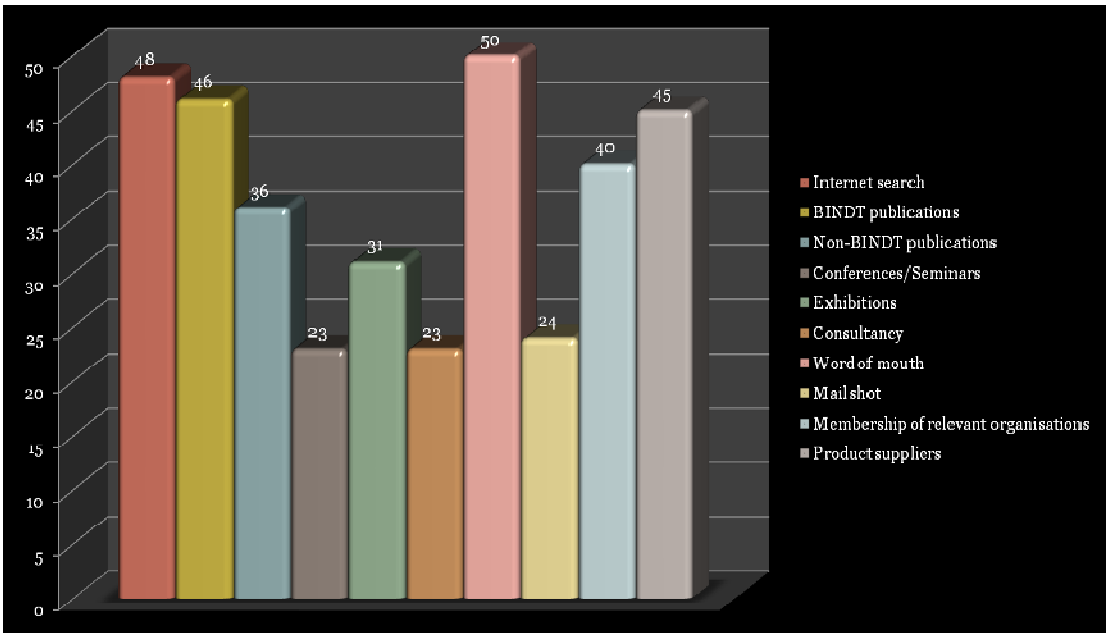

Figure 3 Keeping up to date with developments

Several categories ranked highly in the responses, including word of mouth, internet search, association through institutes and directly from their suppliers. All of these methods of finding information are related; low cost and fast collection. Time and cost as often found, appears to be the key issue.

From the survey it was concluded that the results of the three PANI projects and the associated HSE Guideline documents are not widely known despite the availability of documents on the internet and the promulgation of the information through seminars. It is important to look at alternative ways of getting the message across to those who need this information to improve working practices and to demonstrate that NDT is reliable and repeatable.

From the question about NDT developments, it would appear that improvements in the dissemination of information could be achieved by making better use of the internet, BINDT publications and product suppliers.

5. Application of PANI to other methods

Only 20% of the respondents to the industry survey (2010) thought that the results from PANI projects, obtained from manual ultrasonic inspection, were relevant to other NDT techniques. Despite this, there are many lessons which can be successfully transferred over to other NDT techniques. This is illustrated by the Guidelines documents produced for Surface Techniques and Radiography which were based on the original Manual Ultrasonics document.

Table 1 Relationship between manual ultrasonics and visual testing

Generic Task	Manual UT Task	Visual (Naked Eye) Inspection Task
1. Setting up of equipment	Calibrate equipment	Ensure eyes meet vision requirements
2. Application of the technique	Movement of the ultrasonic probe over the component surface	Examine the item under test ensuring full coverage
3. Observation of signals	Observation of the flaw detector screen	Look at the surface condition
4. Identification of signals	Identification of signals of interest on the flaw detector screen	Identification of possible defect features on the surface
5. Analysis of signals	Analysis of the signal on the flaw detector screen	Examining features more closely to identify origin
6. Reporting	Report results	Reporting findings

Table 1 is an example of how general tasks, UT tasks and visual inspection tasks all have similarities. The human factors that affect the reliability of these tasks are also similar. In practice, tasks 2, 3 and 4 are often applied concurrently. This requires a certain level of vigilance from an operator to identify potential defect signals in the presence of non-defect signals. In the application of all NDT techniques, the operators are applying generic vigilance abilities which have common mode failures such as lack of concentration and not seeing the required features even when looking at them.

6. Conclusion

The PANI projects and other reliability studies worldwide have generated a lot of information in order to assist organisations in improving the reliability of their NDT but unfortunately, despite these efforts to publicise this information there is still:

- A lack awareness across the NDT community

- A lack of appreciation of application to other NDT methods

So, as a small step to address this issue, the PANI summary document has been produced. Once this report has been officially approved for issue, it will become available on the Health, Safety and Environment (UK) website. Other forms for publication are being considered and any views or opinions on this would be greatly appreciated.

7. References

[1] Improving the Reliability of Application of NDT: The Findings of the Programme for the Assessment of NDT in Industry - PANI