University Education and Training for the SGNDT Professional Certification

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Abstract

Singapore NDT (SGNDT) is a new NDT professional certification scheme by the NDT Society Singapore (NDTSS) and launched in 2017 after a rigorous audit process with the Singapore Accreditation Council (SAC). The Singapore of Institute Technology (SIT) is the first Authorised Training Organisation (ATO) for SGNDT. SIT is a university of applied learning with education programmes that are geared towards human capital development for the industry and this includes NDT training. Through an engineering degree programme at SIT, an NDT curriculum is integrated that creates a novel learning pathway for students to gain the SGNDT certification. This learning pathway and pedagogy for the NDT curriculum are presented to demonstrate that students during their university education are able to achieve the SGNDT professional certification to be work-ready and be qualified to practice NDT upon graduation.

Keywords: Education, Training, Certification, Qualification, Applied Learning, Pedagogy

1 Introduction

Certification schemes for NDT are generally derived from NDT societies of various countries. The most widely and internationally recognised certifications are from the American Society for Non-Destructive Testing (ASNT) and the British Institute of Non-Destructive Testing (BINDT). At the same time, certifications from NDT societies are recognised locally and regionally within the industrial influence of these organisations. In the Asia Pacific region, a broad range of certification schemes are available but local certifications are typically absent bar a few countries like Australia, India, Japan and recently Singapore [1].

One of the issues about employer-based certifications like SNT-TC-1A from ASNT is that there is lack of quality control, resulting in an increasing amount of negative sentiment from the industry regarding the reliability of such qualifications. Even central certification schemes like PCN from BINDT have also come under scrutiny recently as the quality control of third-party accredited organisations administering the certifications can be compromised. One of the main reasons for such incidents is the difficulty of regulatory control and monitoring of international certifications by the governing NDT societies attributed largely to geographical separation. The problem also stems from a training programme that is not robust and coupled by the lack of regulation, may not deliver and cover the required NDT content adequately.
In this paper, an NDT training approach as part of a university degree in Singapore following tertiary education standards is presented. This allows engineering students in the degree to gain professional NDT certification during their studies. The training programme is developed in accordance to the recently accredited Singapore NDT (SGNDT) certification scheme administered by the NDT Society Singapore (NDTSS), which facilitates a local quality monitoring and feedback process.

## 2 Certification Scheme

SGNDT is a new local Singapore professional NDT certification scheme since May 2017 by NDTSS that is fully compliant with BS EN ISO 9712:2012 [2]. NDTSS for personnel certification is audited by the Singapore Accreditation Council (SAC) and covers the scope listed in Table 1.

<table>
<thead>
<tr>
<th>NDT Method</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetrant Testing (PT)</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Magnetic Testing (MT)</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Ultrasonic Testing (UT)</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Eddy Current Testing (ET)</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Radiographic Testing (RT)</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Visual Testing (VT)</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Phased Array Ultrasonic Testing (PAUT)</td>
<td>2, 3</td>
</tr>
<tr>
<td>Time of Flight Diffraction Testing (TOFD)</td>
<td>2, 3</td>
</tr>
</tbody>
</table>

Table 1: SGNDT accredited personnel qualification and certification scope for the Product/Industrial sector under ISO 9712:2012.

The certification scheme strictly follows quality assurance documents that details the requirements like training, experience and examinations, as well as process management and document control [2, 3]. SGNDT is equivalent to other internationally recognised NDT certifications but with a local identity, and is thus selected as the primary NDT personnel qualification scheme for university education.

## 3 Education and Training Programme

### 3.1 The University and NDT Facilities

The SGNDT certification is adopted at the Singapore Institute of Technology (SIT), which is the fifth autonomous university in Singapore. SIT focuses on applied learning with an education system and degrees offered that aligns with local industry human capital demands. SIT is the first Authorised Training Organisation (ATO) for NDTSS and the SGNDT certification. The award of the ATO status
is the result of a rigorous review of SIT’s NDT training programme and facilities, with annual audits and assessments conducted on-site to maintain the high standards of the certification scheme.

SIT follows documented best practices [2] for its NDT programme and facilities to operate as a resourceful and well-equipped training centre. The NDT laboratory at SIT premises features a complete suite of conventional NDT methods including VT, PT, MT, UT and ET, see Figure 1. In addition, the laboratory also houses more advanced and emerging NDT equipment including PAUT, TOFD, Digital Radiographic Testing (DRT), and Thermographic Testing (TT), to facilitate applied research work in these methods including application development, projects and consultancy. The NDT laboratory is mainly for practical training of the different NDT methods but classroom teaching are conducted at standard lecture rooms within the university.

![Figure 1: The NDT laboratory at SIT (left), and the NDT equipment available for training (right).](image)

### 3.2 Programme Structure

At SIT, the NDT training curriculum is incorporated in the Sustainable Infrastructure Engineering (SIE) degree that specialises in the land transport industry particularly in railway engineering. Railway engineers are in demand in Singapore as the train network is planned for expansion to double its capacity by 2030. One of the skills required in the railway industry includes regular inspections of tracks and train components, hence the need for engineers to have an understanding of the NDT practice.

Engineering students in the SIE degree have the opportunity to embark on the NDT certification route, similar to offerings provided for the industry. Students clock the training hours required by learning the governing theories of widely practiced NDT methods during classroom teaching from an experienced academic lecturer in the field. Learning is further reinforced through laboratory sessions to allow students to familiarise with NDT equipment used in the industry, following standard operating procedures (SOPs), to inspect specimens like welded joints and railway parts, see Figure 2. Inspection reports produced during these practical sessions are assessed for each NDT method taught. These laboratory sessions are supported and supervised by Professional Officers who are qualified NDT inspectors themselves from their previous work experience in the industry.
A novel approach of blended learning is also infused into the NDT curriculum with the use of flipped classrooms, and sharing sessions by experienced industry NDT practitioners, as well as video demonstrations of test techniques, see Figure 3. At the end of the training for each NDT method, students are assessed through a quiz with multiple choice questions, similar to the general examination conducted for the SGNDT certification.

Students also undertake as part of their degree studies, an Integrated Work Study Programme (IWSP) with full-time work of 12 months in an NDT company. Students can then gain additional training and practical work experience applying different NDT methods for various real applications with guidance from industry stalwarts in the profession. Students have the opportunity to practice NDT in the aerospace, marine, and construction sectors during the course of the IWSP, providing some diversity in future career prospects apart from the railway industry. The IWSP is an SIT flagship module for internship that is closely monitored by academic staff for job scope relevance through biweekly logs and quarterly face-to-face meetings with both the students and industry work supervisors.

Students spending a total of around 100 hours of NDT training at the university followed by 12 months of industrial experience in the NDT field through IWSP, achieve SIT’s Certificate of Attainment to
qualify for the SGNDT certification examination for up to two Level 2 NDT methods. The NDT curriculum at the university focuses on PT, MT and UT, upon feedback by NDTSS that these are the three most commonly practiced NDT methods in Singapore. Following the guidelines stipulated in the SGNDT scheme and ISO 9712:2012 [2, 3], the training hours and the industrial experience gained in this NDT education programme would meet the Level 2 requirements of up to two of these three methods. The specific NDT methods qualified for SGNDT certification depends on those practised during the IWSP with verified work logs of this industrial experience. In the end, students can not only graduate with the degree scroll but also with the SGNDT certificate to be industry-ready when joining the workforce. The NDT education and training programme structure at SIT is outlined in Figure 4.

4 Learning Outcomes

Students undertaking the NDT programme at SIT should meet the following learning objectives:

- identify the fundamental operating principles of NDT methods practiced in the industry
- discuss the capabilities and limitations of NDT methods for effective inspection application
- apply NDT following the inspection process given in SOPs
- interpret and evaluate indications found based on test standards and acceptance criteria
- produce reports with test information and inspection outputs of NDT methods

It should again be pointed out that particular emphasis is given to the NDT methods of PT, MT and UT in the programme.
Student feedback on the NDT programme at SIT has been positive overall with strong interests shown for the practical sessions and due to the relevance of the inspection methods learned to actual industry practices. In the first run of the programme, students have initially indicated the heavy content delivered in lectures during the training of the NDT methods and this affected assessment outcomes. However, this issue has gradually been alleviated through the blended learning approach and with better availability of learning resources through the university library.

The pioneer batch of students undertaking their IWSP in NDT also commented on repetitive inspection jobs, as well as the harsh working conditions in the field especially with the hot and humid weather of Singapore. Although the work environments cannot be changed, the university has taken an active role to communicate with work supervisors more regularly to ensure that the IWSP continues to provide a valuable learning experience, whilst a more robust internship programme is planned to integrate and interchange field work with training, inspection data analysis and research, where possible.

5 Conclusions and Future Work

The NDT education and training programme at SIT has yielded a positive outlook in the development of human capital in the field, as part of a university degree programme. A couple of students from the pioneer batch of the programme has recently achieved the SGNDT certification and expressed overall satisfaction with the learning outcomes and benefits gained.

The programme will be expanded to include continuing education and training (CET) courses for working adults from the industry. At the same time, a new railway maintenance scope is being developed with NDTSS and local railway operators for the SGNDT certification scheme to provide further relevance to the SIE degree in the land transport industry.

References