OPPONENT'S REVIEW
of Dipl.-Ing. Ralf Holstein's doctoral thesis

Doctoral thesis topic:
Qualification Profile of Nondestructive Testing Personnel

Study programme:
Management of industrial systems

Extent of work:
110 pages of text + 11 pages of appendices – evaluation of questionnaire survey

The opponent's review was requested by the Dean of the Faculty of Metallurgy and Materials Engineering, VŠB - Technical University of Ostrava on 27 June 2014.

Current trends in the design and operation of machinery within the EU are significantly influenced by EU Directive 42/2006/EU, which requires that all designers and manufacturers perform risk analyses during the operation of machinery and inform their customers on the results of these analyses. It is therefore possible to say that one of the priorities in the design and employment of the machines is assuring their safety as well as their reliability in compliance with the phrase ‘Safety First’.

While the area of risk minimization in the early stages of the technological life of a machine is the responsibility of machinery constructors, it is up to the users to ensure safe and reliable operation of the man-machine-environment system during its operation. One of possible approaches in this field is the application of methods of technical diagnostics, including the methods of non-destructive testing (NDT) of machines and their parts, e.g. defectoscopy.

Effective application of NDT methods is largely dependent on the utilization of scientifically justifiable methods. The achievement of relevant results from objective evaluation of properties of machines and their parts depends on the relevance of measuring methods, technological standard of measuring instruments and equipment as well as the quality of the personnel, who conduct the non-destructive measurements. Current research – although, unfortunately, as the author rightly points out, not enough research has been conducted in the field – shows that the weakest link in the measurement chain is the human factor, i.e. human being.

Therefore, I consider the topic of the thesis highly topical, as it develops the current knowledge in the field of personnel qualifications. At the same time, it can be stated that the topic appropriately corresponds to the profile of the study programme "Management of industrial systems".
I would also like to note that I highly appreciate the candidate’s high competence in the area of application of non-destructive methods acquired during his long-term experience in the field of experimental methods. A doctoral thesis topic focusing on setting objective requirements on the qualification profile of personnel engaged in defectoscopic measurements requires the symbiosis of the author’s experience, talent, sense of purpose and motivation.

Comments on certain parts of the doctoral thesis

The author correctly analysed the qualities of a professional conducting a defectoscopic experiment in Chapters 1 and 2. I appreciate the fact that he defined areas of industry where these methods are applied effectively. In this regard, I would like to ask the author to explain in the thesis defence discussion, how he sees the possibility of using non-destructive testing methods in the machinery production phase – p. 9 – Introduction. I would also like to suggest that maintenance activities should be analyzed as a phase of machine operation. I do not recommend analyzing them separately.

Chapter 3 of the submitted work is correctly devoted to the description of the current state of research into the effectiveness of utilization of NDT in actual plant conditions, especially in case of technology that involves highest risks (e.g. nuclear industry). In this regard, I would like to ask the author about his experience with the actual conditions of certification of personnel in industries – whether certification is seen as an obligation or free decision of the company that uses measurement results.

The author pays particular attention to personnel of specialized firms performing experimental measurements. As the outsourcing of some activities, such as maintenance, experiments, and safety analyses, especially in large companies, is being highly debated at present, I would like to ask for the author’s opinion about when it is effective for the company to have its own capacities for conducting tests and when it is preferable to outsource these activities.

The author lists several standards for applications of NDT methods in Chapter 3.4.3. Since the application of standards in practice is not obligatory, I would like to hear the author’s view on the status and role of standards in the dialogue between manufacturer and customer. I assume that NDT is the result of long-term studies and numerous experiments and I therefore see no reason for the application of standards. Or, is the area open to negotiation between the machine user and the company which performs the measurements?

In Chapter 4.2, the author proposes hypotheses whose validity is subsequently verified on the basis of results of a questionnaire used in firms operating in the Federal Republic of Germany. I do not dare to estimate the relevance of individual hypotheses, but I gained the impression that relevant answers to some of them would have been available already at the stage of formulation, e.g. in case of Hypothesis 2, which is focused on the pressure equipment and public transport, or Hypothesis 3 related to the fact that accreditation is not mandatory (Fig. 10) and, therefore, it could have been expected that not every inspection institution would be accredited.

The 50% response rate referred to in Chapter 5 can be considered relevant. It documented real interest of the companies in the conducted research. With such response rate, the statistical indicators can be considered as relevant and expressing actual behaviour of companies. Regarding the structure of the questionnaires, however, I assume that high number of questions (35 in group C, Q and O) can be demotivating for respondents. I would like to
ask the author to explain what led him to formulate such a relatively high number of questions.

The results of a questionnaire listed in Chapter 6 provide the reader with a realistic picture of the views of companies on the importance of the parameters that are part of the NDT reliability model – Fig. 34, designed by the author.

The evaluation of the hypotheses is summarized in Chapter 7. Again, it seems that the accuracy in the formulation of the hypotheses was confirmed only in two cases. However, it may also indicate that at present, there exist very few scientific analyses that would allow hypotheses to be based on the known facts and relevant research findings as early as at the stage of formulation. What is the author’s view?

Chapter 8 summarises the results of the thesis. Chapter 8.2.1 describes the role of NDT in society according to standards and laws. As I have already mentioned above, I do not see the application of standards as most appropriate in research-based practice. I consider it mandatory to comply with the laws as well as procedures in which verified research results have lead to proposing legislation amendments to existing laws. In connection with the wording of the last paragraph on p. 85, it is to be noted that I do not approve of the debate on “what safety is acceptable for the company”. Existing EU legislation clearly defines the safety requirements in the Machinery Directive 2006/42/EC or in Directive 89/391/EEC on the safety and health of workers at work.

The second paragraph of Chapter 8.2.3 very well defines the priorities in this field in Germany. I found it interesting to learn that firms invest only limited resources in operators’ training – p. 92. Chapter 8.3 contains conclusions and recommendations for practice. I consider the recommendations correct, mainly because they are based on the authentic and scientifically analyzed data obtained from both companies that perform defectoscopy as well as companies that order the service.

Trends in research into the effective use of NDT specified in Chapter 9 correspond to changes in society, which aim towards safe machines and machine systems with acceptable risks.

The author’s publications can be evaluated positively. They reflect not only the author’s individual activities but also teamwork; purposeful scientific work would be currently unimaginable without it.

Judging by the scientific level of the submitted work and considering all facts,

I recommend that the doctoral candidate be permitted to defend the thesis and after a successful defence, conferring the academic degree

“philosophiae doctor (PhD)”
on Dipl.-Ing. Ralf Holstein in the study programme Management of industrial systems.

Košice, 6th August 2014

Dr.h.c. mult. prof. Ing. Juraj Sinay, DrSc.