REVIEW OF DOCTORAL THESIS

Title of the thesis: RISK MANAGEMENT METHODS FOR INDUSTRIAL SYSTEMS

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a) Topicality

The thesis is closely connected with the problematic of risk management. Particular interest is dedicated to methodology for industrial reliability and risk analysis. This methodology has big history. Traditional methods are mostly based on Fault Tree Analysis and Event Tree Analysis. Because reliability of contemporary products is increasing and systems are more and more complex, original methodology must be adapted, modified or newly designed to reflect new situation. There is necessary to search for new methods able to monitor reliability or identify risk of complex and up to date systems with dynamic behavior, including dependencies, complex hardware interconnections etc. This thesis recapitulates weaknesses of original methods on one hand, brings new view on methods usable for industrial risk analyses on the other hand, coming from stochastic Petri nets, therefore I consider it as highly topical.

b) Fulfilment of goals

The goals of the thesis are clearly described within Chapter 2. In Chapter 5 author argues fulfilment of the goals. Argumentation is based on results achieved in 3 highly impacted journal articles (two articles are in Q1 – quartile in JCR Category, one in Q2), in which author of the thesis participates with the rate 80%, 80%, 50%. I have to say that the thesis is well organized. After perusing of the 3 articles I declare that all three main stated goals were successfully achieved.

c) Chosen methods for processing

Basic methodical platform comes from theory of Petri nets, what I consider as a right alternative to up to date used traditional risk analysis methods, as FTA, ETA, etc. Author showed that Petri nets are a flexible and powerful tool for risk and reliability analysts. This innovative approach extends a classical approach – it enables to take into account a facility to model dependencies and dynamic treatment of events in scenarios as well.

I appreciate a nice author's effort for new adaptation of the PRA-traditional method. The attempt for using it in new industrial sector seems to be successful.

d) Results, new findings

New findings of the thesis are apparently demonstrated in 3 impacted journal articles, otherwise they would never be published in such highly rated journals.

In Article Dis-A2 author solves the problem of dependencies between the pivotal events of the ET – solution of the problem is based on a formal analysis of a non-marked PN model and its properties. We can see a new approach to modeling and analysis of explicit dependencies in an ET by using PN. In paper Dis-A3 author brings a complex modeling and analysis method for complicated

scenarios where a scenario is modeled from its base causes to all consequences of the undesired event by an advanced class of the PN (SPN with Predicates and Assertions). New method (non-traditional) for modeling and analysis of dynamic accident scenarios based on use of the stochastic and deterministic PNs with predicates and assertions was demonstrated. In paper Dis-A1 author recapitulates methods for risk analysis and risk management in selected industrial sector (road/highway tunnels) to find out that in this industrial sector can be newly adapted traditional method (PRA) which up to now is used in other industrial sectors, actually in nuclear and chemical industry.

e) **Importance for practice**

Although PNs are not frequently used in practice at present time in the area of risk analysis and risk management, this thesis can be a promise for future - promise that some time in future many changes may happen in traditional methodology for risk management, taking into account international standards as well.

The thesis showed that this innovative methodological apparatus based on PNs is viable to solve risk problems in complicated practical situations much more efficiently than traditional methodology.

Questions for defense:
It is well known fact, that PNs are viable tool to solve complex dynamic reliability problems, see for example [1-3]. A dynamic approach to reliability analysis is needed for the reliability analysis of systems which are characterized by a strong interconnection among hardware components and the underlying physical processes. Have you any experience with dynamic reliability in risk management (risk analysis)?
If answer is yes, which methodology have you used to solve these problems?

[1] P.E. Labeau, C. Smidts, S. Swaminathan, Dynamic reliability: towards an integrated platform for probabilistic risk assessment, *Reliability Engineering and System Safety 68 (2000)* 219–254
[2] P.E. Labeau, A variational principle in probabilistic dynamics, *Annals of Nuclear Energy 27* (2000) 1543 -1575
[3] Codetta-Raiteri D., Bobbio A., Solving dynamic reliability problems by means of ordinary and Fluid Stochastic Petri Nets, *Advances in Safety and Reliability – Kolowrocki (ed.), 2005 Taylor & Francis Group*, London, ISBN 0 415 38340 4

Conclusion
Finally I pronounce that this doctoral thesis meets requirements to be creative, independent and individual research work. It contains original research results published by author of the thesis that are in accord with § 47, paragraph 4, Act No. 111/1998 on Higher Education Institutions. I recommend this thesis for further process of defense and after successful defense I propose for the author of the thesis to be awarded by the degree of "Ph.D.".

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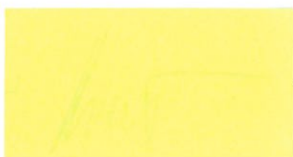
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