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## HABILITATION BOARD DECISION ON THE NOMINATION FOR APPOINTMENT TO ASSOCIATE PROFESSOR

| Masaryk University | |
|---|---|
| **Faculty** | Faculty of Informatics |
| **Procedure field** | Informatics |
| **Applicant** | RNDr. Jan Vykopal, Ph.D. |
| **Applicant's home unit, institution** | Faculty of Informatics |
| **Habilitation thesis** | Teaching Cybersecurity Hands-on |

**Board members**

| | |
|---|---|
| **Chair** | prof. PhDr. David Šmahel, Ph.D. (*Faculty of Informatics MU*) |
| **Members** | doc. Ing. Jan Hajný, Ph.D. (*Fakulta elektrotechniky a komunikačních technologií VUT v Brně*) |
| | Assoc. Prof. Mike Just, PhD (*Heriot-Watt University, Edinburg, UK*) |
| | doc. RNDr. Petr Švenda, Ph.D. (*Faculty of Informatics MU*) |
| | prof. Ing. Petr Tůma, Dr. (*MFF UK v Praze*) |

### Evaluation of the applicant's scholarly/artistic qualifications

Jan Vykopal is a talented researcher in the field of informatics. His research is mainly focused on security, education of security and cybersecurity training. He is an assistant professor with the Department of Computer Systems and Communications and Centre for Education, Research and Innovation in Information and Communication Technologies at Faculty of Informatics, Masaryk University.

In line with his excellent applied research profile, Jan Vykopal is very successful in receiving projects in applied security research and development. He was PI of the projects "Cyber situational awareness and decision support of CSIRTs" funded by Czech Ministry of Interior, "Cyber Czech defence exercise series" funded by Czech National Cyber Security Center, "Sharing and analysis of security events in Czech Republic" funded by Czech Ministry of Interior and others. He was also a key researcher and head of the research sub-programme Simulation of advanced attacks and efficient defence in the project CyberSecurity, CyberCrime and Critical Information Infrastructures Center of Excellence (C4e) funded by Czech Ministry of Education, Youth and Sports.

According to habilitation materials, Jan Vykopal published five articles listed in Scopus database (all in journals of the first quartile – Q1) and 21 articles in proceedings. Currently, the habilitation board found 9 articles in Scopus and 33 conference proceedings papers (9th November 2023). The conference proceedings publications included excellent results in A-ranked (CORE) conferences such as ACM ITICSE and SIGCSE, where he received two best paper awards (2020 and 2022). He also co-authored two software: KYPO Cyber Range Platform and Cyber Sandbox Creator. His publications were also well cited, he has got 1195

citations in Google Scholar (8<sup>th</sup> November 2023) and 513 citations in Scopus (8<sup>th</sup> November 2023).

Jan Vykopal is also cooperating with many international scholars, on cybersecurity education training with dr. Ankur Chattopahyay (Northern Kentucky University, Kentucky), dr. Richard Weiss (Evergreen State College, Washington), Assoc. Prof. Razvan Beuran (Japan Advanced Institute of Science and Technology) or on cyber ranges and human behaviour emulation with National Cybersecurity Lab (National University of Singapore).

**Conclusion:** The applicant's scholarly/artistic capabilities **meet** the requirements expected of applicants participating in a habilitation procedure in the field of informatics.


## Evaluation of the applicant's pedagogical experience

Jan Vykopal has been teaching at the Faculty of Informatics since 2009. He currently teaches in programmes "Cybersecurity", "Computer Systems, Communication and Security", "Software Engineering", and "Software Systems and Services Management". He is teaching courses Advanced Topics of Cyber Security, Cyber Security in an Organization, and several seminars. Based on evaluation of students in the feedback survey, the courses which he developed have significantly better evaluation than the average of the Faculty of Informatics.

He is also successful mentor of the student's thesis: he led 19 successfully defended Bachelor's thesis and 17 defended Master's thesis. He was consultant of the successful Ph.D. student Valdemar Švábenský at Faculty of Informatics with thesis Automated Feedback for Cybersecurity Training.

Jan Vykopal also developed two textbook texts: study materials and lab environments for Seminar on Simulation of Cyber Attacks and study materials for Cyber Security in an Organization in a flipped classroom format. He was also the founder and organizer of KYPO Summer School on Cybersecurity for finalists of the Czech Secondary School Cyber Competition in 2017, 2019–2022.

**Conclusion**: The applicant's pedagogical capabilities **meet** the requirements expected of applicants participating in a habilitation procedure in the field of informatics.


## Habilitation thesis evaluation

The thesis of Jan Vykopal entitled "Teaching Cybersecurity Hands-on" were evaluated by three independent reviewers: Prof. Roland van Rijswijk-Deij (University of Twente, Netherlands), Prof. Fabio Massacci (University of Trento, Italy), Prof. Raimundas Matulevičius (University of Tartu, Estonia).

Professor Roland van Rijswijk-Deij was very positive in the evaluation and stated "I greatly appreciate that Dr. Vykopal takes a hands-on approach to teaching cybersecurity skills. In my view, the work in the thesis bridges the gap between common training methods in the field (CTF, CDX …) and sound educational practices (measurable learning goals, comprehensive student assessment, …). The work discussed in the thesis advance the starte-of-the-art by making new tools available to teaching professionals that teach cybersecurity skills and by providing empirical evidence that these practices actually work."

Professor Roland van Rijswijk-Deij also stated following questions which could be answered in the presentation:

In Section 2.1, you give an overview of the state of the art in cybersecurity education and list various immersive and more offline approaches such as table top exercises. For both categories of work, my question would be: what is the longevity of exercise materials? In other words: how long can exercise materials be used before they become outdated? Especially for the latter category (offline, table top), it seems to me that part of the cost savings hinges on re-use, but to what extent us such re-use feasible?

In Section 2.3, you discuss a contribution on the analysis of CFT games. You note that there is "room for covering other topics such as human aspects of cybersecurity". I fully agree with you, and my question would be: what are ways to do this?

In your conclusions, you discuss that your contributions mainly address teaching technical aspects of cybersecurity, but you also remark that "[you] believe that tools and principles used for training technical skills can be adopted [in the context of training of communication and decision-making skills". I fully agree that such training is needed, beyond believing your tools and principles can be applied, how would you apply them? Can you sketch and example?

Professor Massacci stated that he found the habilitation thesis comprehensive, coherent, and innovative. He said it is extremely relevant work in terms of impact given the current skills gap in Europe on Cybersecurity, a high priority of all European Union states.

Professor Massacci also had following questions:

How many exercises actually fully exploited the capability of the KYPO framework for networked domains? How complicated were such domains?

I would like to know if there is any difference in the achievement of learning objectives on cybersecurity capabilities by students running attack scenarios in more complicated networks?

In summative assessments how to distinguish the evaluation of the individual from the evaluation of the group? This seems to be a key aspect and it is a bit glossed over in both the commentary and in the papers.

Professor Matulevičius concluded that thesis is acceptable for the habilitation degree. He evaluated that Jan Vykopal has significantly led and contributed to the field of cybersecurity educational research. He has researched and developed learning platforms and proposed various methods and approaches for hands-on cybersecurity teaching. He had no questions for the candidate, but he noted in relation to the third section that the candidate focuses much on describing the technical and managerial usage of the environments but does not consider how the learning objectives are achieved and whether the trainees obtained the skills and competencies in cybersecurity. The candidate could react to this note in his presentation.

In conclusion, all reviewers expressed their opinion that the thesis of dr. Vykopal fulfils requirements expected of a habilitation thesis in the field of informatics.

**Conclusion:** The applicant's habilitation thesis **meets** the requirements expected of habilitation theses in the field of informatics.

**Secret ballot results**

| Number of board members | 5 |
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| Number of votes cast | 5 |
| Number of votes in favour | 5 |

**Board decision**

Based on the outcome of the secret vote and following an evaluation of the applicant's scholarly or artistic qualifications, pedagogical experience and habilitation thesis, the board hereby submits a proposal to the scientific board of the Faculty of Informatics of Masaryk University to

| X | appoint the applicant associate professor of informatics

| | terminate the procedure.

Date:         8ᵗʰ November 2023

prof. PhDr. David Šmahel, Ph.D.      ………………………

signature