ENHANCED EDUCATION FOR CYBERSECURITY AND RESILIENCE

Jüri VAIN and Vyacheslav KHARCHENKO

In a rapidly changing technological, organisational and threat environment, the enhancement of cyber security and resilience of organisations, communities, and nations requires in-depth knowledge, expertise in diverse fields and continuous learning.

This volume of "Information & Security" reflects on current developments in the rapidly growing field of education and training aiming to deliver the capacity and expertise needed to provide cybersecurity and resilience. Most of the contributions present results of the TEMPUS SEREIN project "Modernization of Postgraduate Studies on Security and Resilience for Human and Industry Related Domains." This project, http://serein.eu.org/, aims to develop new curriculum for MSc, PhD and training courses for engineers and managers. The MSc program covers review of challenges in dependability and security including post quantum computing cryptography, technologies of systems and networks cyber security assurance, HMI security engineering, resilient PLD-based systems, risk analysis of security and resilience and others. Formal methods of system security and resilience assessment, security issues for web, cloud and other modern technologies and security system management are considered in PhD courses. The in-service training program includes the techniques and tools for different security and resilience critical domains.

The corresponding topics are covered by this I&S volume to:

- examine the definition of competence requirements;
- present innovative teaching and learning methods and tools;
- describe bachelor, masters, and doctoral programmes in cybersecurity or closely related fields and analyse respective experience;
- provide detailed description of blocks or modules of particular interest;
- present training courses in cybersecurity and resilience;
- analyse the implementation of gaming in the process of education and training;

- present best practices of university-industry cooperation in cybersecurity and resilience.

This volume consists of two issues and represents the topics above as follows.

The first section examines the status and initiatives aiming to enhance cybersecurity education in Ukraine. The article by Potii and Oliynykov provides an authoritative overview of the Ukrainian educational system in the field of cybersecurity.[1] The second article demonstrates how the European Union through its TEMPUS programme modernization of postgraduate studies on security and resilience for human and industry related domains.[2] In this article, the coordinating team of the SEREIN project elaborates on its objectives, organization, and key results.

Section 2 examines tools and techniques used to enhance cybersecurity education. In the first paper of this section, a team from the Liverpool John Moores University provides a comprehensive survey of cybersecurity teaching and learning laboratories and draws valuable conclusions in their utility.[3] Then Zhukovyts'kyy and Ostapec present original tools created to support practical cybersecurity research by students working on their MSc Theses.[4] In the final contribution to the section, a joint team of authors from Greece and Ukraine describes the technology and training application of the IMECA-based technique for security assessment of private communications.[5]

The third section examines the inclusion of key related topics in cybersecurity education. First, a joint team from Volodymyr Dahl East Ukrainian National University in Severodonetsk and the Kherson National Technical University analyses the experience designing a curriculum and teaching cybersecurity of critical infrastructures.[6] Then, Pomorova and Lysenko elaborate on the education and training issues in the application of formal and intelligent methods for security and resilience.[7] The third article by Gordieiev (University of Banking in Kyiv), Lobur and Kozak (Ternopil Ivan Pul'uj National Technical University) analyse the experience from the incorporation of commercial training programmes in academic curricula on ICT security.[8] In the final peer-reviewed article, one of the editors of this volume with a co-author present educational and research activities aiming to support safety and security of Smart GRID.[9]

The "Monitor" section of this volumes adheres to its main topic and presents a generic reference curriculum on cybersecurity, developed by a multinational team on behalf of NATO and Partnership for Peace Consortium of Defense Academies and Security Studies Institutes.[10] The curriculum is freely available to all interested readers. It has been endorsed by NATO, and partner nations may use existing policy mechanisms to request support for its adaptation and implementation for their national needs.

* * *

While this volume covers a wide range of topics related to cybersecurity education and training programmes, it is certainly not exhaustive. The intention of the "Information & Security" is to continue to address this theme and, thus, to make a humble contribution to a safer and more secure world.

Acknowledgement

References

[1]   Potii, Oleksandr V., and Roman V. Oliynykov. "Ukrainian Educational System in the Field of Cybersecurity." *Information & Security: An International Journal* 35, no. 1 (2016): 11-27, https://doi.org/10.11610/isij.3501.

[2]   Boyarchuk, Artem, Oleg Illiashenko, Vyacheslav Kharchenko, and Jüri Vain. "SEREIN Project: Modernization of Postgraduate Studies on Security and Resilience for Human and Industry Related Domains." Information & Security: An International *Journal* 35, no. 1 (2016): 29-48, https://doi.org/10.11610/isij.3502.

[3]   Topham, Luke, Kashif Kifayat, Younis A. Younis, Qi Shi, and Bob Askwith. "Cyber Security Teaching and Learning Laboratories: A Survey." *Information & Security: An International Journal* 35, no. 1 (2016): 51-80, https://doi.org/10.11610/isij.3503.

[4]   Zhukovyts'kyy, Igor, and Denis Ostapec. "Development of Tools for Practical Research on Cybersecurity in Msc Theses." *Information & Security: An International Journal* 35, no. 1 (2016): 81-97, https://doi.org/10.11610/isij.3504.

[5]   Androulidakis, Iosif, Vyacheslav Kharchenko, and Andriy Kovalenko. "IMECA-Based Technique for Security Assessment of Private Communications: Technology and Training." Information & Security: An International Journal 35, no. 1 (2016): 99-120, https://doi.org/10.11610/isij.3505.

[6]   Skarga-Bandurova, Inna, Alexandr Ryazantsev, and Katerina Kiryushatova. "An Experience Report on Education and Training Programme in Cybersecurity of Critical Infrastructures." *Information & Security: An International Journal* 35, no. 2 (2016): 123-132, https://doi.org/10.11610/isij.3506.

[7]   Pomorova, Oksana, and Sergii Lysenko. "Formal and Intelligent Methods for Security and Resilience: Education and Training Issues." *Information & Security:*

An International Journal 35, no. 2 (2016): 133-150, https://doi.org/10.11610/isij.3507.

[8] Gordieiev, Oleksandr, Taras Lobur, and Ruslan Kozak. "Integrating Cisco Systems' Educational Programs in ICT Security Academic Curricula." *Information & Security: An International Journal* 35, no. 2 (2016): 151-163, https://doi.org/10.11610/isij.3508.

[9] Brezhniev, Eugene, and Vyacheslav Kharchenko. "Smart Grid Safety and Security: Educational and Research Activities." *Information & Security: An International Journal* 35, no. 2 (2016): 165-178, https://doi.org/10.11610/isij.3509.

[10] Tagarev, Todor. "A Generic Reference Curriculum on Cybersecurity." *Information & Security: An International Journal* 35, no. 2 (2016): 181-184, https://doi.org/10.11610/isij.3510.

About the Authors

Jüri VAIN is Professor at the Department of Software Science, School of Information Technologies, Tallinn University of Technology, and coordinator of the TEMPUS SEREIN project.

Prof. Vyacheslav KHARCHENKO is Head of the Computer Systems and Networks Department and R&D group on Dependable Computing at the National Aerospace University "KhAI" in Kharkiv, Ukraine, and Head of the Centre for Safety Infrastructure-Oriented Research and Analysis, RPC Radiy. Prof. Kharchenko coordinates the activities of the Ukrainian organisations in the TEMPUS SEREIN project.