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B. Wepner/ G. Huppertz: Identification of emerging technologies with security implications: Experience and results from the ETCETERA project

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Scope:	Scanning for emerging technologies with security implications in time frame 2020 to 2030 by using three different technology scanning methods	
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The EU FP7 project ETCETERA aims at identifying Critical and Emerging Technologies relevant to security in the European context. The results will lead to recommendations for a European Security Research Agenda that deals with upcoming technological opportunities and threats, to alleviate the critical dependencies on technologies for member states and to provide alternative technological solutions. In work package WP4 "Scanning for Emerging Technologies with Security Implications" emerging technologies were scanned for their security implications in 10 to 20 years' time.

Different methods to identify emerging technologies were performed in a parallel fashion by three research institutions: Isdefe (Spain), AIT (Austria) and Fraunhofer INT (Germany). A comparative analysis of the results of the three methods was performed. Based on this comparative analysis, ideas were explored to derive a novel method for this kind of technology scanning, using the best properties of the different methods.

From all three partners involved a list with technologies were identified with only few overlaps in the results. Since the focus of the foresight activity of Isdefe and Fraunhofer INT lies on technological development potentially leading to future capabilities or applications in about ten to twenty years, the strength of these approaches is the distinct sensitivity of the experts involved to detect possible security aspects of identified technology developments at an early stage.

Using bibliometric analysis on the other hand with the very general search term "security" a broad, non-partisan overview of the topic was gained by AIT. Alongside

with technical topics and issues, cross sectional (social and psychological related topics) and environmental themes were identified.

Thus new trends and issues for future demands outside the focus of experts are taken into account. Also stakeholders, scientific experts and important organizations engaged in a certain technology can be identified in a back cast view that furthermore can reveal Hype-Cycle developments of certain technology topics.

Altogether more than 120 emerging technologies from 13 technology areas have been identified, 70 of which were rated as having significant impact in security.

The general approach in this project was to search for emerging technologies and prioritise the results from the three different scanning methods applied by three research organisations.

To combine the strengths of the scanning approaches it is proposed to weave them together, e.g. in a three step modus using bibliometric analysis for a widespread overview on main topics, then assigning experts in the relevant areas for a detailed desk top research based on the foregoing results, and finally confirming the findings by a focused bibliometric analysis with more precise and concrete search terms.

For the prioritisation process the WBAM method was applied to assess the identified technologies and proved to be a very useful and objective tool. However, the process depends on some parameters that always need to be taken into account when interpreting the results.

Table: Example of a resulting list based on a prioritisation process using the WBAM method.

Rank	Emerging Technology	Security Relevance	Ethical Consideration	Market Potential	Application Potential
1	Homomorphic Encryption	6	4	3	3
2	Post-Quantum Cryptography	6	3	3	3
3	Power System Security	6	3	3	3
4	Effective Water Ressources Management	6	3	3	0
5	Terahertz (Imaging and Substance Identification)	6	2	1	3
6	Quantum Cryptography	6	2	-1	3

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