Emerging technologies in civil security—A scenario-based analysis

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ABSTRACT

Civil security is a major issue on the European policy level and for the European market as a future lead market. Civil security technologies and their implementation are generally characterized by high complexity, multi-stakeholder involvement and a high level of regulation. Due to these characteristics and the influence of societal aspects, it is extremely difficult to evaluate the future developments and applications of emerging security technologies. This is why only a small number of studies have addressed this issue so far and empirical insights into these aspects are still scarce. Our paper addresses this research gap by applying scenarios to consider different societal aspects and their impacts on emerging security technologies and their applications. Based on quantitative and qualitative data and are used as the evaluation background for emerging security technologies. The results show that this approach is suitable to consider technological and non-technological drivers and barriers, and to derive measures and recommendations. The paper contributes to research on technology innovation systems from a challenge-oriented policy perspective and gives new impulses for future research, especially in the field of civil security.

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1. Introduction

Civil security is a central topic in security policy programmes and for domestic strategies. At European level, the "EU Internal Security Strategy in Action" (European Commission, 2010a) addresses the following identified key challenges to the security of the European Union: serious organized crime, terrorism, cybercrime, border security, and the management of natural and man-made disasters. Today, civil security is an essential aspect of European security policy since hazards, threats, and risks of heterogeneous origins are transferred into the same risk context. Furthermore, the issue of security research as an element of the grand societal challenges also plays an important role within the European Framework Programme for Research and Innovation, HORIZON 2020 (European Commission, 2014). At the moment, there is still some concern that European security research funding focuses exclusively on business and technology and not on solving societal challenges. A foresight approach may be one way to not only address the grand challenges of the future, but also consider such evolving concerns.

Civil security technologies are generally characterized by high complexity, multi-stakeholder involvement, and a high level of regulation. Due to these characteristics and the influence of societal aspects, evaluating the future developments and applications of emerging security technologies is a difficult and complex process. Existing methods of technology evaluation have two major weaknesses: they tend to focus on technology or user aspects rather than on analysing the problem in an integrated way and are often not future-oriented in a long-term frame, but only analyse the current situation. A foresight approach based on a systemic innovation understanding and the integration of heterogeneous aspects like ethics, the market situation, or the level of European integration could add further value (Dosi et al., 1988; Edquist, 2005; Lundvall, 1986). The evaluation process should consider technical details as well as the demand originating from society and the expectations concerning technologies. Especially where security technologies are involved and, for example, the development of security measures, societal needs and concerns are of the highest

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relevance since the technologies might be rejected otherwise. A systemic approach that encompasses diverse aspects is suitable in the context of the evolving concept of security and preventive security policy (Bierwisch et al., 2012). These aspects include, for instance, demand and social aspects, political and framework conditions, industrial systems and infrastructures, the education and research system and their dynamics.

We chose the scenario approach combined with quantitative methods like patent and publication analyses as well as market studies to meet the challenges listed, derive actions and reflect upon emerging technologies in the light of different futures. The methodological approach used in this paper was primarily developed within the European research project ETCETERA.[1] In this project, global security scenarios provide the basis for evaluating the development and application potential of emerging security technologies. Each of the developed scenarios postulates a possible and realistic future situation regarding the global and specific key factors of the development and application of security technologies. For example, societal changes, the attitude in society towards technologies, market developments, global dynamics, civil security, European policy, and current trends in different fields of technology were taken into account. This means the approach focuses not only on the technical feasibility of new technologies; it also integrates different stakeholder perspectives by considering ethical and societal concerns at the early stage of technology research and development. This kind of evaluation allows holistic integration of qualitative criteria, quantitative data, interdependencies, and different stakeholder perspectives. Ultimately, this foresight methodology has the potential to support different stakeholders in policymaking, especially regarding critical topics that may determine and influence the future of societies.

The purpose of this paper is to illustrate how foresight methods, particularly the scenario technique, can be used for the evaluation of emerging civil security technologies. One objective of this paper is therefore to outline how the technical and non-technical drivers for and barriers to these security technologies can be identified at an early stage of technology development. Their impact on the future development and application potential of these technologies is also discussed. The specific research focus is on whether and if so how societal needs and concerns regarding technologies and their applications can be identified, addressed and taken into account at an early stage of the technology development process.

The paper starts by outlining the methodological background and briefly describing the core elements of foresight and the scenario technique. This is followed by the description of a security framework and specific aspects concerning emerging security technologies and the security market. The third section is devoted to the methodological approach as used in the ETCETERA project for the assessment of emerging security technologies using global scenarios as a systemic evaluation background. Based on this, examples of the results are presented and discussed in the fourth section. The paper concludes with a summary of the key messages.

2. Framework: foresight and evaluating emerging technologies

The consideration of user aspects and societal needs is a crucial element when evaluating technologies. According to the main perspectives of innovation (processes), a balanced view of both technology push and market pull is an essential factor for the success of a technology (e.g. Di Stefano et al., 2012; Mowery and Rosenberg, 1979; von Hippel, 1976). Currently, the technology development side within technology evaluation tends to focus on technological aspects, cost optimization and saving potentials. On the user side, there has been an upsurge over the past decades in the techniques used for analysing acceptance (e.g. Davis, 1985, 1989; Lin, 2003). Here, many different aspects like usability, privacy issues or health concerns are considered. But these techniques have two main limitations: First, their results focus mainly on a buy or use decision, and second, they lack long-term future orientation. The latter is important when assessing the application and development potential of emerging technologies. Another specific aspect for the selection of the evaluation approach is the nature of the security technology and the security industry field as mentioned above. A systemic approach is suitable for the specific challenges associated with security technologies. This is why we decided to use a foresight approach that combines the integration of technical and non-technical aspects, a long-term horizon, and the systemic analysis perspective.

Our approach is described in more detail in the next two sections. Section 2.1 introduces foresight principles and the scenario method and Section 2.2 addresses the specialities associated with security technologies.

2.1. Foresight and the scenario technique

For this work, the technology foresight concept (e.g. Martin, 1995; Martin and Johnston, 1999; Miles, 2010) is necessary because of the research focus in this paper—evaluating emerging technologies regarding their future development and application potential to enhance the European security market as well as the resilience of society. The technology foresight approach applied in the ETCETERA project is based mainly on the scenario technique, one of several foresight methods (e.g. Burt, 2007; Postma and Liebl, 2005; Schomaker, 1995).

Foresight is defined in many different ways. One suitable definition for the purpose of our paper is the following:

> „[…] foresight is the process of developing a range of views of possible ways in which the future could develop, and understanding these sufficiently well to be able to decide what decisions can be taken today to create the best possible tomorrow." (Horton, 1999, pp. 5)

Horton emphasizes the necessity of thinking in different possible futures in order to adapt to possible future developments by appropriate decision making in the present. We hold that foresight is a process that supports the exchange of information and discussion about technologies with future relevance for the whole of society by involving stakeholders. This method can lead to a common understanding of the concerns and needs of different perspectives with regard to emerging technologies. Furthermore, foresight can indicate