

## **FUTURE THREAT SCENARIOS FOR IDENTIFYING SOCIETAL SECURITY NEEDS – THE METHODOLOGICAL APPROACH BASED ON EUROPEAN PROJECT ETTIS**

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### **Abstract**

This paper outlines the methodology of developing scenarios in the context of security that can be used as a base for meeting societal challenges today. These challenges are seen in handling of threats that might occur in the future which is described in alternative scenarios. These scenarios represent different combinations of alternative developments and trends in politics, economics, technology and society. Handling threats that might affect the society implies finding solutions. The usual way in foresight activities and technology assessment, in particular in the field of security, lies in outlining solution-oriented options and recommendations for arising challenges. For the project ETTIS (European Trends and Threats in Society), this approach was modified by integrating the need-perspective. This need-oriented approach for deriving solutions ought to address the actual needs of the society in order to find the appropriate solutions and can be seen as an intermediate step between the identification of threats and solutions. The analysis to date has shown that the involved experts have very different perceptions of threats as well as security needs: (i) There is a difficulty to define what is the difference between needs and solutions. (ii) There are conflicts and cross influences between needs. (iii) Finally, despite the different framework conditions in scenarios, the resulting needs do not vary significantly in different scenarios, however the impact differs between them and is significantly higher or lower.

Keywords: Scenarios, security, needs, threats, society, research project, cyber, nuclear, environment.

## **1 INTRODUCTION**

Within the project ETTIS (European Trends and Threats in Society), alternative future scenarios were developed, taking into account the interactions between threats and societal security needs [7], [8]. For the identified needs, in the next step security solutions should be proposed. These results should finally support the setting of security research priorities based on security-related needs arising in society. The proposed approach does not only take into consideration the usual driving question which solutions are possible for meeting a special threat, but rather focuses on security-related needs in society that might arise in different threat scenarios [8]. The developed scenarios describe different future situations based on combinations of security-related developments and trends in politics, economics, new technologies and society.

In general, the scenario methodology complements and extends conventional methods of forecasting. As a planning tool, it is particularly useful when strategic decisions need to be made within the context of specific societal, economic or political framework conditions and when developments in these spheres cannot be predicted over a lengthy period of time. Even though it is not possible to predict the future precisely, the

scenario methodology can be used to develop plausible visions of the future, commonly referred to as scenarios [6].

The process of creating threat scenarios in ETTIS considered on the one hand contextual factors which have a high relevance for the field of security (e.g., EU security policy or policies, demography, trends and drivers in security technology) as well as the identification of emerging trends and global developments. On the other hand, threat-related factors and further relevant aspects were included which describe the most important threats in three focus areas: cyber infrastructure, nuclear and environment. They apply only to a particular area (e.g., global safety norms for dealing with nuclear material, malware economics or environmental awareness and education in society).

This paper outlines the theories of human needs which were investigated for the needs of the project (Chapter 2) as well as the methodology of developing threat scenarios based on different contextual scenarios (Chapter 3). Furthermore, Chapter 3 presents some exemplary results of the threat and need identification. The main results referring to the process on the whole are presented in Chapter 4. The conclusions are dedicated to the discussion about the concepts of needs in theory and praxis (Chapter 5).

## 2 APPLYING THEORIES OF NEEDS TO THE PROJECT

Theories of needs offer various, in part conflicting definitions and concepts of needs. They range from psychological, to philosophical, political and social science definitions [1], [3], [5], [10], [11], [13]. Despite their differences, a common point of most of the theories is the attempt to classify and structure needs in order to offer an objective and transferable needs-framework. One of the oldest but also best-known approaches is Abraham Maslow's theory of individual needs "A theory of human motivation" (1943) [10]. Maslow distinguishes five different types of needs: physiological, safety, love, esteem, and self-actualization. Starting with physiological needs as a basis for staying alive, when this is fulfilled, the following needs arise subsequently. Maslow presumes that a human being does not aim at fulfilling the higher-level needs until the lower-level needs are satisfied. Therefore, this hierarchical concept is also represented by a pyramidal illustration. Maslow's theory has a strong intention to be motivating as it focuses the self-realization of a person.

Although being a psychological inquiry, Maslow's hierarchical theory of needs has had a major influence on organizational behavior studies. Having a major success as a managerial theory, Maslow adjusted his theory himself in 1960 by addressing growth motivations. Nevertheless, a critical point in this model is that it is not applicable to all societies and civilizations. Although the level of physiological needs is essential for all human beings, the weight of the other needs may differ [1]. In the following decades, several critiques, but also modified and refined concepts on theory of needs enriched the discourse. For example, adopting Maslow, but rejecting the strict order, in the E.R.G. theory, Alderfer reduces the needs of a human being to a set of three: "[...] obtaining his material existence needs, maintaining his interpersonal relatedness with significant other people, and seeking opportunities for his unique personal development and growth" [1]. Accordingly, the abbreviation E.R.G. stands for the words "existence", "relatedness" and "growth".

More recent theories outline the impact of individual versus societal needs. E.g., Doyal and Gaugh outline that human needs are subjective and therefore have to be regarded on an individual and a societal level [5]. They propose their own categorization, but reduce it to simply two levels: individual needs and societal needs. They argue that "basic individual needs", to which they count survival/health and autonomy/learning, are "[...] those goals which must be achieved if any individual is to achieve any other goal [...]" [5]. At the same time, they claim that humans as "social animals" have social

needs which also have to be satisfied in order to meet the basic individual needs. This level describes the abstract universal needs on an individual and societal level and may be considered as basic conditions for maintaining individual and social life. Building on that, Doyal and Gaugh extend the structure “[...] by linking the notion of historical progress with the optimisation of basic individual needs [...]”, claiming that their system is then able to cope with “[...] contemporary debates about social policy and human welfare” [5] Again, “the optimisation of universal needs through history” may be seen as an approach, which does not correspond to their general position, that needs are subjective states. But the basic structure of “abstract universal needs” is quite useful to show that, firstly, there are interdependencies between the needs of the individual and the society and, secondly, that they make an objective classification very difficult as they depend on the specific societal context.

With this orientation to different spheres where needs may arise or collide, Doyal and Gaugh’s theory is also similar to Bradshaw’s theory of need categories, of which Bradshaw mentions four: He distinguishes between (i) “normative needs” defined by experts setting specific standards, (ii) “felt needs” which individuals define themselves, (iii) “expressed needs” that occur when “felt needs” are expressed in terms of a demand of a specific service and the (iv) “comparative needs” which emerge when comparing one group with another, which have the same characteristics but different deficiencies [3]. An essential point for Bradshaw is the manner in which needs may occur or be expressed. Additionally, there is a difference between individual and societal needs, and consequently between needs in different societies, too. Bradshaw’s taxonomy highlights another challenge in finding an appropriate definition: There are needs on different levels that are not expressed in the same way, or even not expressed at all. As a consequence, there might be needs which are not being recognized.

Still, it is possible to get an insight into the needs that are generally conceivable. When concentrating on needs emerging in a society, a closer look at the capability approach, which has been firstly introduced by Amartya Sen and experienced main contributions by Martha Nussbaum, is useful [11]. In the capability approach, the question about human needs is converted to the question what the real capabilities of a human being are, that means “[...] what people are actually able to do and be” [11]. Here, Bradshaw’s “felt needs” for example are upstaged – the main point is the definition of capabilities that are assigned to each human being<sup>1</sup>, followed by the needs for meeting the capabilities.

A crucial difference to Maslow or theories based on E.R.G. is that the capability approach rejects economic growth as an indicator of quality of life. Nussbaum proposes an “open-ended” list of central human capabilities, including (1.) life, (2.) bodily health, (3.) bodily integrity, (4.) senses, imagination, and thought, (5.) emotions, (6.) practical reason, (7.) affiliation, (8.) other species, (9.) play and (10.) control over one’s environment in political and material terms [11]. The idea is that people should be able to maintain all these capabilities. Nussbaum also emphasizes that this list is meant to take into consideration cultural differences and is therefore in an open-ended structure. In addition, the items are specific rather than abstract and general, so that they may be adjusted within their framework by citizens or their legislatures [11].

At the same time, Nussbaum’s list of human capabilities indicates on the one hand that there are corresponding needs for maintaining the capabilities, and on the other hand that these needs and capabilities may differ in their significance in different societies. Needs are met by satisfiers and sometimes also challenged by threats. According to Nussbaum, the crucial insight is that needs emerge in different contexts with different

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<sup>1</sup> According to Nussbaum, the capability approach is strongly connected to the idea of human rights [8]. For the relationship between needs and human rights, see also [9].

weights. One may also say that different scenarios are like different contexts in which the ability to maintain capabilities may be tested.

What can be taken into account from the human need theories for setting up a need definition for a project dealing with security trends threats in society? Although there is no standardized theory of needs to start from, the aspect of security is considered in almost every need theory, e.g., Maslow's "safety need" [10], Nussbaum's need for maintaining the capability of "control over one's environment" [11], safety and security needs in organizations in the E.R.G. theory [1], Streeten's identification of security and safety needs as a right [12], etc. Regarding the whole concept in which they are set, the weight of security aspects as a source of needs is not always the same. This makes it impossible to adopt one of these theories as a working definition for the ETTIS project.

The following reasons show that the different definitions of security needs that can be found in literature do not cover all aspects of security that are addressed in the ETTIS project. Regarding threats and consequences that emerge from new technologies, focusing the uprising needs with a need-theory mainly based on self-realization is too far-fetched as these are set individually and can hardly be unified to general needs. The explicit focus on the growth factor in Maslow's and the E.R.G. theory is also too one-sided in regard of security issues. Furthermore, needs covering basic requirements of human survival, which are discussed in every need theory, are too basic to be considered in a foresight process.

At least, Doyal and Gough show that one may set a frame of "abstract universal needs" – which may also be an abstract universal need for security – by considering the interdependencies between individual and social needs as well as the historical framework where they arise. In this sense, in order to derive security needs, there is a theoretic opportunity, e.g., by using future scenarios instead of a historical framework for deriving security needs in specific contexts. A first step may be done by defining security needs as societal needs. For example, by an examining survey on societal needs and subjective well-being of people in 195 states, Tay and Diener came to the conclusion, that security needs are also societal needs [13]. Therefore, the society as a whole should be focused for identifying security needs and needs emerging in societies, respectively, e.g., as described by Bradshaw or Tay and Diener [3], [13].

Besides the definition of a need per se, for identifying needs it is helpful to know the threats on the one hand and the satisfiers of needs on the other hand. The satisfiers in ETTIS may also have the character of a solution<sup>2</sup>. Thus, a first step remained the identification of possible threats as a basis for deriving needs. To be more precise, it is also essential to refer to security, e.g., by naming the needs "societal security needs".

### 3 METHODOLOGICAL APPROACH

The aim of the scenario development was to describe alternative future worlds in three focus areas cyber infrastructure, nuclear and environment to identify possible threats. The scenarios were used to analyze how different threats might affect society across different plausible futures described in the threats scenarios. They enabled the discussion about different inter-linkages between threats and needs in relation to societal, political, technological and economic issues.

The research work was generally divided in three parts [7]: (i) The first consists of interviews with key stakeholders, (ii) the second of information mining using IT tools and (iii) the third of analysis of future studies in relevant fields and expert workshops to enable the direct exchange between the different end-users. All these activities were used to prepare and validate the development of scenarios in each focus area;

<sup>2</sup> To identify in the further steps in the ETTIS project.

however, each task delivered various inputs: The interviews brought insights about threats and needs as well as first ideas of solutions, the information mining about threats and the analysis of future studies and expert workshops about future developments (trends), threats and societal security needs.

The *interviews with key stakeholders* [7] provided an input regarding current and future threats and societal security needs. These stakeholders were conventional security research end-users (e.g., police, technical relief teams), public institutions and research organizations (e.g., ministries of the interior) as well as representatives from public and civil society organizations addressing societal needs on a general level (e.g., religious communities, NGOs).

*IT-based weak signal scanning* [7] was used in particular to explore emerging threats based on sources from the Internet. The weak signal scanning delivered all sorts of information about weak signals being early signs to events, which point to future threats, needs or wild cards and across the focused fields, e.g., “sensors and tracking” or “surprising side effects of genetic engineering”, within. In that way, it was helpful in specifying the thematic focus within the areas of investigation. However, the results needed to be interpreted by human experts to verify the automatically generated classification.

The *analysis of future studies and expert workshops* delivered input to the identification of trends, threats and security-related needs. The workshops created an added value by enabling the deeper understanding of the global security field as a context for the focused areas. The target group of the workshops was the user group, which encompasses most relevant stakeholders from the different security-related organizations, civil society organizations, the public and researchers, high-level policy-makers in the field of security as well as other stakeholders.

The workshops made a significant contribution to the identification and structuring of all relevant factors with a high influence on the fields cyber infrastructure, nuclear and environment today and in the future, to the identification and discussion of threats arising across the scenarios and finally to the need identification and validation of the results from the scenario development process [7], [8]. Three different types of expert workshops were conducted: (i) the focus group workshops to gain expert opinions about the most relevant aspects in the focus areas and about their future development, (ii) the consistency workshops to build scenario drafts and discuss them with end-users as well as (iii) the scenario validation workshops to discuss scenarios, threats, while identifying societal security needs which are the basis for the development of scenarios dependent solutions.

Four different context scenarios were developed, each making different assumptions for the future global powers, economical arrangement, security industry, security understanding and concerns in society, attitude towards security technologies, European R&D infrastructure and further driving forces (Fig. 1).

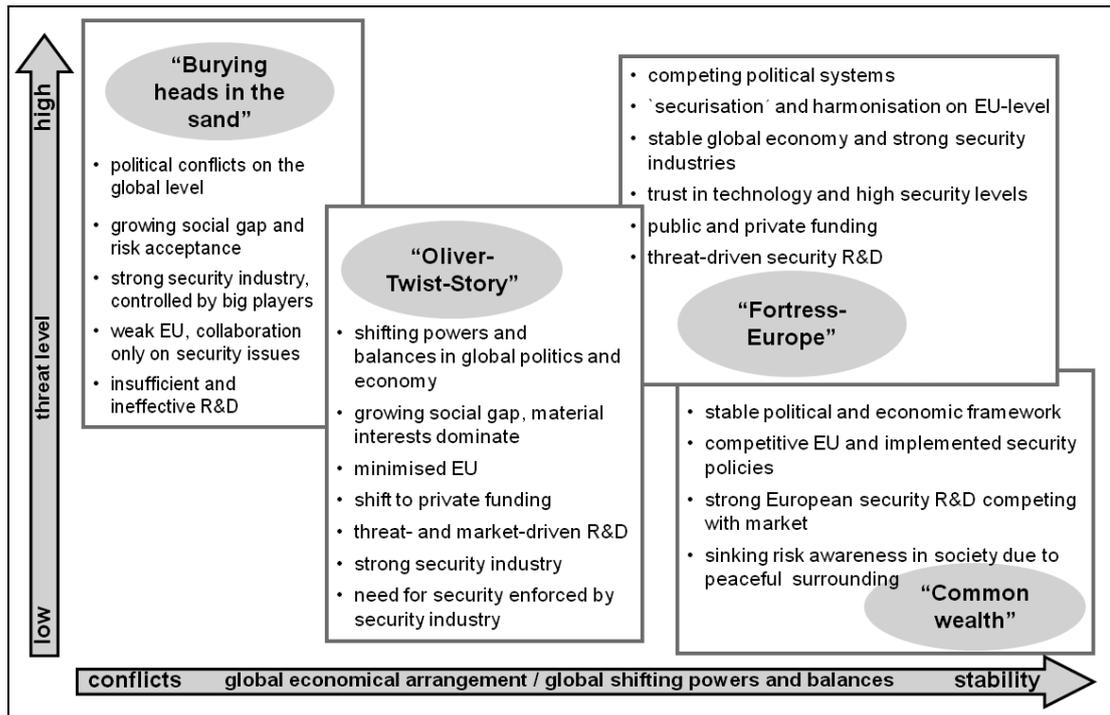


Figure 1: Characteristics of the context scenarios in overview [7].

Each scenario sets the basis for one chosen threat scenario in each focused area: cyber infrastructure, nuclear and environment (Fig. 2). The scenarios refer to a period of 10 to 15 years. For the domain cyber infrastructure, a shorter time horizon has been set (5 to 10 years).

Context	1 "Common wealth"	2 "Fortress-Europe"	3 "Oliver-Twist-Story"	4 "Burying heads in the sand"
Cyber infrastructure (C)	C1 Good new cyber world	C2 Almost open	C3 Going private	C4 Fragmented world
Nuclear (N)	N1 Greening the image	N2 High-security structures	N3 Losing significance	N4 Losing acceptance
Environment (E)	E1 Compliance with green	E2 Regulating sustainability	E3 Awareness without action	E4 Neither awareness nor action

Figure 2: Four context scenarios as the basis for threat scenarios in each area [7].

In addition, threats relevant for each area were identified and discussed. The prioritized threats were described in detail. This was a necessary step to handle the large number of identified threats by structuring them and finding a common level of a threat description. The prioritizing was based on criteria, such as future relevance, possible impacts (who, where, what), "likelihood" (including factors that influence it), societal relevance/impacts as well as the resulting societal security needs. Furthermore, only threats with high impact were considered. In total, more than 60 threats were discussed and the related needs in society identified (see examples in Tab. 1).

Given the point that threats not necessarily need to be intended, but can also evolve as unintended effects of other activities, we decided to frame as: (i) threats related to criminal activities, (ii) threats related to business activities, (iii) threats related to governmental activities, (iv) threats related to consumer activities and (v) systemic threats: a set of threats that were not caused as an intended or unintended consequence of activities, but more as threats related to the organization, technological development and structure of the relevant system itself. The threats find themselves caught between policy and economic developments with many interdependencies between these fields [7].

Additional insights were gained about the nature of threats which is twofold: There are threats with a procedural character, e.g., lack of safety requirements for handling nuclear material, instable economic situation or lack of human resources in R&D for security, and threats with an event character, e.g., terroristic attack, natural disaster. As the scenarios included threats with mostly procedural character, threats with event character were additionally listed and described in order to investigate what security needs might arise when a specific threat (event) occurs in different scenarios (Tab. 1).

<p><b>Scenarios with the main characteristics</b></p> <p><b>Possible threats with event character</b></p>	<p><b>“Regulating sustainability”:</b></p> <ul style="list-style-type: none"> <li>• Regulation on the EU-level in favor of the environment</li> <li>• Measures for environmental protection on the EU-level</li> <li>• Higher environmental awareness due to the measures and education</li> <li>• Higher importance of nature-compatible economics</li> </ul>	<p><b>“Awareness without action”:</b></p> <ul style="list-style-type: none"> <li>• Gradually responsibility of companies for environmental problems</li> <li>• Slightly increased environmental awareness in society</li> <li>• Less implementation of the EU strategies for environment protection</li> <li>• Solutions for environmental challenges on the local or regional level</li> </ul>
<p><b>Extreme weather conditions due to climate change</b></p>	<p><b>Societal needs:</b></p> <ul style="list-style-type: none"> <li>• Efficient common international mitigation policy and agreements</li> <li>• Identification with the same goals and actions</li> <li>• Stable climate</li> <li>• Support the adaptation to climate change</li> </ul>	<p><b>Societal needs:</b></p> <ul style="list-style-type: none"> <li>• Efficient common international mitigation policy and agreements</li> <li>• Identification with the same goals and actions</li> <li>• No reduction of the human life quality*</li> <li>• Stable climate</li> <li>• Spreading the knowledge about climate change and its consequences in society*</li> <li>• Support the adaptation to climate change</li> </ul>
<p><b>Food fraud and food terrorism</b></p>	<p><b>Societal needs:</b></p> <ul style="list-style-type: none"> <li>• International agreements referring to resource distribution</li> <li>• Maintaining the access to resources, supporting economic growth</li> <li>• Being adequately nourished (variety of nutrition)</li> <li>• Self-prevention and personal responsibility</li> </ul>	<p><b>Societal needs:</b></p> <ul style="list-style-type: none"> <li>• International agreements referring to resource distribution</li> <li>• Prevention against social polarization, radicalization and segregation*</li> <li>• Maintaining the access to resources, supporting economic growth</li> <li>• Being able to have good health*</li> <li>• Being adequately nourished (variety of nutrition)</li> <li>• Self-prevention and personal responsibility</li> <li>• Fighting against the corruption*</li> </ul>

\*Additional needs identified in scenario “Awareness without action”

Table 1: Need identification based on threats occurring in scenarios – examples of scenarios and threats in the focus area environment [8].

## 4 RESULTS

To summarize the results of the threat discussion, following insights should be pointed out [7]:

- Firstly, the exercise and all the related discussions have clearly shown key problems in the identification of emerging threats. This is mainly due to the following: Many threats are often variations of existing ones carried with different (technical) means, for example, identity theft (capture of online identities instead of forging passports, etc.)
- Secondly, though they are already well-known, existing threats may change the way how they are carried out in many other ways, like change of target groups or combination with other threats. On the one hand, this underlines that “old” threats can very easily and fast become “new” threats and, on the other hand, that this may lead to different impacts and consequently different needs.
- Thirdly, emerging threats often arise from an unforeseen combination of technologies, motives and possibilities.
- Finally, all threats which are assigned to the same or even similar threat sources have the same effects on societal security needs. Further, it was argued that the threats are probable in each of the four scenarios. The only difference is that some threats are more likely to happen and have a higher impact in some scenarios than in other ones.

The discussion about societal security needs and the additional analysis of theories of human needs were extremely useful to identify these needs which were mentioned more frequently across all focused areas. Due to the fact that different threats may have similar or the same impact, like different types of accidents or attacks, similar or the same needs result from these threats. To demonstrate the variety of the identified needs, a consolidated list of needs was developed.

Deducted from the theory of needs, a catalogue with needs was developed. It based on 15 different approaches, included 12 different dimensions of needs, e.g., life and health (contains needs describing aspects related to human health, such as clothes, rest, cure or health insurance), politics and rights (contains political aspects, often also expressed in the form of rights like autonomy, freedom, justice and independence) or education (related to gaining and increasing our knowledge and competences, being curious and understanding and solving problems, and of course the education itself). One further important category was the security and protection related, e.g., to the security against violence, living in a safe area or even defense. The needs and need categories identified in the theory corresponded strongly to the needs identified in the project (see examples below). However, in the second case, some specific needs were additionally identified, e.g., international cooperation or risk management, which were not listed explicit in the theory.

The following security-related needs deducted from the project built the cut set across for cyber infrastructure, nuclear and environment: protection (e.g., of people, goods or immaterial goods); trust building and reducing fear as well as building safety culture and responsibility (e.g., trust in government or own responsibility); transparency of information during and after an incident (e.g., public communication about risks and measures); education and training (e.g., maintaining a skilled, knowledgeable workforce, educated society); regulation (e.g., implementation, improvement) and international cooperation (e.g., regulation, agreements, enforcement) as well as risk management (e.g., impact planning; simulation; modeling).

To summarize the results of the identification and discussion of security-related needs in society, following challenges should be highlighted [7], [8]:

- The needs stay either at a more abstract level describing issues like the need for protection which is strongly oriented towards the basic needs described in the theory, or they easily end up at a level close to describing solutions, like specific types of training measures or technical solutions. In the first case, needs did not vary in the specific context of the focused areas cyber infrastructure, nuclear or environment. Furthermore, due to the variety of need types in the theory as well in the project praxis (e.g., societal vs. individual or related to security or not), the boundary between needs and solutions becomes increasingly blurry.
- Conflicting needs are in the security area strongly represented, e.g., the basic question security or “freedom”. This is made evident by the need-based approach chosen in ETTIS. This controversy might be illustrated by the question of identity in the Internet: While in many cases like disproportion, but also in cases like data trails the protection of anonymity would be seen as an advantage, many other cases show the need for clear identification like vigilantism or cyber mobbing. This underlines the need for new approaches in security research that go beyond the classical approach of changing security for freedom with all its potentials for abuse.
- The difference in the perception of threats, i.e., the question if a threat is resolvable and how, leads to the diversity of appropriate solutions. Solutions strongly depend on understanding the threat. The answer results in the different level of impact in each scenario.
- Finally, there was the challenge to determine different needs for the different scenarios. Although the developed scenarios cover a very broad spectrum of future possibilities due to the consideration of a wide security context as well as three different thematic fields, in most cases two, three or even four scenarios showed similar patterns for each domain. In those cases, it was hard to derive different needs. Only in some cases, it was clear that one or two scenarios vary strongly due to the different framework conditions in these scenarios. However, the impact differs between scenarios and is significantly higher or lower. Based on that assumption, the resulting needs will not vary so much in-between the scenarios (see example in Tab. 1).

Despite some similarities in the consequence, different solutions should be proposed in different scenarios depending on the need intensity.

## 5 CONCLUSIONS

The scenario approach is useful for analyzing how different threats impact the society across different plausible futures. They enable the discussion of different inter-linkages between threats and needs in relation to societal, political, technological and economic issues. These results were used to evaluate what kind of solutions could be suggested or should be developed to meet these needs in the future. Moreover, scenarios provide a framework for prioritizing the solutions. For the identified needs, solutions of both a technological and non-technological nature may be proposed. The first ideas of solutions could be generated while making the needs concrete. For example, a need for a qualified workforce is more concrete, when specific training packages will be suggested – which might be a possible solution for this need [7], [8]. The ongoing research uses in particular the cut-down set of needs across all focused areas for this purpose.

The research of the literature on the theory of needs (human needs) contained defining terms, stock-taking and structuring the existing classifications of needs as well as the transfer of these results to the field of security, in particular to cyber infrastructure,

nuclear and environment. This analysis brought significant insights into the project: (i) consolidation of the different human need classifications in a catalogue of human needs, (ii) identification of societal security needs and (iii) the identification which needs found in the theoretical approaches emerge in project praxis and under which circumstances.

Due to the complex tries of numerous authors to give a scientific concentrate of human needs, the scientific discourse does not provide a tailored framework for integrating the need-perspective in foresight. The stock-taking and comparison of the different approaches was therefore an important task. All the investigated need classifications include similar dimensions or categories which can be expressed as needs, for example, knowledge, relationships or security.

The discussion on societal security needs in the project showed some difficulties related to this task. Analogous problems arose while investigating the theories of needs:

- The first problem was that the terming of societal needs and societal security needs, respectively, differed strongly among the experts involved in the project. The underlying problem was twofold: One point is that security needs and societal needs, respectively, have different meanings in the different groups, so results and conclusions might vary. The second point is the challenge to distinct between needs related to the society and to an individual as well as the differences between the European societies which are communities living in different countries or regions including institutions, companies and politics.
- The second difficulty was the differentiation between societal needs and resulting solutions. The main difference was either the focus on societal security and related solutions, such as “traceability of actors” or more societal needs such as “trust or confidence”. In many cases, the experts’ suggestions combined needs and solutions like in the case of artificial intelligence safeguards, where trust builds through regulation of the process (i.e., requirement of human action for critical decisions). All in all, the discussions led to the questions how societal security needs can be specified and to what extend it is possible to separate needs from solutions during such a process of identification. Moreover, the expert groups also identified security itself as a societal need, where further detailing would lead to problems.

Deriving needs within the ETTIS project remains challenging due to the difficulty to find a balance between the need formulation on a very abstract level (especially if they should apply to all thematic areas) and the use of more concrete formulations which make it difficult to separate the needs and satisfiers (solutions).

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