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Exploring Near-Future Potential Extreme Events(X-Events) in the Field of Science and Technology

-With a Focus on Government Emergency Planning Officers FGI Results -

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Abstract

This study aims to predict uncertain future scenarios that may unfold in South Korea in the near future, utilizing the theory of extreme events(X-events). A group of 32 experts, consisting of government emergency planning officers, was selected as the focus group to achieve this objective. Using the Focus Group Interview (FGI) technique, opinions were gathered from this focus group regarding potential X-events that may occur within the advanced science and technology domains over the next 10 years. The analysis of these opinions revealed that government emergency planning officers regarded the "Obsolescence of current technology and systems," particularly in the context of cyber network paralysis as the most plausible X-event within science and technology. They also put forth challenging and intricate opinions, including the emergence of new weapon systems and ethical concerns associated with artificial intelligence (AI). Given that X-events are more likely to emerge in unanticipated areas rather than those that are widely predicted, the results obtained from this study carry significant importance. However, it's important to note that this study is grounded in a limited group of experts, highlighting the necessity for subsequent research involving a more extensive group of experts. This research seeks to stimulate studies on extreme events at a national level and contribute to the preparation for future X-event predictions and strategies for addressing them.

Keywords: Extreme Events (X-Events), Government Emergency Planning officers, Scientific and Technological Development, Side Effects, Incidents

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1. INTRODUCTION

Foresight is a study of change and uncertainty. Through foresight and predictions, we can anticipate opportunities and threats in advance, enabling early warnings, providing enough time for decision-making, and fostering innovation to expand new ideas and perspectives. In other words, due to the significant feature of uncertainty in 21st-century change, it is imperative to engage in future prediction to minimize the damage it may cause and adapt to cascading and simultaneous changes.

While accurately predicting the future is challenging, signs of change are undeniably present. By recognizing these signs of change, we can proactively explore indicators of future crises and disasters, offer early warnings, and develop various scenarios and response manuals for post-event management. In essence, through future prediction, we can respond to crises and disasters with agility and flexibility, minimizing the impact[1]. Currently, in South Korea, various factors that can trigger new changes are identified, and one of them is the field of science and technology. Approximately 40 years ago, Moravec's Paradox was introduced, stating, "Hard problems are easy and easy problems are hard" [2]. This paradox eloquently encapsulated the phenomenon of the time, highlighting the disparities between human and computer abilities. It continues to be frequently referenced in articles related to artificial intelligence. However, despite Moravec's expectation, advanced science and technology have continued to advance, especially after the Fourth Industrial Revolution. The development in these areas has led to a continuous reduction in the disparities between human and computer abilities, including reasoning, cognition, and interaction. In particular, artificial intelligence has already reached a level of learning without human intervention, using deep learning and machine learning. As shown in Figure 1, it is advancing at least twice as fast as the government's predictions. As a result, it has become challenging to gauge the extent of advancement in these areas beyond 2025.

However, paradoxically, the advancement of such science and technology may pose a significant threat to us. Malfunctioning AI algorithms, the threat of deepfakes, digital propaganda, ethical concerns in biotechnology, and heavy reliance on scientific development may lead to numerous problems. Additionally, terrorist and criminal organizations can also easily exploit advanced science and technology. The industrialization and development of science and technology have led to various issues such as environmental pollution, exacerbated social inequality due to economic development, human alienation and isolation caused by social networking, increased unemployment, privacy invasion, and security issues. Moreover, as advanced science and technology continue to develop, the time for new technologies to reach and be adopted by the public has become significantly shorter, as past cutting-edge technologies have become foundational technologies, accelerating the introduction and popularization of new technologies. Against this backdrop, it is deemed entirely possible that X-events related to science and technology that we have never experienced or even imagined before could occur in the near future. Therefore, we aim to identify potential future events, the problems they may bring, and suggest response strategies.

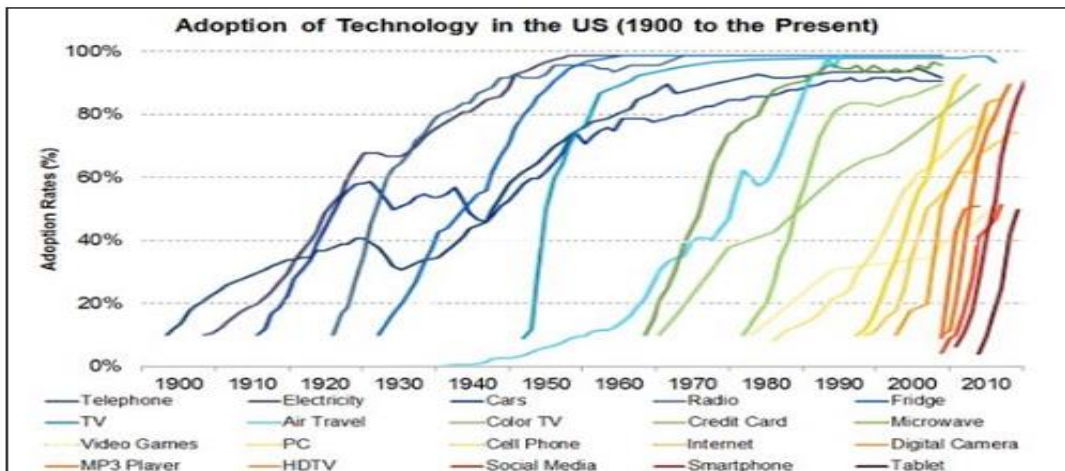


Figure 1. New Technology Application and Transmission Period in the United States[3]

2. Theoretical Reflection on Extreme Events

Before us lies an unimaginable multitude of possibilities, which is precisely why future prediction is so challenging. However, this does not render prediction itself meaningless. Predicting a range of possibilities allows us to be flexible in responding to unforeseen circumstances. Among the potential future scenarios, X-events represent events that are difficult to predict and have a low likelihood of occurrence. However, once they occur, they have far-reaching consequences, including loss of life, property, territory, societal disruption, and economic paralysis. Recent prominent X-events include the 9/11 terrorist attacks (2001), the influx of a large number of African refugees into Europe the UK's withdrawal from the European Union (2016), and the COVID-19 pandemic (2019). X-events are challenging to predict, and due to a lack of existing data from past occurrences, estimating their ripple effects is difficult so immediate and effective responses may be limited if an X-event were to occur.

To overcome these limitations, futurists have been exploring X-events using various methodologies such as Scenario Planning [4], the Delphi Method [5], and Cross-Impact Analysis [6]. However, X-events can emerge not only from professional and authoritative sources like academic theses, historical analyses, and educational journals but also from everyday individuals and media, such as artistic or literary works, science fiction novels, unpublished records, and speeches. Paradoxically, what may be considered the least likely future is often the most likely, and seemingly absurd and ridiculed ideas that do not appear plausible can be more useful for predicting extreme events. Therefore, to predict and prepare for extreme events, a wide range of opinions must be considered, and even seemingly outrageous ideas should not be dismissed [7]. X-events can be intimidating, given their significant and extreme consequences. However, they should not be treated as something to avoid and ignore[8]. Instead, with a long-term perspective, they can be viewed as opportunities, because effectively utilizing external shocks can even transform a crisis into an opportunity[9].

3. Analysis of Expert Opinions on X-Events

For this study, government emergency planning officers were chosen as the focus group. These emergency planning officers are individuals from various organizations, ranging from public institutions to private companies, responsible for planning, coordinating, and implementing actions based on mobilization guidelines to prepare for national emergencies.

Table 1. Expert Opinion

Impairment of current technologies and systems
<ul style="list-style-type: none"> - Communication network and artificial intelligence errors caused by high-output energy - Collapse of the current information and communication system - National computer network paralyzed - Widespread loss of network functions due to cyber terrorism - Large-scale cyber terrorism occurs due to hacking and cyber attacks - Collapse or weakening of competitiveness of existing national infrastructure industries - Industrial activity is sluggish due to disruptions in the supply of materials and equipment that are highly dependent on technology from other countries - Nuclear power plant accidents such as radioactivity leaks - Disasters due to uncontrollable nuclear energy - Increasing social inequality due to information imbalance

Overcoming the limitations of current science and technology
<ul style="list-style-type: none"> • Suppressing global warming by commercializing carbon dioxide capture technology • Development of fossil energy alternative technology
Problems caused by artificial intelligence
<ul style="list-style-type: none"> • The emergence of cyborgs and their domination of humanity • AI controls humans • AI has reached the limit of ethical issues that are difficult to judge • Ethical issues in AI • AI malfunction causes international problems such as nuclear crisis • AI surpasses human labor • Expansion of unmanned systems due to advancements in AI technology • The era of unmanned operation begins in all workplaces • Rapid increase in unemployment rate and rapid change in industrial system due to new technology
Formation of a new hegemony
<ul style="list-style-type: none"> • North Korea attempted a nuclear attack after possessing a large number of small tactical nuclear weapons • Korea's acquisition of nuclear state status • Development of science and technology causes new cold war system
Enter new fields
<ul style="list-style-type: none"> • Satellite war breaks out • The beginning of a new battlefield combining AI and robots • Commercialization of AI-based unmanned attack weapons • Emergence of active weapons system combining AI and drones • Security issues arise due to the emergence of hostile drones and flying cars • Security issues arise due to commercialization of unmanned technology • Development of space mineral mining and transportation technology • Space travel becomes a daily routine

They are experts who conduct research and preparations for various emergency situations within their respective organizations. Given their diversity and expertise, it was believed that they would be helpful in

predicting X-events that could occur in the near future from a national defense and security perspective. Therefore, they were selected as the focus group. The research team selected 32 government emergency planning officers and gathered their opinions on potential X-events in advanced science and technology fields within the next 10 years using the Focus Group Interview (FGI) method. Subsequently, the research team compiled their opinions and derived meaningful results through grouping and keyword analysis. The X-events anticipated by the government emergency planning officers can be summarized as shown in Table 1.

As seen in Table 1, the opinions of the government emergency planning officers can be categorized into four main X-events: "Overcoming the current limits of science and technology," "Obsolescence of current technology and systems," "Issues caused by artificial intelligence," and "Formation of a new superpower," and "Venturing into new domains." The presented opinions encompass various problems arising from the advancement of artificial intelligence, as expected by many people, as well as issues related to technological development such as environmental pollution and alternative energy production. Some opinions include the unforeseen emergence of a new Cold War regime and activities like space mineral mining and transportation. A few of these interview contents are described in a narrative format in Table 2.

Table 2. Expert Interview Results

"Due to the development of science and technology, the era of space mineral mining and transportation will soon come. Even now, various projects are underway, such as recycling of space projectiles and commercialization of space tourism. Therefore, in terms of the developmental trend of such technology, it will also be possible to collect core minerals from satellites and planets such as moon and Mars, and transport them back to Earth. Such space minerals and transportation can be expected to reorganize the supply network of minerals that some countries such as gold, diamonds, radium, and rare earths are monopolized, and therefore, economic and political dynamics can be expected."

<Research Participants A>

"Due to the deepening of science and technology protectionism and the economic downturn, the New Cold War will begin. The US –China hegemony competition will lead to the field of science and technology, and the intensification of science and technology protectionism in each country will collapse the keynote of free trade. Subsequently, the export market for raw materials, subsidiary materials and finished products are reduced, and the export –oriented domestic economic downturn and prolonged low growth are likely to be prolonged due to these science and technology."

<Research Participants B>

"Due to the development of AI, employment will be worse than now, and mechanization and digitization will lead to loss of humanity and ethical contradictions. AI, mechanization, and unmanned will surpass human labor in many areas in the near future, and companies will prefer AI and unmanned over humans. As a result, the inequality of wealth is expected to intensify. In addition, there is a possibility that AI will be difficult to judge ethical and humanity, and more problems will continue to rise."

<Research Participants C>

Comprehensive analysis of Table 1 and Table 2 reveals that government emergency planning officers identified "Obsolescence of current technology and systems" with a focus on cyber network paralysis as the most likely X-event in the field of science and technology to occur within the next 10 years. Additionally, under the category of "Issues caused by artificial intelligence," they pointed out the increase in unemployment due to the development of new technologies. Furthermore, they presented challenging and complex opinions, such as the emergence of new weapon systems and ethical concerns related to AI.

Science and technology represent the key to solving global challenges in areas such as population and climate while also harboring the potential to cause new tensions and divisions. The rapid progress of science and technology over the next 20 years will not only transform human experiences and capabilities but also

trigger new tensions and disruptions at the societal, industrial, and international levels.

This will include an intensified technological competition between nations to secure technological competitiveness, increased societal unrest and political conflicts resulting from exacerbated internal and international inequalities, friction between governments and businesses over control and promotion of key technologies, and the emergence of various challenges, including the replacement of existing jobs and the creation of new ones, leading to friction between established and emerging industries [10]. Therefore, science and technology serve as both a factor that generates new tensions and divisions, and as the key to solving global challenges. Hence, strategic future prediction is essential to absorb anticipated frictions and side effects, develop strategies for recovery, and establish long-term policy directions for a leap into more advanced systems.

4. CONCLUSION

The U.S. National Intelligence Council regularly selects population, environment, economy, and science and technology as key factors driving change over the next 20 years, and they prepare periodic scenarios regarding the current status and prospects for each of these elements [11]. This underscores the importance of population, science and technology, and climate fields as significant factors influencing society, nations, and international relations. Through this study, diverse opinions of government emergency planning officers were examined. X-events are more likely to occur in unforeseen areas compared to those that many people predict, making the discourse they have formed meaningful.

However, this study has its limitations as it was conducted with a small group of experts. The reason for the need for further studies following this attempt lies here. As the prominent futurist Jim Dator stated, "It is very risky and unwise to plan for only one future. You must devise policies that can respond to whatever future unfolds." [12]. If experts from various sectors, including civil, government, military, business, academia, and research institutions, collaborate and continue with diverse and ongoing follow-up studies, we can minimize the damage from potential X-events that could occur without warning. In other words, we need to be prepared for an unpredictable future. We hope that this study will catalyze the activation of X-event-related research across various fields in society. Through the utilization of accumulated data, we can develop various scenarios, response manuals, and strategic future predictions for each X-event, along with the formulation of national crisis management strategies.

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