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Electronics and telecommunications in Poland, issues and perspectives Part I: Society and Education

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ABSTRACT

Since the 1930s of the previous century, this country has been developing electronics in a systematic and institutionalized manner. Originating in low-voltage electrical engineering, its original, more widely known moniker was communications. It was at this era when both radio and television were only getting their starts. Electronics, as a field of study and development, focuses on the creation and manipulation of electrical and electromagnetic signals. Long-distance signal transmission is an area of study within the field of telecommunications. Microelectronics, radioelectronics, optoelectronics, photonics, acoustoelectronics, magnetronics, bioelectronics, energoelectronics, material engineering, semiconductor physics, automation and robotics, mechatronics and microsystems, informatics, teleinformatics, software engineering, and many more all fall under the umbrella of electronics and telecommunications (ET). Electronic components and circuits constitute the backbone of all ET devices and functional systems, including computers, data warehouses, cell phones, televisions, the Internet, global positioning systems, and more. The field of ET is part of the larger hi-tech industry, and its products include a wealth of valuable information that may often outweigh the cost of labor and raw materials. In recent years, ET has emerged as a key player in the information economy, taking part in the creation, storage, processing, transfer, dissemination, and application stages. Among ET's many contributions to humanity are the following: the beginnings of AI development, the co-creation of intellectual property, the search for knowledge in large data sets, the advancement of medicine, virtual and augmented reality, the

Keywords: Topics covered include: electronics, telecoms, the information society, universities, schools, industries, trade groups, regional growth, and monetary concerns.

INTRODUCTION

In this review article, the author expresses his or her own personal opinion on a few topics under the purview of the Polish Academy of Sciences' Committee on Electronics and Telecommunications (KEiT). This document draws on a series of Committee talks on current topics in telecommunications, microwaves, microelectronics, optoelectronics, materials and technologies, circuits and signals, and electromagnetic compatibility (EMC) held throughout 2009. The debates' primary objective was to provide a snapshot of the consensus among experts. The overarching goal was to have a voice in the national conversation about how America measures up to global trends in areas like science, technology, higher education, innovation, industry, and the economy, as well as social professional activities and political lobbying. For this country to continue its social and economic growth and to remain at the forefront of global competition, it must adopt a coherent and

In this work, we will use the acronym ET to refer to two different things: the broad sense, which includes the societal and cultural effects of ET, and the restricted sense, which refers only to the rapidly expanding field of science and technology. ET encompasses not just broad areas of IT (collection, storage, processing, and publication of many types of information) and ICT (information and communications technology) in the sense of technical affinity but also in a popular social perspective. The latter phrase is commonly seen in specialized literature and among the European Framework Programs' (EU FP) own jargon. Throughout this work, the acronym ET refers to a broad range of topics, including but not limited to ICT, education, research, science, technology, industry, economics, and even the arts and culture. The precise meaning of the acronym ET at a given location in the text is dependent on the specifics of the ongoing discussion at that location.

This summary of ET is meant to serve as a broad introduction to the more in-depth arguments made in the KEiT Chapters. In an effort to describe ET anew and place it in the social space under the conditions of rapid development processes, we provide here a brief, subjective, and insufficient summary of the ET. Currently, the KEiT lacks the resources and manpower to conduct the kind of comprehensive research necessary to analyze this topic thoroughly. Despite the fact that many of the signalized threads are not further extended, the work aims to convey succinctly the whole picture of the state and evolution of ET. The work is written in the style of a journalistic essay and provides a comprehensive but imprecise picture of ET by considering not only scientific and technological but also educational, vocational, economic, and social factors. The ET is defined as a large social sphere that has had crucial effects on the progress of civilization in the first section of the study. The subsequent chapters expand on this image via the lens of a select number of niches in research and technology. In the paper's second section, ET is defined more narrowly as, first - a field of research and development with an exceptionally large development potential, actively shifting the boundaries of our knowledge, and second - a field that generates directly many useful applications that facilitate and improve the quality of our daily lives.

The paper's introduction covers the following topics related to the ET's current status and future growth: The current and potential roles of ET in society are discussed, as well as its many facets (R&D, utility, and infrastructural), as well as the various directions in which ET is currently developing in each of these areas. Finally, some issues involving the role of ET (and vice versa) in fields such as education, continuous training, science, higher education, professional community, and industry are also analyzed. In addition, the article provides brief summaries of such topics as communications, information and communication technology, radiolocation, microwaves, microelectronics, nanoelectronics, optoelectronics, electron technology, electronic circuits and systems, signals, and electromagnetic compatibility. Fundamental research, new ideas, and practical applications may be found in all of these areas, which include the laboratory, construction, hardware, and the increasingly vital software.

The ET summary report offered here is only a small part of the larger effort by the government to map out the most crucial areas for advancing the country's research infrastructure and economy. When all the sectoral contributions are added together, they should provide a comprehensive and up-to-date image—the kind of picture that's required in order to formulate a strategy for R&D, innovation, sector, and industrial growth, and to couple that strategy with European objectives. Such an approach involves large-scale endeavors, such as deciding on and then constructing infrastructures such as national centers for hadron therapy, advanced materials, synchrotron radiation, free electron lasers, and atomic industry and nuclear energy utilities. These endeavors require substantial participation from the ET and are funded through a mix of national and European funds. It is not necessary to choose between energy sources. This claim is supported by the additional security that diversity provides, as well as the renown of the nation generating the cutting-edge technology at the moment. Any nation that provides such opportunities but fails to build large, world-class research infrastructures in the fields of energy, biomedicine, etc., is, by definition, on the periphery of or even outside the global technological leadership.

This study argues, and the authors agree, that the rapid growth of the ET industry presents a significant opportunity for the country to join the expanding club of technological and social leaders. Technical, governmental, industrial, professional, and economic communities are only few of the many that express this view. There is a widespread conviction that contact with extraterrestrials is one of the driving forces behind the progress of modern civilisation. The focus of the study is on a subset of this bold claim. The aim is not to prove it but to have the reader think more deeply about the topic.

This paper presents the ET industry as an engine driving research and development in many related scientific and technological fields, and as a wide, fast, and efficient application platform that is increasingly intruding into all aspects of human and social life, from the most fundamental aspects of our being to our safety, health, education, and culture. The study provides a wealth of references for the ET evolution depicted here. Numerous resources are freely available online and may be found inside the websites of various governmental and non-governmental organizations. Indirect access to some materials is provided through the ability to place orders with specialized institutions that focus on sectors, research and development and innovation, markets, and economic projections, including those in the field of high technology. Such in-depth industry predictions are rather costly when purchased individually. However, periodic standardized projections for certain regions (Central and Eastern Europe) are available from significant organisations such as the World Bank. The growth of the high-tech markets in these regions has been predicted in great detail and by industry. They may be accessed by all of the key economic and financial actors. These projections do not look good for us for a number of reasons. Both the European Union's economic agenda and independent forecasting institutes contribute to their development. The article takes the form of a free declaration, authors' view, scientific essay about the status of the ET in Poland against the backdrop of global tendencies, in contrast to these larger and more in-depth materials.

1. ELECTRONICS AND TELECOMMUNICATIONS REVISITED

Electronics encompasses the creation and processing of signals in the form of electrical currents, voltages, and electromagnetic fields, and is itself both interdisciplinary and multidirectional. Active, passive, discrete, and distributed, electrical, magnetic, acoustoelectronic, optoelectronic, acousto-optic, photonic, microwave, terahertz, and integrated electronic components and circuits implement the functions on signals. The fields of semiconductor physics, technical physics, optics, magnetism, chemistry, materials engineering, and applied mathematics all play a role in the advancement of electronics. Diodes, transistors, integrated circuits, processors, thyristors, lasers, resistors, capacitors, coils and solenoids, filters, resonators, transmission lines, optical fibers, sensors and actuators, power supplies, modulators, comparators, amplifiers, detectors, connections and connectors, printed circuit boards, etc. are all fundamental electronic components and subassemblies.

Contemporary electronics, together with allied fields of knowledge including electrical engineering, electro-chemistry, mechatronics, telecommunications, automation, and information technologies, using the achievements of technical physics and applied mathematics, embraces more and more particular branches spanning from classical RF technology, radio-electronics, electro-acoustics, via microelectronics and nanoelectronics, optoelectronics and laser technology, photonics, image processing and science, display technology, microwaves and THz technology, high-power electronics, teleinformatics, software engineering, integration of hardware and software, multidimensional design, analog and digital as well as mixed design electronics, computer engineering, video engineering, home and office electronics, industrial electronics, quantum electronics, metrology, bioelectronics and medical electronics, biophotonics, modeling and simulations, to microsystems, MOEMS, and novel disciplines like spintronics (magnetronics) and atomtronics. The number of academic disciplines and professional disciplines that collaborate closely and productively with ET is growing at a rapid clip.

Telecommunications is a field of study that focuses on the long-distance transmission of any type of information and the means by which this information is processed. It has close ties to electronics and information technologies. A telecommunication system, which is responsible for transmitting and processing information, consists of a transmitter, which converts the message into the form of a physical signal, a transmission medium, which is separated into channels or organized into a network, and a receiver, which converts the signal back into the original message. Analog and digital transmission, cable, optical fiber, satellite, radio and television transmissions, broadcasting (soon to be digital), signal quality research and optimization, general and specific statistical properties of signals, signal and data transmission theory, coding and decoding, multiplexing and demultiplexing, modulation, the Internet, local and access networks, transport networks, and industrial telecommunications are all areas of study and function within the field of telecommunications. Like other areas of law, like as traffic laws, the Law of Telecommunications governs telecommunications in modern society. The rules governing telecommunications in any country that can be considered civilized are, on the whole, relatively similar to one another, notwithstanding certain variances in their actual implementation.

A narrow, technical definition obscures the bigger picture of the contentious area. When taken as a whole, the fields of electronics and telecommunications (ET) offer a vast expanse for the advancement of science, research, and technology. It's a part of the economy that's becoming increasingly important and useful in modern life. It's marked by rapidly growing connections to a wide range of other societal sectors. The new limits and connections do more than just add up their impacts, nor do they only boost productivity or bring integrated departments into the current day. A new system of interpersonal interaction is being developed by ET. It's developing a whole new quality in tandem with similar strands. Knowledge-based societies are the new norm. The information age ushers in a new type of man, one who is adept at utilizing not just the growing troves of data on human understanding but also information and communication technologies and, in the not-too-distant future, artificial intelligence and augmented reality. The economy at the disposal of the knowledge society is dominated by the intellectual weight of its products and services. The cost of inputs like materials, energy, and labor is a small fraction of the product's total value. These requirements are met by ET goods and services. The knowledge layer is responsible for a rapid increase in the ratio of intellectual to material values, which has recently surpassed an order of magnitude in several instances. This proportion may become much higher in the years to come. By improving the finding, storage, processing, transmission, and use of intellectual assets, the ET/ICT sector actively and extensively contributes to the development of a knowledge market.

Strong globalization dynamics are at work in the field of ET. Both the physical layer (the look and feel of a smartphone or digital camera) and the mental layer (user interfaces, software, and accepted practices) of ET products and services are highly standardized on a worldwide basis. In particular, techniques of labor and communication at the intellectual and user levels start to coalesce into a distinct, global language that is gaining increasing societal acceptance. Machine-to-machine communication appears to be gaining ground at the expense of other channels of transmission. This trend is only going to strengthen over time. Personal contact with the machine, and increasingly with other people via the machine, is of utmost importance to us. The language used by humans to communicate with ET machines is becoming increasingly accessible, and we can only hope that, very soon, the machines will comprehend us completely and address us directly and specifically. In the present moment, the language is not as polished and natural as we had hoped. The time when people all across the world can communicate effortlessly with machines, an area known as extraterrestrial technology, is drawing near.

High technology like ET is part of a larger, more complex system that serves society as a whole. In today's civilizations, this framework encompasses the entire high-tech manufacturing and repair process. The civilizations that are 'convicted' to the role of reproduction solely are those that lack their own, complete renewal cycle. Rather than being in a vacuum, the technical development cycle must be integrated into primary and global development cycles in which all inputs are given equal weight. Many civilizations may only take part in secondary development cycles because they lack an offering suitable for the first cycle. Fundamental and applied research, higher education, doctoral education, professional and continuous education, basic and intermediate education, an innovation layer, and a flexible industry that efficiently absorbs innovations are all necessary parts of the development cycle for maintaining and replicating high technologies for use in advanced societies. There is a distinct but interconnected social functional infrastructure supporting each of the aforementioned stages of the development cycle. Everything in this tier of civilisation functions smoothly and is endowed with a great degree of mutual trust. It may appear, at least at first glance, that many civilizations, and especially these open ones, cannot afford the financial and human resources necessary to create their own complete cycle of high technology. The competitive nature of the economy depends on the rapid development of this area, which in turn depends on the freedom of enterprise, the ability to make informed decisions, the concentration of available resources, the realization of results, international cooperation, and participation in global processes.

Since the entire field of ET is developing quickly, which is equivalent in some ways to efficient transfer between the fundamental and applied knowledge, this suggests that the gap between the primary and secondary cycle of knowledge and high technology generation, and the re-creation of the competitive economy, is not as large as it might otherwise appear. The often relatively significant investments needed for the entire cycle support mean that in practice this gap is quite large. The size of this gap also stems from a number of other factors. In an effort to save money on development, some nations deliberately forego primary cycle participation. There are nations that cannot possibly afford to be so heavily involved. The local economic position, aspirations, expectations, objectives, and development plan all have a role in determining the extent to which a community is involved.

Due to its interconnectedness with so many other rapidly evolving spheres of modern life, the field of ET development is both expansive and elusive to precise description. When these connections are severed, and the field is reduced to its theoretical or technological or direct application elements, a false impression emerges. The hardware and some of the software that make up the developing global Internet are both part of ET systems. Simultaneously, the Internet integrates a growing number of functionalities, including but not limited to: telephony, television, multimedia, audio and video conferencing, information technologies, knowledge data bases, health protection systems, environmental protection systems, financial and safety systems, and the creation of, not to be omitted, values on economic, administrative, social, and cultural fronts. These norms have far-reaching effects on the international information infrastructure and, by extension, on society as a whole. A growth curve like this has never been seen before. This is a first in the history of the human race. The use of ET and ICT is crucial to the revival of society. They are expected to do more than just lay the groundwork for the future information society's infrastructure. Due to the ET's rapid progress, people now have far grander hopes for it.

When discussing the ET, it is imperative not to gloss over its vital role in the country. It affects a substantial portion of its structure. Oftentimes, the research conducted in this field, mostly at academic and industrial institutes, has only a tenuous connection to the demands of the country. There is no direct link between the job market and graduate study. Both academic institutions and businesses are wary of one another. The process of recreating and implementing advanced technologies does not include academic institutions and government labs (or they are very loosely involved with it). The international industry that is present in this country primarily engages in assembly work rather than R&D and has not established any truly significant research facilities. A few shining stars among technology parks can't rescue an otherwise bleak outlook. Actually, there aren't that many of them. Modern microelectronic fabrication sector cannot be established due to a lack of readily available funding. The lack of an active central pro-developmental strategy, among other social, economic, and political factors, makes it highly unlikely that this sector would be located here even if such funding were available. The local information and communication technology software business caters almost entirely to global clients. Simple foreign items that might be readily created in the country's own factories dominate the domestic market. According to worldwide data compiled mostly in the United States and EU-ordered figures on the use of ET (infrastructures and software) in the economy, administration, and consumption, Poland is ranked towards the bottom of the list. A severe lack of confidence amongst the participants of the aforementioned social activities has emerged as a result of the local economic condition. The key restraining elements for the development of high-tech infrastructure in this nation are the aforementioned lack of trust, and consequent ignorance of the issue and process participants, lack of development plan, boldness, and comprehension.

Is it conceivable for us to go back to where we should be in terms of sophisticated ET technologies in the very competitive global market, given our aspirations and resources? Is it conceivable to redefine ET's place in our country to reflect its growing significance abroad? Is it feasible to build a local economy that is correctly and sustainably tied to the global economy on the back of a fully developed and self-sufficient high technology cycle, encompassing R&D, innovation, and industry? There must be a plan for growth, prioritization, implementation, job security, a solid legal foundation, the development of unique research and application pathways (or "regional specialization"), the training of sufficient engineers, the establishment of conducive conditions for ongoing professional development, and the promotion of favorable financial preferences for the individuals and organizations at the center of the debate. Rebuilding mutual, social trust of all players in the relevant processes requires a foundation of excellent and solid rules of science, higher education, innovation, and the economy.

As was said up above, ET is just one subfield within the much larger realm of high technologies and cutting-edge scientific disciplines. A lot of the issues that have been shifted to ET are valid and sufficient in relation to related fields of established technology and many branches of science, technology, and economics. The viewpoint stated here is, thus, broader than only the realm of electronics, communications, and computer science.

The state of higher education and science as a whole, as well as the integration of these fields with K-12, the economy, and society at large, appear to be central to many of the phrases employed here.

2. POSITION OF ELECTRONICS AND TELECOMMUNICATIONS IN SOCIAL SPACE

ET, in conjunction with kindred fields, plays a significant role in the creation of the new civilization at the most fundamental societal level. When it comes to the contemporary economy, military, homeland security, health, and the conservation of the natural environment, as well as the arts, sciences, and cultures, ET is a foundational aspect. Extraterrestrials are an unprecedentedly potent technological and civilization integrator. To use a metaphor, ET might be seen of as the "philosophical stone" of modern culture. During the Middle Ages, people diligently, but fruitlessly, looked for such a path to progress. Finding it, putting it to use, and progressing to the next, higher level of growth may need a certain level of maturity on the part of the society. Perhaps a new fundamental discovery is on the horizon, one in which the medieval ether played a pivotal role. If we could learn more about the Higgs field, may we one day figure out how to practically utilize the gravitational field for communications or tele-transportation?

To be more respectful and up-to-date, we might refer to the societies that make extensive use of the technological and intellectual foundation of ET and have this field firmly rooted in the social life as information societies or knowledge based ones. The national and worldwide ICT networks are now home to a wealth of information that is both directly and indirectly created, processed, encoded, deposited and stored, aged and rejuvenated, and subject to acquisition and dissemination at both the primary and secondary levels. In this light, the issue of how it is feasible arises: how can knowledge be generated automatically with only the indirect participation of human intellect? How helpful will this information actually be? More and more of these knowledge-discovery methods, which are fundamentally supported and facilitated by ET systems, are coming to our attention. For quite some time, it has been speculated that well-organized collections of statistics and other data, such as forms, pertaining to events, processes, occurrences, etc., may conceal previously unknown but invaluable information. As with other research methodologies and technologies, knowledge discovery through databases is gradually becoming the norm today, and as such, is susceptible to standardization processes.

Numerous government and corporate ranking organisations have historically and continue to rate and categorize the wealth of civilizations. The grade has been updated to incorporate the ability to possess and organize knowledge. This information has a direct and immediate impact on people's well-being, security, civil liberties, and the prospects for growth in a given country or society. Through the massive investment, simply gigantic accumulation of intellectual properties, and the development of increasingly sophisticated virtual reality and artificial intelligence in these systems, ET is gradually becoming more than just a material basis, an object of these transformations. It's possible that in the far future, the all-pervasive, extraterrestrial super-networks will serve as a depository for the advanced knowledge of the next generation of humans. There is now no doubt in our minds that this kind of decentralized, virtual intelligence will participate in all the decision-making processes and future advancements of our society.

By taking an active role in the dissemination of information, ET helps level the playing field for all citizens, expand their horizons in terms of what they can achieve, motivate them to pursue education, propel them into the workforce, and strengthen their commitment to civic duty and the common good. The ET causes massive shifts in the social landscape through more intense human connection. Extreme growth in fields like research, transportation, medical, food production, and the creation of cultural products is highly synergistic with such avalanche developments in the information sector, which embrace the technology and the way we utilize the information. This development arrow can only point forward in developed nations. It raises the standard of living and gives people more options to tailor their lives to their preferences. The Internet and virtual or augmented reality are being embraced by a new generation as if they were always there; as if they were gifts from the heavens, something we've had at our disposal from the beginning of time. Researchers from a wide range of disciplines, including sociology, psychology, anthropology, medicine, biology, culture, and many more, are studying the rapidity with which humans are adapting to the new information space.

At the professional level, where ET systems are conceived, prototyped, assembled, and implemented to build a new civilization's infrastructure, its meaning and reception are distinct from those at the popular, individual, and social levels. These two dimensions, or sides, of ET—the user and the infrastructure—are inextricably linked and demonstrate a powerful synergistic impact, but they are subject to distinct rules. The divergence of these regulations, which is likely to continue, has important repercussions for the contested field. When it comes to production and infrastructure, the user layer breaks away. For the time being, the user layer consists solely of shiny new devices and services of questionable use. As time goes on, the community's interest in and awareness of the industrial layer dwindles. The foundations of ET vanish within the broader context of technological society. However, it may be argued that other fields that help build the foundations of society also have user and infrastructure sides. The field of ET, however, stands apart. The ET's ability to amass and synthesize vast stores of information, as well as to design AIs and VRs, contribute to this distinction. Directly referring to the individual's experience, we say that one is "immersed" in such a reality, and referring to the larger social context, we say that a "virtual society" is created.

On the one hand, from the perspective of the user, ET is viewed through the lens of the rapid advancement of technologies like smart homes, smart cars, PDAs, e-books, personal and social communications, and smarter, more frequent, and more permanent use of intelligently expanding network resources.

People who use these connected and multi-purpose gadgets more often are unwittingly laying the groundwork for a brave new information e-society. E-health, e-banking, e-education, escience, e-university, e-communications, e-trade, e-administration, e-justice, e-culture, and countless others are just some of the many new electronic and virtual versions of these that have been built in this society on the back of a new ET infrastructure. The effects of virtualization affect both individuals and societies as a whole. An individual's digital assistant can serve as a substitute for a wallet full of cards and documents such an ID, passport, driver's license, credit cards, portable health records, professional credentials, a landline, a cell phone, and a TV. Many of these features are already present on modern smartphones. A unified platform for all digital personal assistants geared toward global social communications and the introduction of many new features is an inevitability that can't be ignored. Some of these prospective capabilities appear to be really helpful, significantly fostering a person's personal and social growth. However, the prospect of future precise and global control, paired with some of these factors, causes us great concern.

The second perspective is an infrastructure one; science and industry have placed ET into the realm of essential modern civilization infrastructure by generalizing from specific user-device solutions. Like the transportation system, electricity grid, communications and information networks, municipal networks, environmental engineering, financial and banking systems, and health and safety systems. Independently, the ET department does not build its own infrastructure but rather gives support to a wide variety of other technological systems in use today. The ever-increasing complexity of ET hardware, when combined with the rapid development of software - where the greatest IP values are embedded and frozen - is breaking away from the strictly technical frameworks and laying the groundwork for the creation of something entirely new and different. In the future, this emerging phenomenon may be referred to as a "virtual intellectual social infrastructure." As of right now, the ET is actually dictating the future of other types of infrastructure. These days, we just use terms like "smart" to describe things like our homes, streets, vehicles, workplaces, etc. We will definitely say this about the intelligent civilization's architecture once the islands of specialized AI unite, powered by the new ET, and bury themselves into their carriers. But that's not all of it. The scope of the ET's potential impact is enormous.

The ET's user and infrastructure sides were maturing in a way that was akin to the growth of other systems with similar architectures. Vehicles and the road system operate together seamlessly in the transportation industry. A transmission grid and electrical receivers make up the power system. The items and stores of commerce. Numerous specialized networks (telephone, television, radio, time distribution, localization, global positioning system) and user terminals have been paired up by ET. As it stands right now, it looks like we're seeing the birth of a brand-new value, the embryo of a massive multifunctional network integration. This approach will have far-reaching effects on other areas as a result, including through integration with ET. There is no longer any doubt that ET has played a crucial, and is continuing to play, a crucial role in the integration of user layers and a wide variety of infrastructures in modern society. In the present day, we use the brief and simplistic term "service integration" to describe the initial stages of the process. This field is positioned as an active co-creator of the entire sector's body of knowledge because of its ability to integrate seemingly distant services, make increasingly effective use of expanding data bases, automatically discover knowledge in methodically gathered large amounts of data, make the infrastructure flexible to enable dynamic fitting to the current and/or local needs, and involve the ET in all of these processes.

3. ELECTRONICS AND TELECOMMUNICATIONS: EDUCATION AND SOCIETY

Education and the so-called well-established professional community are important contexts for the development of ET. It's impossible to assess the true significance and proper growth of a sector in society without the presence of such layers, directed/dedicated to it. Without social respect, a discipline has little chance of flourishing. It is hard to convey the significance of the professional community and social education to the growth of a complicated field like ET in a single paragraph. We will focus on a short, but no means exhaustive, set of concerns.

Experts in the Field of ET The area concerning ET education and professional community (also analogously for other related fields) comprises such categories, areas, functions, actions, rules and institutions as: education on preschool and elementary school levels directed to technical practices and sciences, high quality multidirectional education on intermediate level, outreach and dissemination of ET (and technical sciences) in broad circles of the society, record of the history of the discipline in different forms like museum of technology, Internet, portraits of eminent people – representatives of ET, social professional institutions – organizations, associations, foundations, professionals clubs, continuous professional education of easy access and many education levels, combination of professional training with managerial, economic and business education, effective promotion of entrepreneurship in the ET area, scientific and technical conferences for industry, trade fairs, educational and technical publishers – books and journals of various levels for different social groups, radio and TV, auditions of high technologies, Internet and adequate imaging of the discipline in it, R&D projects of a wider social extent, cooperation with self-government, local and central administration, serious institutionalized community lobbying on behalf of the progress, development, science and economy; cooperation with industry; cooperation for safety; international cooperation – including European; advisory and consultative activities concerning ET and its social vicinity.

Where the Media Stands on ET Television and the Internet serve crucial roles in educating the public, disseminating information widely, and keeping people up to date on developments in high technology (including ET). Good, very meritorious, compelling by arguments pertinent to the situation, popularizing, and issue writings regarding high technology, published in the most prominent and serious social and political journals, play a role, although one with a different focus. This is a rare form of journalism in the United States. Experts in a given subject often entirely avoid or skip covering this tricky but potentially significant area of scientific journalism for a variety of reasons. Reasons for this include a lack of history, an unwillingness to engage with the lay public, etc. Journalists are the most common authors who tackle such issues, although they are not always up to the challenge. Because of this, the resulting texts are inappropriate for an experienced reader. When a meaningless study on advanced technologies is published in the prominent serious socio-political press, the professional community does not fight against these activities and feels helpless. The media doesn't care if the experts object because they'll just ignore them. In the mainstream media, science has little significance and has been treated as an interesting aside for quite some time.

In order to promote a favorable public perception of its research and industrial endeavors, ET's worldwide program of development currently includes ambitious new projects in one sector of R&D (in this case, ET). To think of popularization as a major aspect of development, an investment in the future, via the very serious treatment of education and social information, is simply now an important part of democracy. Putting money into targeted advocacy and training always pays off. The payoff is typically substantial, manifesting as widespread public comprehension of more nuanced issues connected to the field of R&D under consideration. As a result of these procedures, talented young people often enter the industry, and, what is not meaningless, politicians are often more lenient when making judgments about development and investment.

Engineering is a Highly Esteemed Profession A severe crisis in the engineering profession has been noted for some time in this country and in several other European societies. As a result, Europe and Poland are experiencing a severe lack of engineers. Overusing market mechanisms, the developed world reaches cynically into other nations for their pool of available human resources. Many young engineers emigrated to the West from middle European nations. This is a continual process. It's like the life-threatening, unending bleeding of an actual live thing. Young individuals in the nation typically choose for less challenging courses of study in social sciences. It is the responsibility of the nation to ensure that the engineering profession continues to enjoy its high standing. The majority of the ET's workforce consists of these engineers. Civilization's hard infrastructure is built by these engineers so that others might use it in a systematic and ever-more-efficient manner. No discussion about the growth of a cutting-edge field like ET is even feasible unless we actively seek out and support the most talented and capable young people and encourage them to enter the engineering profession.

ET Internet Portals Currently, the Internet is the most dynamic, operational, and interactive medium for disseminating knowledge on scientific and technological developments and for engaging in extensive social engagement. There is a lot of information online about extraterrestrials and the progress of this field, and it is growing and getting better all the time. Trade, business, information, industrial, community, science, debate, and help forums are just some of the types of ET portals you may find online. Shop, companies, products, services, press and news, questions and answers, publications, standardization, conferences, trade fairs, continuous education, professional training, employment, certificates, authorizations, calendar of events, discussion forum, webcasting, logging, and personal configuration are just some of the typical functionalities and contents of some of these portals. The future of efficient social communications lies in platforms like Twitter, Facebook, YouTube, and others; therefore, serious institutions and organizations like IEEE and CERN (and really many others) actively participate in these platforms.

Access to Wideband Internet Broadband connectivity The Internet is such a hot topic in the country that there has been heated debate about whether or not individuals should be afforded certain legal protections. Internet, like other products in the ET industry, has long already broken through to the mainstream, ushering in a whole new social reality. There are online colleges that provide courses and have virtual laboratories. In the field of science and technology, the Internet was the first thing to allow the development of global bibliometric instruments for conducting sophisticated, dynamic, multi-criteria evaluations of the individuals and organizations that make up the field. Internet has become a dynamic mirror, recorder, archive, and, in some circumstances, very objective reviewer of the outcomes of research, development, and inventive activity, not just in the ET sector but elsewhere as well. The whole scientific and academic community in the free world is open to this kind of public evaluation. Because of this, a lot has changed, or more accurately, everything has changed. Some conservative research and academic groups in the country, also in the field of ET, fail to recognize, fail to implement, and simply disdain and ignore these strong instruments of information technologies, leading to widespread confusion among the next generation of scientists and researchers. The Internet has positioned itself as the premier judge of scientific progress. These procedures are gradual and need for some time for equilibrium to be reached.

Groups Representing the ET Industry Organizations of professionals who are engaged in societal life also have a significant influence in the evolution of the fields they represent. There are a plethora of credible institutions like these operating in the United States. The SEP, or the Association of Polish Electrical Engineers, is the oldest and largest of these organizations. When it comes to research and development, the economy, and working with the government at the national level, SEP takes the lead on a number of significant logistical and administrative projects on behalf of the whole community. A well-organized group of professionals may be able to make a noticeable difference in the progress of the sector of science and technology that they represent. Other groups often reflect more specialized subsets of ET or cross-disciplinary research. The Chief Technical Organization (NOT) is one example of a federative organization. Their impact on the growth of the technological sciences might be substantial. Engineers and scientists have made significant contributions to the ET sector.

researchers from this country working for influential international scientific bodies. IEEE is one such group. When it comes to students, Ph.D. candidates, and young scientists and engineers, most large associations with a national or worldwide reach have their own goals in mind. Conference proceedings can be published in international databases such as IEEE eXplore, the American Institute of Physics' Scitopia, SPIE Digital Library, and the Optics InfoBase.

EV Research Publications There are just a handful of must-read scientific and technical periodicals in the whole nation's ET community. Some journals are moving to English, others are trying to get indexed in databases like ISI and Scopus, others may continue to publish in Polish, and still others .

are still trying to figure out what the essential value of their IF (impact factor) is. All of these issues are fundamental to the journals' current operations. There is no end in sight to the challenging changeover era for national professional journals. Only when certain national publications achieve worldwide circulation will they play a significant role.

Conventions of the Scientific ET The ET research community at large hosts a plethora of yearly conferences covering a wide range of topics. They tend to be infused with regional flavor. Some are held in conjunction with influential international groups like IEEE, expanding their reach beyond the local community. Most conferences contribute significantly to the training of future scientists. Opinions regarding the devaluation and inflation of conferences are occasionally voiced in the ET national research community. This is due in part to the abundance of yearly conferences and the related choice to not assign any ranking factors to the papers presented at these events. In a linear relationship between IF and the total amount of classification points, journals are ranked.

4. COMMITTEE OF ELECTRONICS AND TELECOMMUNICATIONS OF PAS

The PAS ET Committee's (KEiT) areas of expertise are evolving. Similar to the evolving function of the entire Academy, things now are different than they always were. Each committee is responsible for a certain set of tasks. Organizations with members chosen by the general public. The Academy receives its funding from the Polish Ministry of Science and Higher Education (MNiSzW), with the bulk of the money going to pay for its several research centers and central administration. As social institutions, the committees get scant funding. The funds from this grant will be used to cover the costs of committee publications and scientific meetings. The committee's current practical options are limited. Larger projects involving the academic and scientific communities, as well as innovation and the economy, must be funded either by the public sector or by the institutions that employ the committee members.

Back in 1960, we set up the ET Committee. Electron technology, electronic materials, and electromagnetic compatibility are also areas of expertise, along with microelectronics (ET circuits and systems), optoelectronics (lasers, optical fibers, imaging), microwaves (circuits and antennas), signals, circuits, and systems (digital signal processing, electronic circuits with the application of artificial intelligence), and so on. ET committee has sections dedicated to each of these topics. Promotion of faculty, nominations for state awards for scientific achievements, nominations for new members of the Academy, co-organization of scientific conferences, tracking the development directions of subfields of science, evaluation of large research projects, and political lobbying are all within ET committee's purview as required by law. Many technical universities, government and industry labs, research institutes, and new research firms nurture the fields covered by the committee, but only a few tens of these bigger institutions exist in the nation. More than 300 scientists and engineers are represented among the committee and sections. Reports analyzing the current and future condition of important fields of study are a required function of committees. Committees should also seek to integrate and coordinate R&D operations, as well as propose strategic orientations. Lack of a unified vision and development strategy and massive waste of R&D activities, at extremely low financing of research by the state, is one of the most major shortcomings and causes of limited efficiency in Polish science.

Communications The objective evaluation of the research potential in communications in this country is extremely high. This assessment is based on a summary of teleinformatics research and development trends. It appears that many domestic research institutions are eager to take part in foreign initiatives, particularly those funded by the European Framework Programmes (FP). The EU FP are more in line with applied research. The nation is responsible for funding and conducting fundamental studies in this area. Polish teams' previous FP participation has not yet translated into adequate economic progress for the country. However, a robust and resolute centralized strategy is still needed to link research and the economy. There should be tax breaks for major corporations and help for small and medium-sized businesses as part of this approach. and for creative projects. This unfortunate state of affairs, in which the two realms are decoupled, is not improved by the new science law. This means that Poland's innovative economic performance won't suddenly surge, dropping it to the bottom of Europe's ranks. The planned studies focus on advancing ICT application development across the disciplines of the arts and social sciences, biology, and technology. This involves creating knowledge bases for storing, analyzing, and making effective use of existing knowledge, as well as developing an integrated knowledge system that enables knowledge acquisition from disparate and heterogeneous data bases. This proposal appears to be well-intentioned and grounded in the realities of research across Europe and the world. In addition to potentially increasing the proportion of home effort in the global pool, the realization of such international initiatives by big and powerful national teams with relevant experience may produce practically valuable outcomes.

Microwaves Wireless communications (including cellular telephony and wireless Internet), satellite communications, digital radio and television (terrestrial, satellite, mobile), satellite navigation systems, radiolocation systems (civilian and military), anti-collision systems, diagnostic systems (technical and medical), monitoring and localization, remapping, and remapping are just some of the many uses of electromagnetic waves from microwaves to THz in modern society. The most prevalent applications of microwave and antenna technology are in cellular telephones and wireless Internet (IEEE 802.11 and 802.16). M2M connections, which eventually lead to the Internet of Things, are among the most promising new uses of this technology. Radio, wireless sensor networks, radio labels, NFC, pervasive computing implemented in dense saturated wireless areas, and/or smart surroundings are all part of the M2MC sphere of influence. • Extending the range of increasingly higher frequencies used; • Using unlicensed, unused high frequency bands for new applications like next-generation car radar systems; • Using Terahertz (THz) bands for safety imaging as a non-ionizing alternative to X-rays; etc.

Edholm's law states that the total throughput of wireless transmission doubles approximately every 18 months, which is significantly quicker than the growth of throughput in cable transmission.
Systems tend to shrink in size as a result of natural selection, which allows for greater efficiency in production and expanded capabilities.
In consumer RF electronics, a multisystem approach allows for collaboration across competing standards.
• Ecological constraints; the natural upper bound on frequency bandwidth.

Microelectronics Creating innovative goods that include cutting-edge micro and nanotechnologies presents Poland with a significant opportunity to modernize its economy. Neither the ICs' maker nor a production facility capable of using them are local. However, the growth of nanoelectronics in Poland should be based on the country's in-house design of standard, mass-production ICs and the country's fabless mode outsourcing to appropriate foundries overseas. Highly specialized heterogeneous solutions of MEMS for multi-disciplinary applications present a new scenario. Due to the wide range of technologies and materials employed, the lack of readily available standards, and the need to secure intellectual property, foundry manufacturing of MEMS is unsuitable. A newly developed national nanoelectronics center should investigate the fundamental notion behind the MEMS demonstrator/prototype. The developed solution can then be made available to the cutting-edge business sector. It's possible to arrange mass manufacturing with an overseas foundry. A research foundry vibe may permeate the proposed national center for nanoelectronics. The hub's goal is to get the integrated system concepts developed in academic and government labs to a point of maturity where they may be transferred to the foundry sector in a fabless fashion. The facility is also a potential site for the one-off and/or limited series manufacturing of cutting-edge micro and nanosystems. Some applications might be evaluated for use in new ventures.

Optoelectronics Photonics is a broad field that draws from a variety of scientific disciplines to address a wide range of practical challenges in research, industry, medicine, and other fields. It's a newer name on the scene. Semiconductor optoelectronics, laser technology, optical fiber technology, optical communications, image optoelectronics, photon physics, classical and modern optics, quantum optics, atom optics, nonlinear optics, high-energy photonics, infrared and ultraviolet optics, information optoelectronics, optical computing, adaptive optics, nano and micro optics, astronomical optics, and industrial optics are all subfields of modern optic
In our country, not all of these fields have reached the same level of development. There is a sizable, well knit, and well-organized photonics community across the country. The Polish Optoelectronics Committee (the Association of Polish Electrical Engineers) and the Section of Optoelectronics of the Institute of Electronics and Telecommunications are the two primary professional bodies responsible for coordinating the

Optoelectronics (Polish Academy of Sciences' Committee on Electronics and Telecommunications), the Section on Optics of the Physical Society of Poland, the Polish Society of Synchrotron Radiation, the Polish Society of Sensors, and the Photonics Society of Poland (a successor to SPIE Poland Section, the International Society for Optical Engineering). Opto-Electronics Review, Optica Applicata, and Photonics Letters of Poland are some of the specialized scientific and research publications published by this group. Blue photonics, materials for photonics, semiconductor lasers, optoelectronic functional modules, and their applications in industry, medicine, research, and safety are just a few of the photonics-related topics that have been the focus of recent large-scale national research projects funded by the state. The community plans for the next large-scale initiatives that have potential for widespread use in industry.

The photonics research and development community gets together annually at the few major national conferences on the subject. Specifically, these are: Optical Fibers and Their Applications is held once every 15 months in Biaystok and Krasnoyarsk, while the Laser Technology Symposium is held once every three years in winoujcie. Wilga hosts a yearly symposium on Photonics and Web Engineering where young scientists in the field of photonics gather to share their research. Students in their twenties and thirties are presenting master's and doctoral theses at this venue. various conferences bring together the leading figures in various fields to discuss the current level of domestic research and the future prospects for these technologies. Some of the largest European laser research programs, HIPER and ELI, are being undertaken by this community as well. These initiatives include the construction of a free electron laser called POLFEL, which is affiliated with the national center of synchrotron radiation and the national center of hadron treatment. The national community of photonics might use these efforts as a foundation for developing a strong specialism that extends beyond national borders.

Light sources; high power lasers; pulse lasers; high energy lasers; FEL; THz lasers; semiconductor lasers; metrological lasers; optical frequency rulers; imaging matrices; photo detectors; photolithography; semiconductor; integrated; image; fiber; meta-materials; nonlinear optoelectronics; photolithography; and photonics are all areas of research that have contributed to the growth of photonics in the United States. Advanced specialty components, such as sensors of nonelectrical values for construction and building sectors, environmental protection, and medical, may benefit greatly from the country's work in photonics.

Technologies If America wants to realize its potential in the field of ET materials and technologies, the separation of science from industry implementations is essential. The advancement of science needs to be in touch with current events across the world. A forecast for growth and a plan for scientific and industrial advancement should be drafted by the relevant community. Here are some broad questions that need to be addressed. When it comes to the local ET sector, should local scientists provide assistance and/or create new economic subjects, such as inventive spin offs? Which kind of collaboration and resources are most important? The funding source(s) ought to be industry-directed grants, federal funds, etc. Do we confine our efforts to Europe or do we cast our net wider? If we don't invest in fundamental research, we risk losing our ability to keep up with the pack. The country risks becoming a mere consumer of high technology if adequate funding for research is not provided. All of the aforementioned inquiries pertain to the training of appropriate personnel. In turn, the education is linked to places of higher learning, working circumstances, laboratory work, and financial compensation.

Without a doubt, the following trends will spread over the world: Micro- and nano-systems (MEMS, MOEMS, NEMS); Nanotechnologies; Biotechnologies; Structures and electron devices, spin and photon devices, and new materials (including those with less silica in silica, multilayer structures, and functional materials). The expansion of this field in the United States is supported by the following arguments: Poland has a number of top research groups in ET materials and technologies that maintain close contact with their counterparts around the world; this human capital is an opportunity for further growth, especially in certain production niches that may result in the creation of small and medium sized businesses.

Signals and Systems In the foreseeable future, the following lines of inquiry will predominate in the study of signals, circuits, and systems: distributed sensory networks for safety and environment monitoring; energy saving systems of information processing (mobile energy, embedded energy saving systems, energy harvesting); and the synthesis and design methods of programmable circuits (PSoC, FPGA, NoC), dynamic programming; the development of virtual ET components. Nonlinear circuits; automotive electronics (low-loss energy converters, high-power ICs, hybrid vehicle drives, and greater voltage); helping with simulations of extremely large systems dealing with highly wideband signals new methods of human-machine communication; multimedia data repositories; image recognition and processing for medical engineering; accessibility for the elderly, the sick, and the disabled; efficient, functional, and reliable remote medical systems; enhancing systems for health protection, medical diagnostics, and treatment; anthropomorphic technical devices copying human educational and intellectual functions; interactive radio and television; 3D television; intelligent safety systems;

Miniaturization, weight reduction, reduced power consumption, increased portability of electronic systems, integrated analog-digital and mechanical-electronic design, programmability and dynamic re-configurability of ET circuits, concurrent synthesis of hardware and software, increased data transmission rate and immunity to interferences, and an increase in embedded intelligence are all areas that have been proposed as top priorities for ET signals and systems research.

Electromagnetic Compatibility Electrical and electronic equipment with good electromagnetic compatibility (EMC) is one that functions normally in a given EM environment without creating disturbances that interfere with the performance of other equipment in the same vicinity. The gadget satisfies all three criteria: it does not interfere with others, it is not affected by the emissions of other devices, and it does not interfere with itself. The gadget can be used in an EM environment where the amount and kind of disturbances are suitable for its use. Radio, television, cellphone, and radiolocation transmitters, as well as errant electrical household equipment, all contribute to the electromagnetic field (EM field) experienced as disturbance. Emission of disturbances is distinguished from immunity to disturbances by EMC. Electromagnetic interference is a factor that can diminish a device's performance. The rule PN-EN 55022 includes recommendations from the Polish Standardization Committee about allowable disruption levels. Several locations around the nation are suitable for taking the necessary reference measurements. Poznan's Institute of Logistics, Katowice's EMAG, Gdynia's CTM, Wroclaw's WIL, and Wroclaw's Uni. of Technology are all taking part. Research in EMC has expanded into the relatively new field of electromagnetic (EM) contamination of natural habitats and, more specifically, human proximity. EMC studies aim to find better ways to ensure that electronic parts, circuits, devices, and entire systems aren't themselves disruptive. Standardized EMC certification processes apply to all manufactured goods.

5. SUMMARY

We are currently in a time of rapid and increasing progress in IT, which is expected to become a societal cornerstone in the not-too-distant future. As a state, a people, and a culture, we shall take part in this transformation, either obliviously or actively. How much we should, can, will, and must invest in this endeavor is the central topic being discussed. We all hate having to remain passive. The action is quite expensive, thus the question may need to be rephrased. How many people are we able to accommodate?
at lacks a high-tech industry. The ET industry's growth has been quite fruitful. ET offers the quickest return on investment compared to other options in the same space. The following subfields fall under this industry (as they do in comparable ones):

• the fields of science, study, and development, both theoretical and practical;

In this article we will discuss: the three tiers of higher education; the professional community; the importance of innovation, applications, and patents; and the importance of education, ongoing education, professional training, outreach, and dissemination.
• business, production, commerce, and service sectors of the economy.

Although seemingly unrelated, these fields are integral parts of what is being referred to here as society's "full cycle of high-tech reproduction." Without that one link in the chain, the whole thing falls apart, exposing the science to the danger of becoming irrelevant and irrelevant in society.

Prospects for the Future of the ET Industry In the industrialized world, the ET industry will see rapid and dramatic growth, and not just steady growth. Numerous scientific, economic, social, and political arguments lend credence to this view.

The evolution of the Internet has given birth to a brand new phenomenon: virtual reality. Avatars, digital representations of real people, fill the online world and are imbued with the full capabilities of a digital existence. Intelligent and self-aware Avatars will become increasingly dependent on their human masters. Virtual reality has already made its way into many other industries, including retail (virtual fitting rooms), the barbershop (pain-free haircut modeling), and many more. The growth of electronic commerce has been rapid. More and more of our purchases are being made online.

In many areas of society, consumer electronics already dominate, several adjustments will be brought in tandem with ET development. The day has almost come for screenless, holographic projection of videos in 3D on televisions. Since the transition from mechanical and hydraulic systems to electrical ones results in a significant rise in power consumption, the electrical system of automobiles will soon migrate from 12/14V to 36/42V.

Some nations further encourage ET development by heightening public interest in the field. Student-focused, high-stakes, and extensively publicized American competitions in this field have gained international renown. Issues like this arise in fields as diverse as computer science and robotics, with applications as varied as wideband data transmission from a lunar rover and swarms of robotic soccer players. Many people watch these events because they pose challenging research problems. New practitioners of these disciplines and technologies make up the bulk of the audience, followed by researchers and funding officials.

The future of the ET industry in Europe is bright. Europe is dead set on becoming an advanced information society. A lot of attention and resources are being put into finding methods to fund this course of action. Europe encourages and demands a noticeable increase in ET research from its member nations.

industry of Poland's ET The European Union's commitments and worldwide economic conditions will ensure that the ET sector develops in this nation at a minimum speed, regardless of the scenario (political or financial). Systematic development of the information society's required infrastructure and its user components is required. Soon, citizens of this country might expect to get ID cards that are entirely digital. The next phase of digitizing government in the country and Europe appears to require them. They make possible fully digital forms of administration, such as e-health records and e-services. The electronic identification card, which will include a pin protection system and be given soon after the birth, would be provided at no cost.

There is a government-led initiative here to promote digital television. The goal is to completely phase out analog methods and switch to digital ones as quickly as feasible in radio and television transmission. Digital technology are ubiquitous, allowing for the next level of information system integration in the United States and Europe.

We're curious about the potential implications of these policy shifts for the science and economy around ET in this country's capital. Important choices should be made following input from experts in science, education, society, business, and economics. Seemingly, the decisions should focus on the following areas: guaranteeing the existence and protection in this country of the full recreation cycles for selected sectors of high technology; encouraging the development in the country of social infrastructure dedicated to developing, supporting, and understanding science; and determining the trajectory of science development in the country.

Priority research areas are identified, and a realistic, fixed funding level for science and innovation is established.

The Age of Information Poland is progressing in a time of increasing global interdependence. Major shifts with far-reaching implications for our national economy are taking place around the globe. Therefore, the foundation of the national plan should be the implementation of activities in tandem with the development of a knowledge-based economy (NBE). This sort of economy is defined by the growth of economic sectors linked to the processing of information and the advancement of research. Industries associated with high technology and the tools and services of the information society are of special interest. The knowledge-based economy is synonymous with advanced technology, widespread use of information and communication technologies (ICT), and even the information civilisation. The NBE relies on knowledge and information as its primary means of transport because these are where the company's edge and competitive advantage originate. Science development, as a fundamental instrument for increasing the knowledge resources, combined with proper use of its effects and building a creative and entrepreneurial society, and eventually an information society, offers Poland its best chance to improve its competitive position in Europe and the world.

Invitation for Debate This summary document is just the beginning of a larger body of work put together by the KEiT PAS and its several specialty groups. It's based in part on what the sections had to say. The views are varied and written in an authorial style. They are the end product of the Committee's deliberations and efforts over the past twelve months. Several plenary sessions of the Committee, attended by representatives from the fields of research, higher education, industry, economy, and government, were held, during which the viewpoints were given. The opinions were formulated with these specialists' input in mind. However, the article libraries and universities. The ET Committee hopes to make its stance about its area of competence known to the public via this compiled opinion. At the same time, PAS' ET Committee would like to extend an invitation to all relevant organizations working in the ET and science management sectors to engage in a community-wide conversation and collaborative effort on this topic. Influence actions, such as lobbying, based on a sufficiently broad community platform that encompasses social and economic domains, are a crucial component enhancing the growth of the aforementioned subfield of research and technology.

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