NANOTECHNOLOGY, SOCIETY AND NATIONAL SECURITY

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Abstract

Nanotechnology is defined as one of the most important technologies of the 21st Century. The ability of technology to deliver possibilities far beyond the known borders so far has led the debates to be multi-faceted between hopes and concerns from obscurity. Scientific success stories of mankind that take centuries on any subject now take place in the processes expressed in hours. There are always new revolutionary results that make all of the stories written so far trivial. We have to rethink the words impossible and imagination" and now dreams do not seem so far from being real. With the "nano" phase of technology, the developments that will make a significant impact on every detail of our social life. We expect nanotechnology to be a paradigm shift in technology. As such, by fundamentally changing what is possible on offensive and defensive matters, nanotechnology has the potential to either cause harm or provide strategic advantage to a nation based on its level of readiness. Similarly, with the social media revolution, we have seen a lagged impact on social fabric through the impact of a new technology. We are recently noticing of these changes could be weaponized. Thus, such long term sociological impacts must also be considered.

Keywords: *Sociology, Nanotechnology, Nanoscale, Nanoscience, Biotechnology, National Security, Defense.*

NANOTEKNOLOJİ, TOPLUM VE MİLLİ GÜVENLİK

Öz

Nanoteknoloji 21. Yüzyılın en önemli teknolojilerinden bir olarak tanımlanmaktadır. Bazıları için toplumsal dönüşümde yeni bir çağı simgeleyen bu teknoloji, günümüzde akıllı niteliğiyle birçok ürün ve üretim sürecinde yer almaya başlamıştır. Teknolojinin şimdiye kadar bilinen sınırların çok daha ötesinde olanaklar sunabilmesi ise tartışmaların ümitler ve bilinmezlikten kaynaklanan endişeler arasında çok yönlü ilerlemesine yol açmıştır. İnsanoğlunun herhangi bir konuda asırlar alan bilimsel başarı öyküleri artık saatlerle ifade edilen sürelerde gerçekleşmektedir. Bugüne kadar yazılmış öykülerin tamamını önemsiz kılan ve her an devrim niteliğinde yeni bir sonuçla karşı karşıya kalınmaktadır. İşin doğrusu "imkânsız" ve "hayal" kelimeleri üzerinde yeniden düşünülmek zorundadır. Artık hayaller gerçek olmaktan o kadar da uzak görünmemektedir. Nanoteknoloji ile milimetrik boyutlara ulaşan teknolojik ürünler, sosyo-ekonomik olarak insan yaşamının her alanında sarsıcı etkilere yol açacaktır. Bu nedenle, nanoteknoloji, hücum ve savunma konularında mümkün olanı temelden değiştirerek, ülkenin hazırlık seviyesine bağlı olarak o ülkeye zarar verme veya stratejik avantaj yaratma potansiyeline sahiptir. Aynı zamanda sosyal medya devriminde gördüğümüz üzere bu tip teknolojik değişimlerin de sonradan görülen bir sosyolojik etkisi vardır. Bu etkilerin sosyal medya özelinde nasıl silah haline getirilebileceği yeni yeni görülmeye başlanmıştır. Bu nedenle uzun vadede sosyolojik etkilerin de milli güvenlik açısından değerlendirilmesi gerekir.

Anahtar Kelimeler: *Sosyoloji, Nanoteknoloji, Nanoçağ, Nanobilim, Biyoteknoloji, Milli Güvenlik, Savunma*

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INTRODUCTION

When the advances in science and technology in the human history from past to present are examined, it is possible to see that the world has undergone significant changes throughout all of these developments. These changes can be evaluated as the effects of advances in scientific and technological fields in general. However, it is noted that humans have a desire to create a force on the environment where they live, rather than the effort to make sense of the world. This reason is the main driver for the development of the society in a technical sense.

When the developments in the history of humanity are examined, it is also possible to see a shift from the macro axis to the micro axis. Thus, the tools and machines which were made from very coarse material in the first periods were reduced to smaller dimensions over time. In recent years, technical production activities have been moved to a different dimension. With this study, the first sparks were ignited, not only in the scientific field, but also that the technical developments, including the changing of the world in the personal, social and even general terms, could be achieved.

There has been many estimates of the economic, political and social impact of novel technologies enabling formation of new structures from the substances at the molecular level. While the full impact of these advances are yet to be seen, it is widely expected to be similar to that of discovery of fire and literature, the invention of electricity, steam machines and computers.

When we consider nano-technology from a conceptual perspective, it is possible to say that the concept derives from two separate words "nano" and "technology". The concept of “nano” from these two words is a Greek word that is used in the sense of “dwarf”. Nano-technology, which is formed by the fusion of the concepts of nano and technology, can be defined as technology produced with very small size materials. It is seen that the concept of nano-technology was first used in Tokyo Science University. It is not possible to say that the concept used by Professor Norio Taniguchi, who was employed in this University in 1976, was known by a large group in the early days. However, at the point reached with the studies after the introduction of the concept by Taniguchi, concrete examples in this field has begun to be introduced. In fact, the concept of nano-technology was announced in 1986 by Drexler in a study that has a huge impact on the world, not in theory, but in practice (Nanotechnology: The Next Great Wave of Innovation, 2013).

The concept of "dwarf" which is used in the structure of nano-science and related technology and evaluated as the origin of the concept refers to a structure far from small. When the studies are examined, it is seen that the nano-technology and the studies within this technology cover the design and construction process according to the functions and properties of the atomic level structures, systems or instruments. In this context, nano-technology production process or technology is defined as a production technology at atomic level. When the literature is examined, it is seen that this branch of science is defined as a science that examines the structures, dynamics and properties of systems having at least one of the macroscopic spatial structures which have very different characteristics from both small, molecular and large systems in all dimensions (TÜSİAD - Sabancı University Competitiveness Forum Report, 2013; Jain, 2007). Based on this definition, it is possible to say that the study area of the nano-technology structure is quite small structures.

Characteristics of nanotechnology:

1. Nano-technology is the technology of possibilities.

2. Nano-technology changes the traditional one and enables the production of products with higher standards through new production methods.

3. Nano-technology is multidisciplinary.

4. Nano-technology is universal (TÜSİAD - Sabancı University Competitiveness Forum Report, 2013).

From self-cleaning systems (Tung, 2011) to non-staining fabrics, from the killing the cancer cells without damaging the body to long lasting effect creams (Tran, 2020), from non-odorless socks to use in food safety (A. J. Thekkethil, 2019), the nano-technology entering our lives is a new technology revolution. New products in the fields of health, defense, textile, energy and electronics will facilitate human life. It is already accepted as the key technology of the 21st century.

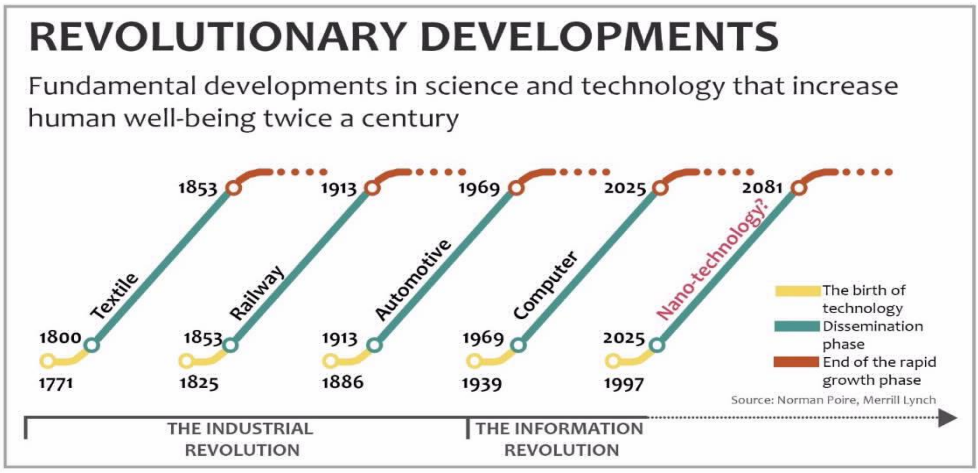

Figure-1. Industrial revolutions that affect humanity since the 19th century (Bilim Teknik Dergisi, 2006)

As shown in the Figure 1 above, it is foreseen that nano-technology will spread rapidly after 2025. It is thought that this process will continue until 2081.

As it has been shown throughout the history, the introduction of any new technology will have direct and indirect implications in national defense. With the nano-technology, we are talking about a fundamental shift in redefining what is possible across all domains of technology. As such, we expect significant national security impact of nanotechnology from offensive and defensive perspectives. Additionally, the impact of technology on the change of social fabric has recently been a topic of discussion. Not only we estimate that there likely be a fundamental social impact but we also estimate that such impact may have fundamental national security ramifications.

1. THE DEVELOPMENT OF NANO-TECHNOLOGY IN THE EU AND TURKEY

The Australian Prime Minister's Council for Science Engineering and Innovation, conducting research on nano-technology, is making a brief description of nano-technology. In this definition, nano-technology is considered as "engineering at the molecular level". According to this definition, nano-technology is a common term for technologies, techniques, and processes within the range of 1 to 100 nanometers, including the manipulation of matter at the smallest level (NBRR, 2005). In a report published by TUSİAD in 2008, nano-technology was considered

as a total structure of many technologies and techniques rather than a specific engineering or scientific field and was defined in this context (TÜSİAD - Sabancı University Competitiveness Forum Report, 2013). In the definition of nano-technology made by Jurvetson, nano-technology has been considered as the point of connection of many scientific fields, but rather than scientific knowledge, this information has been evaluated as an assembler umbrella (Jurvetson, 2007).

The budget allocated to nano-technology in the world is very high (Bhushan, 2016), and it has been included among the key priorities in the developed countries, which have early understanding of the importance of the beginning of technology until 2025. If anything, when these investments were made, it was contemplated that, in the future, the idea that the level of development of countries will be measured by nano-technology levels is increasing day by day (Çıracı, 2010). Of course, the time will tell whether these projections were correct.

In the European Union (EU), a nano-technology network was established in 2003 and reports on nano-technology were published. On May 12, 2004, the European Commission drew the main policy in the field of nano-technology with the declaration "Towards the European Strategy for Nano-technology" and nano-technology was brought to the forefront in terms of competition (Aydoğdu, 2011). In the areas determined by the European Commission, Framework Programs aiming to increase the competitiveness of the international market are considered and nano-technology is considered as the priority area (TUBITAK Science and Technology Magazine, 2006).

In the EU, nanotechnology has 2 main objectives. These are:

1. Introduction of innovative products produced in nano-technology to existing industrial sectors.

2. The development of new materials, tools, products and processes is the promotion of the creation of new industries and new sectors (Aydoğdu, 2011)

80 companies in the field of nano-technology have been supported within the EU, with the 4th Framework Program conducted between 1994 and 1998. In 2001, €45 million was allocated to nano-technology within the scope of the 5th Framework Program. With the 6th Framework Program covering the years 2002-2006, nano-technology was announced as a priority area and the support increased to €150 million Euros. One–third of EU public expenditure is transferred to nano-technology. The plan "Nano-sciences and Nano-technologies: Action Plan for

Europe 2005-2009" prepared by EU on 06/2005 tries to evaluate the studies carried out in the field of nano-technology in a different way.

In the report containing three approaches:

1. Carrying out R & D studies related to the social field, giving importance to ethical principles,

2. To value the ideas of the end-user in the sectors such as health, environment and security of nano-technology-based production,

3. It is aimed to motivate international cooperation (Aydoğdu, 2011).

It is argued that the key technologies identified in the plan will have an important role in the development of the country in the short term. These key technologies are industrial biotechnology, nano-technology, advanced materials, photonics, micro and nano–electronics, and advanced production systems.

Turkey has also noticed the importance of nano-technology started to transform into a new industrial revolution before it is too late. Strategic studies, financial investments, collaborations, support and incentives have begun in the field of nanotechnology.

When the studies in the field of nano-technology in Turkey are examined, as of today, it is possible to say that there is no progress at the world level or the expected level. Studies in nano-technology which emerged in the 1950s and developed in the 1990s around the world have not yet reached the expected level in Turkey due to the fact that Turkey is not included in these developments and remains a spectator. However, it is possible to see that many studies have been carried out in the field of nano-technology since the beginning of 2000's following the developments in the world in Turkey. Turkey, which is lagging behind the world as of the start date of the mentioned studies, has gone on to create a number of plans and programs in order to close this gap.

One of the most important plans and program studies carried out in this area are the studies carried out within the framework of the vision which was described as the vision of Turkey in 2023. With these studies, activities in the field of nano-technology are also included in the subjects which are wanted to be brought to world standards in almost every field in Turkey.

When this document is reviewed, it seems that it is a document containing the plans to create parallel developments worldwide developments in science and

technology in terms of Turkey, to include Turkey among the world's technology level and the scientific and technological activities to be carried out in this context.

Within the scope of Vision 2023 Strategy Document, it is mentioned that nanotechnology activities will have a big impact in the next 10 to 15 years and new markets will emerge in this field. In addition, it is also stated that nano-technology activities and developments in this field will create new economic markets in the short term and in this context will lead to profound changes in economic activities (TUBITAK 2023 Vision, 2017). Based on these expectations or future predictions, the activities in the fields such as nanoelectronic, nanophotonics, nanomaterials, nanofabrication in Turkey were added to the priority action plan. In this context, in order to carry out the necessary R&D activities, teams have been formed and activity plans which include the methods and ways to be followed as a result of the examinations of the teams that have been created have been generated. This road-map includes the establishment of the necessary research structures, the establishment of policies on a country basis, the provision of necessary resources to the developments, the provision of the necessary manpower and the raising of awareness in the field of nano-technology in the society.

The main components of this objective are education, health, transportation, agriculture, food, construction, infrastructure, energy, information, communication, defense, aviation, environment, textile. Socio-economic targets supporting these elements were determined (TUBITAK 2003-2023 Strateji Belgesi).

Socio-economic targets identified are:

- To have a say in international trade by determining production areas to gain a competitive advantage,
- Improving the quality of life of society,
- Providing economic development by ensuring sustainability in designated production areas,
- To adapt to transformation in a world where societies produce knowledge and transform knowledge into economic and social benefits, to strengthen the infrastructure of information and communication technologies (TUBITAK 2003-2023 Strateji Belgesi).

In order for Turkey to overcome this threshold;

- Making production and automation a flexible structure,

- Developing clean production, information – intensive and high added value products,
- Increasing competitiveness in key sectors for the economy,
- Increasing the ability to develop materials, space and defence technologies,
- Improving the quality of life in food safety, infrastructure, transportation,
- To ensure sustainability, it was concluded that technological infrastructure should be established properly by being competent in energy and environmental technologies (TUBITAK 2003-2023 Strateji Belgesi).

To carry out the above-mentioned activities, it is necessary to know the basic technologies. These technologies, called “Strategic Technologies”, are (TUBITAK 2003-2023 Strateji Belgesi):

1. Biotechnology and gene technologies,
2. Mechatronic
3. **Nanotechnology,**
4. Information and communication technologies,
5. Energy and environmental technologies,
6. Material technologies,
7. Design technologies,
8. Production technologies.

Nano-technology, an important area in achieving the intended targets, is able to increase the gap between weak and strong countries. Nano-technology is defined in the Vision 2023 Document as an area that has the power to change human life and economic activities from head to toe with new products and markets it will create.

2. AREAS WHERE NANOTECHNOLOGY WILL BE USED

2.1. Nano-technology Applications in the Field of Medicine and Health

The most popular branch of nanobiotechnology, which combines nanotechnology with biotechnology, is shown as "nanomedicine" (TUBITAK Science and Technology Magazine, 2007). Nanomedicine now investigated in clinical trials for diagnosis, treatment, monitoring and control of biological systems. Nano-technology is very effective in the process of obtaining the results of the analysis of a disease within a very short period of time. In practice, primarily nano-devices are produced. Thanks to nano-technology, drugs are transported to the place where

they are needed by the so-called "drug transport" method. The devices produced by nano-technology will be able to circulate in veins, stick to the cells they give direction thanks to receivers and remove damage in the cell with micro-scissors (Liu, 2018).

Another development of nano-technology in the field of medicine is the method of replacing dead cells with artificial tissues. Thanks to the new methods, it will be possible to prevent the loss of tissue that occurs in organs such as brain, spine, heart and kidney which are critical in the human body (Nejati-Koshki, 2017).

Other nanotechnology driven technologies, having the ability to make changes on the DNA, are capable of regaining the ability to regenerate hormones that lose the ability to produce hormones in the treatment of diabetes caused by the lack of insulin hormone in the body (Cho, 2019) (Gerace 2017). Tissue engineering, aimed at repairing damaged organs and tissues in the body, will improve the quality of human life in the near future with nano-technological approaches (Zarrintaj, 2017).

While some of the data belongs to earlier stages of clinical research, these new methods enabled by nano-technology are poised to disrupt the future of medicine and human health. It is important to realize from the perspective of national security that these developments can both be used offensively and defensively. On the defensive side, nanotechnology could be applied in 'pre-deployment screening, combat causality treatment, field medical health, and long-term recovery' (Nichols 2016).

Such developments in nano-medicine will invariably be applicable to the field of defense. One could easily foresee the developments contemplated above to be applied in fighting force health and readiness. We also contemplate other, defense specific applications of nano-technology from the lens of health. If anything, countries like the USA started exploring the impact of nano-technology on defense from early 2000s onward. The reason for this effort is that biotechnology may be leveraged to detect biological attacks through microsensors (US Congress Committee on Armed Services, 2001) and other attack vectors (Shipbaugh et al, 2004) (US National Academies of Sciences, Engineering and Medicine, 2017). These efforts have since been replicated by other countries like India as well (Phukan, 2018). However, what could be used defensively could still be used offensively and majority of research focuses on defending a country against a pathogen that may be generated in a lab for offensive purposes (US National Academies of Sciences, Engineering and Medicine, 2017).

2.2. Nano-technology Applications in Textile Field

All the textile materials obtained as a result of nano-technology are called nanotextile. The different properties that are given to textile materials in nanometer sizes bring with them important developments. In the production process using nano-technology and nanomaterials; performance is increased in machinery and operations and new properties are gained in textile products.

In the textile industry, progress has been made in the development of strong fibers and fabrics for biomedical and military applications (Yanılmaz, Karakaş, 2018). Materials produced by nano-technology provide fabrics with features such as water and oil repellent, bad odor formation prevention, stain retention, wrinkle, cool in summer, warm in winter, breathability (Asif, 2018) (Choi, 2017). With the addition of nano-apparatus and nanosensors into the fabric, the dresses enter to a form which can hear, see, feel and produce energy (Molnar, 2019). Thanks to these, water and energy savings as well as protection against harmful rays will reduce the negative effects on human health. By measuring the environmental stimulus by means of microphones and receivers, the bed sheets that can change color depending on the room and body temperature, pulse rate, blood pressure, heart rate, blood sugar regularly followed by the patient who sends an automatic warning to the hospital in case of emergency, treatment of lonely and elderly patients can be performed remotely (Promphet, 2019). Textile products giving the drug when needed by following the functions of the body, protecting from microorganisms, non-wrinkle, developed by imitating lotus flowers, dirt and oil-repellent, breathable, emitting nice scent, treating wounds are on the market (Üreyen, 2006).

If, as explained above, nanotechnology completely changes the national safety paradigm, then the nanotechnology augmented textiles could be the best countermeasure against this paradigm shift. Armed Forces of other countries are already started working on sensors that could be embedded on textiles earlier in this century (US Department of Defense, 2009). These investments have since drastically altered the state of the art in defense related clothing (Davies, 2020). Similarly, the most realistic and cost – effective path to protect the populace would also be deploying the detection and protection measures through nanotechnology augmented textures as it was applied to military textures.

2.3. Nanotechnology Applications in Defense, Space and Aviation

Nano-technology researches first started in the United States in order to reduce the weight of combat equipment weighing 45 kg in order to increase the military's mobility. The use of nanotechnology for the first time in the field of defense within a national plan is evident that defense is important for the economic, political, social and social integrity of the countries (Uldrich, Newberry, 2008). It is among the targets of the defense sector to realize chemical and biological combat vehicles, nanostructured explosive and armor projects for military requirements. The need for manpower is reduced with nanorobotic systems and by means of nano-sensors, harmful gases and radioactive structures can be detected and nuclear defense systems can be controlled.

For the national defense and security of nanotechnology, many applications and areas of use are specified. These are miniature sensors, high-speed communication tools, unmanned land, sea and air vehicles, high performance on military platforms, improved chemical, biological and nuclear detection systems and maintenance vehicles, improved systems for the monitoring and prevention of nuclear fallout, improved manpower performance (Özer, 2008).

With the use of nanotechnology, low energy-consuming, radiation-resistant, high-efficiency computers, nanostructured sensors, flight systems supported by nanoelectronic, heat-resistant nanostructured coating materials can be developed (Edwards, 2018).

2.4. Nano-technology Applications in the Field of Environment and Energy

Nanotechnology, which has significant implications for the efficient use, production and storage of energy, has new potentials in the utilization of energy resources (TÜSİAD Competitiveness Strategy Series, Tarihsiz). It is the most promising in terms of renewable energy sources. Fossil fuel reserves, which are the main energy source of today, are visibly decreasing, their costs are increasing and the world economy has a negative effect on this situation.

By means of nanoparticles, metals can be made lighter, harder and more powerful, and because of the softness and forming properties of ceramics, the energy and fuel usage rates of the materials decrease. Thanks to nano-technology, friction costs may decrease, the energy need will be reduced, and the reduction of raw materials and energy use will provide cleaner production (TÜSİAD Competitiveness Strategy Series, Tarihsiz).

In the field of energy storage, nano-technology applications include the use of nanoparticles for battery and fuel cells. With the contribution of nano-technology in this field, it is foreseen that the production of water-powered vehicles and batteries will soon be possible (Durgun, 2006).

Nano-technology is considered as the last point in green production; it enables the elimination of the environmental problems created by modern science and technology and the development of production systems that allow the prevention of waste.

Harnessing nanotechnology for national defense applications remains an interest for a number of countries. Not only US Navy has a number of programs that are focusing on energy creation and storage projects but also US Department of Defense closely tracks the investments of ally and enemy countries in this field (US Department of Defense, 2009) (US National Academies of Sciences, Engineering and Medicine, 2017). The reason why such applications are an area of interest is that cleaner and cheaper energy production and storage through nanotechnology will enable the armies, navies and air forces of the future to have a longer – range attack capabilities with less dependence of resources and lower footprint thus enabling a very large strategic advantage.

2.5. Nano-technology Applications in the Field of Informatics and Electronics

Nano-technology is the key to future information and communication technologies. According to Moore's Law, the computer performance doubled every eighteen months and their size halved since the 1950s maintain their validity until the 2020s, However the computers produced with new nano-technological developments will go down to molecular sizes. With the introduction of nanophotonics technologies that examine the relationship of nanostructures with photonics and nanotechnology to light, the acceleration of computers, Internet speed and the capacity of DVD information storage will increase by hundreds of times and there will be serious developments in the field of information-communication (TÜSİAD - Sabancı University Competitiveness Forum Report, 2013).

The most important variable in this field is the economic miniature and fast processors with high performance. These processors are expected to be much smaller in size, higher capacity, faster and more energy efficient than current computers. With the widespread of mobile phones with versatile displays, electronic books, nano refrigerators that destroy odor and germs and other electronic devices, the demand will increase and the market will expand (TÜSİAD

- Sabancı University Competitiveness Forum Report, 2013). OLED technology, an important component of nanoelectronics, is a technology with low energy use and wide viewing angle. Today, it is used in laptops, mobile phones, GPS systems and digital cameras.

Nano-technology applications give signals that smart phones and tablet computers can produce flexible structure in the coming years. Quantum information processing projects, which are important elements of the security of countries, are carried out quietly in the research centers of countries today. Quantum information processing research through nano-technology is one of the priority civil and military research areas of various countries as a guarantee of national security and independence (TUBITAK Vision 2023 Project Nanotechnology Strategy Group).

From the perspective of Informatics and Electronics, the core challenge that we should be ready for is the introduction of Quantum Computing. With the first viable quantum computer, majority of the cryptography systems in place will be rendered useless and could be broken instantaneously (NIST, 2016). The first mover advantage in this area will be very important as there will be a significant imbalance of power between the nation (or non-state entity) to have this capability versus those who do not. Further research must be conducted on the government level on preventing and responding to this thread.

2.6. Nanotechnology Applications in Transport Field

Automobile industry is one of the industries with a wide range of applications most feeds the economy in Turkey and in the world today. For this reason, studies on nano-technological applications in the automobile industry have increased in recent years. The reflection of nano-technology to transportation industry are composed on the subjects such as the engine parts, the materials and friction-oriented works, automobile glass, wiper, rear-view mirrors, paint, fuel additives, exhaust filter technology, hydrogen storage, sensor applications, the use of carbon nanotubes in tires.

Because nano-technology allows for a deliberate placement of molecules, plastic materials are as solid as they are light. Today, easy scratch-free metallic paints, friction-reducing, engine life-extending parts have been produced. In automobile tires, inorganic clay and polymers intended to be used instead of black carbon will allow the production of environmentally friendly tires; nuclear wastes

can be detected with the help of nanosensors and nanorobots, and waste control and filtering will be ensured (Erkoç, 2010).

2.7. Nanotechnology Applications in Food

The application of nano-technology to agriculture and food was carried out by the US Department of Agriculture for the first time in December 2002. Nanotechnology applications in the food sector are limited although they are everywhere (Gültekin vd., 2011). The applications focus more on food safety and food packaging. Since food processing processes consist of different technologies, nanotechnological applications vary in food. The life of the foods strengthened with nanoparticles is prolonged; color, texture and consistency increase and antimicrobial properties are developed in packaging. The methods used in food packaging provide savings in storage and distribution. With the help of nanosensors, a number of important information, providing new benefits to producers and consumers, box milk or yogurt products such as hot air for long periods of time as a result of the deterioration of the difference in the packaging can be produced (Boyacıoğlu, 2017).

2.8. Turkey's Opportunities

Turkey has numerous opportunities in the field of nanotechnology studies. These opportunities are driven by the general structure of the country as well as Turkey's industrial and technological resources. Below are potential opportunities for Turkey in developing a robust nanotechnology industry.

- The opportunity to benefit from various international funds within the EU framework programmes,
- The presence of capital all over the world and seeking investment opportunities,
- Opportunity to enter new products and services created by technology development,
- The dynamism that developed textile industry in the country can provide to national economy with the help of nano-technology applications
- Opportunities for defence, aerospace and aerospace industry investments
- Advantages of proximity to the developing energy market in supplying energy and raw materials,
- New beginning of nano-technological studies in the world.

2.9. Threats Facing Turkey

In addition to advantages, Turkey has a lot of threats in this field. These threats are generally driven by the country's general economic and political structure and could be further exacerbated by global economic and political conjecture. Below are some examples of the aforementioned threats.

- Brain drain due to insufficiency of job opportunities and wages,
- Political instability,
- Foreign political influences, pressures and global economic turmoil,
- Increasing competition in the market, increasing market dominance of multinational companies,
- Non-realization of foreign investment flow,
- Unable to keep up with the rapid development of science and technology in the world
- Non-regulated policies for nano-technology
- Intensive competition conditions in the international economy.

3. SOCIAL REFLECTIONS OF NANO-TECHNOLOGY

The point reached in technology and the demand for products at this point increases the investments made in this area and in addition, the formation of new investment plans. When the newly created plans are examined, it is seen that an investment activity has started in nano-technological activities, but efforts have begun to draw attention to this point in the social field. These developments in the technological field lead to a society structure that is more familiar with the developments in other technological areas, especially in nano-technology. This creates a social structure that is intertwined with technology, and this close relationship with technology enables the formation of a technological lifestyle and this combination enables the formation of consumer practices. When considered in this context, it is considered as a problematic issue that will change in the future, and the upcoming period is considered nano-era in the integration of nanotechnology and society. In this context, the thoughts about the formation of nano-era in nano-societies, which are to be shaped, have not been able to go beyond the scenarios which are still described as futurist. However, many researchers have attempted to clarify the social structure of the nano-era in line

with the analysis (Bainbridge, 2007a). It is possible to list the results achieved in this regard as follows.

Social reflections on the nano-technology should be a core area of interest from the perspective of national security. Though the changes predicted in material domain will have a fast-onset and tangible impact, the long – term social impact might be more deleterious. For example, only a few decades after the launching the first mass social media network can we notice the overall impact on the society. But as a result, we see social engineering having a large impact on the security of nations (Bradshaw, 2017).

We have tried to identify some of the components of the society that may be impacted from these shifts, but we strongly recommend further research in this area.

3.1. Effects on Family Structure

The family, which is the building block of society, is among the first to be discussed in the new social structure to be developed with nano-era. In a study called Surway2000 research, individuals present different interpretations about family life in the new age. According to the data obtained from the research, it is thought that families will have a stronger structure in the next century, called nano-era. However, it is stated that there will be a decrease in divorce rates and it is also stated that there will be a return to the traditional family type. However, in some of the opinions put forward in the light of the researches on this subject, it is mentioned that there is an increase in the divorce rates when the long-term nano-era is taken into consideration and this may have some bad effects on the children coming to the new world. However, some research results suggest that a transformation will occur towards a family structure where the definitions of the family will be reproduced (Bainbridge, 2007b).

When the researches and the results are evaluated, it is not possible to reach a clear conclusion on what kind of impact technology will have on society and the family. In addition to all this, there is no clear explanation as to what impact the nano-technological developments will have on family life. However, it is emphasized that there will be an increase in birth rates along with technological developments and that there will be a great impact of nano-technology on the control or progress towards the increase of the population. Another effect of nano-technology in family life and social life is the increase in the average life due to

developments in medicine and the increase in the elderly population due to nanomedicine applications (Bainbridge, 2010).

However, it is clear that technology has a fundamental impact on the family dynamics as a whole (Villegas, 2013). Additionally, families, as a unit have a fundamental impact on social change (McKie, 2005). Therefore, further research must be conducted on the long term direct and indirect impact of this fundamental change in technology on national security.

3.2. Effects on Religion and Belief System

After the integration of technology into society, it is possible to see the effects of technology in all areas of human being as a result of individuals dominating nature. The increase in the capacity of the human being to be intertwined with technology leads to the formation of the psychology of creativity in the human being, and it is possible that this will lead to a conclusion such as the removal of the human from religious values. In this regard, Bainbridge emphasizes that the tendency of proximity and distance to religious belief will increase in nano-era and that, in other words, there will be some polarizations in these matters. As a matter of fact, it is among the predictions that people can shift to different poles in the form of being able to put them in a creative position or to analyze the point reached by the creator with the opportunities provided by the technological structures dominated by people and the new products it creates (Bainbridge, 2010). The opinions of Surway2000 participants and the expectations of experts in this field are that progress in scientific knowledge will spread to society without prejudice or challenge in the field of traditional religious belief (Bainbridge, 2010).

The effect of technological developments on faith is taken into consideration in terms of religion. Leiss considers this issue as technology idols. Leiss's concept of technology idols is dealt with in the form of magic, religious beings and loyalty to unreal social traditions. In this context, it is suggested that the individuals who are connected to the thoughts that arise along with the commitment to technology can see a deeper structure in these thoughts (Milberry, 2010).

3.3. Cultural Structures and Their Effects on Education

In researches, it has been concluded that technology and culture are in a state of war because of the disconnection between cultural structures and technology. However, due to developing technologies and these technologies, the possibility of a faster transition to cultural structures is ignored. As a matter of fact, the increase in the speed of communication can accelerate the cultural flow in the inter-

communal and in the same society. When new structures developed with nano-technology are examined, it is mentioned that a period of 3 or 7 years will be more extensive and fast communication possibilities will be reached with smaller computers or computer equipment. In this context, it is possible to mention that nanotechnology has a positive impact on the transfer of culture or the fulfillment of the functions of culture (Baird, 2007).

With this new cultural approach or new cultural outlook, it is mentioned that the emergence of the so-called "trans-humanist" groups will be facilitated. Trans-humanists are defined as groups that advocate that human nature can be transformed by technology, or that people are obliged to transform in their nature. With the emergence of these groups, there is a problem of leadership in the nano-society structure which is developed by nanotechnology. In this leadership problem, moral scientists and philosophers are shown as leaders for trans-humanists. As expected, scientists or engineers are not led by these groups. The main purpose here is not only the development of technological innovations but also the construction of cultural infrastructure and its prerequisites to prevent alienation (Bainbridge, 2010). In this context, it is expected that individuals who are active in the field of thought rather than technical personnel will lead the leaders of trans-humanists. Experts in this field talk about the development, culture of scientific developments in today's world and the existence of the culture of saving the world (Baird, 2007). In this respect, scientific developments in the field of nanotechnology can serve both cultures in the global sense and in the sense of protecting the world while the point at which point it will be weighted or what point will be taken ahead depends on the tendencies of societies (Baird, 2007).

CONCLUSION

Technology always develops with the curiosity of human learning. The accumulation of knowledge and communication technologies has increased the speed of science and technology. The high level of progress in the field of science and technology, which requires intensive research, has created the "new basic technologies" phenomenon. New core technologies include information technology and generic technologies. Among the generic technologies, nano-technology is at the forefront because of its multiplicity of use, its ability to enable product and process innovation in all sectors, its practicality, its multidisciplinary and synergistic structure and its strategic importance for the world of research. Nano-technology includes completely new materials, products and systems, creating new markets, and is therefore destructive. Scientific discoveries do not change society

in general directly; they can set the stage for the change in the context of developing economic and social needs, resulting from a combination of old and new technologies. As a result of the studies carried out in the 1980s, nano-technology, which was first mentioned in the 1960s, clearly revealed the positive impact of technological developments on competitiveness, has gained importance as a result of the understanding that materials can acquire new and different features as materials become smaller. The innovation of nano-technology, which has positive effects in many industries, and the height of its development rate, makes it difficult to see its impact as a whole. However, the fact that the introduction of nanotechnology will cause a paradigm shift not only in national defense but all aspects of life makes it an important factor to consider from the perspective of national security. The technology will not only improve defensive options but also vastly increase the offensive options in hands of a country's state and non-state adversaries. The reaction of the society to this development will make it easier for us to see the impact of nano-technology. The positive and negative impact of nano-technology on society depends on the reaction of the society to nano-technology. We also must ponder this impact proactively as the societal ramifications of this paradigm shift will have as strong and long – lasting effects in the material side. In order to see its impact on society more clearly, nano-technology needs to take place in more human lives and complete the incubation period.

Nanotechnology will affect the social life positively or negatively like the technologies of the past. Developed countries dependent on technology have begun to consider high-yield nano-technology as one of the priority areas to be supported within strategic plans.

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