

**T.C.
NECMETTİN ERBAKAN ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
ULUSLARARASI İLİŞKİLER ANABİLİM DALI
GÜNEY ASYA ÇALIŞMALARI VE
ULUSLARARASI İLİŞKİLER BİLİM DALI**

**TECHNO-POLITICS IN ASIA:
HI-TECH COMPETITION
BETWEEN CHINA AND INDIA**

UMUT YAVUZ

YÜKSEK LİSANS TEZİ

**DANIŞMAN:
PROF. DR. MURAT ÇEMREK**

KONYA-2021



T.C.
NECMETTİN ERBAKAN UNIVERSITY
SOCIAL SCIENCES INSTITUTE
SOUTH ASIAN STUDIES AND
INTERNATIONAL RELATIONS



**TECHNO-POLITICS IN ASIA:
HI-TECH COMPETITION
BETWEEN CHINA AND INDIA**

Umut YAVUZ

POSTGRADUATE THESIS

Department of International Relations

Advisor: Prof. Dr. Murat ÇEMREK

June 2021
KONYA
All Rights Reserved

BİLİMSEL ETİK SAYFASI



Öğrencinin	Adı Soyadı	Umut YAVUZ		
	Numarası	17811401031		
	Ana Bilim / Bilim Dalı	Uluslararası İlişkiler / Güney Asya Çalışmaları ve Uluslararası İlişkiler		
	Programı	Tezli Yüksek Lisans	X	
		Doktora		
	Tez Danışmanı	Prof. Dr. Murat ÇEMREK		
Tezin Adı	Asya'da Tekno-Politika: Çin ve Hindistan Arasındaki İleri Teknoloji Rekabeti			

Bu tezin hazırlanmasında bilimsel etiğe ve akademik kurallara özenle riayet edildiğini, tez içindeki bütün bilgilerin etik davranış ve akademik kurallar çerçevesinde elde edilerek sunulduğunu, ayrıca tez yazım kurallarına uygun olarak hazırlanan bu çalışmada başkalarının eserlerinden yararlanılması durumunda bilimsel kurallara uygun olarak atıf yapıldığını bildiririm.

DECLARATION PAGE

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Umut YAVUZ

 KONYA	T.C. NECMETTİN ERBAKAN ÜNİVERSİTESİ Sosyal Bilimler Enstitüsü Müdürlüğü	 NECMETTİN ERBAKAN ÜNİVERSİTESİ KONYA SOSYAL BİLİMLER ENSTİTÜSÜ
---	--	--

ÖZET

Öğrencinin	Adı Soyadı	Umut YAVUZ		
	Numarası	17811401031		
	Ana Bilim / Bilim Dalı	Uluslararası İlişkiler / Güney Asya Çalışmaları ve Uluslararası İlişkiler		
	Programı	Tezli Yüksek Lisans	X	
		Doktora		
	Tez Danışmanı	Prof. Dr. Murat ÇEMREK		
Tezin Adı	Asya'da Tekno-Politika: Çin ve Hindistan Arasındaki İleri Teknoloji Rekabeti			

Yüksek teknoloji çağımızda insanları birbirine bağlayan ve yaşamın merkezinde küresel bir kavram haline geldi. Tekno-politika ise politikanın ve teknolojinin siyasete ve haliyle insana bakan yönünü incelemektedir. Asya dünya nüfusunun büyük bir kısmını barındıran ve yüksek teknolojinin siyasette belirleyici olduğu bir kıtadır. Dünyanın en kalabalık iki ülkesi Çin ve Hindistan teknoloji ve tekno-politika konusunda da önemli devletlerdir. Bu iki devletin bölgesel teknoloji odaklı hegemonik rekabetleri küresel siyaseti de şekillendirmektedir. Bu çalışma Çin ve Hindistan'ın havacılık, uzay, siber uzay, mekatronik: robotik, biyoteknoloji ve nükleer teknoloji alanlarındaki politikaları ve küresel rekabetteki durumlarını incelemektedir. Çin ve Hindistan tekno-politik rekabeti sadece iki ülke arasındaki ilişkileri değil bölgesel ve küresel dengeleri de yeniden şekillendirmektedir.

Anahtar Kelimeler: Çin, Hindistan, tekno-politika, ileri teknoloji

 KONYA	T.C. NECMETTİN ERBAKAN ÜNİVERSİTESİ Sosyal Bilimler Enstitüsü Müdürlüğü	 NECMETTİN ERBAKAN ÜNİVERSİTESİ SOSYAL BİLİMLER ENSTİTÜSÜ
--	---	--

ABSTRACT

Author' s	Name and Surname	Umut YAVUZ		
	Student Number	17811401031		
	Department	South Asian Studies and International Relations		
	Study Programme	Master's Degree (M.A.)	X	
		Doctoral Degree (Ph.D.)		
	Supervisor	Prof. Dr. Murat ÇEMREK		
Title of the Thesis/Dissertation	Techno-Politics in Asia: Hi-Tech Competition Between China and India			

High technology has become a global concept that connects people in our age and is at the center of life. Techno-politics, on the other hand, examines the side of politics and technology that looks at politics and human beings. Asia is a continent that hosts a large part of the world population and where high technology is a determinant in politics. China and India, the two most populous countries in the world, are also important states in terms of technology and techno-politics. Regional technology-oriented hegemonic rivalries of these two states also shape global politics. This study examines the policies of China and India in aviation, space, cyber space, mechatronics: robotics, biotechnology and nuclear technology and their status in global competition. The techno-political rivalry of China and India reshapes not only the relations between the two countries but also the regional and global balances.

Keywords: China, high technology, India, techno-politics

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my advisor Professor Murat Çemrek. Without his efforts and encouragement, this thesis would not have been completed.

I also dedicate it to my beloved father, Nihat Yavuz, who passed away at the first month I started to write this thesis.

Umut YAVUZ
KONYA - 2021



ABBREVIATIONS

AAI	: Airports Authority of India
ACS	: American Chemical Society
AD	: Anno Domini
AEC	: Atomic Energy Commission
AFDA	: American Food and Drug Administration
Aramco	: Arabian American Oil Company
AVIC	: Aviation Industry Corporation of China
BC	: Before Christian Era
BCG	: Bacille Calmette Guerin
BIRAC	: Biotechnology Industry Research Assistance Council
CEO	: Chief Executive Officer
CCTV	: Closed Circuit Television
COMAC	: Commercial Aircraft Corporation of China
COVID19	: Coronavirus Disease 2019
DAE	: The Department of Atomic Energy
DCA	: Defense Cyber Agency
DNA	: Deoxyribonucleic Acid
DPT	: Diphtheria-Pertussis-Tetanus
EFB	: European Federation of Biotechnology
ESA	: European Space Agency
FDA	: Food and Drug Administration
FDI	: Foreign Direct Investment
FAA	: Federal Aviation Administration
GCI	: Global Cybersecurity Index
GDP	: Gross Domestic Product
GII	: Global Innovation Index
GW	: Gigawatt
GWe	: Gigawatt electrical
HAL	: Hindustan Aeronautics Limited
H-T	: High Technology
ICT	: Information and Communication Technologies
IAEA	: International Atomic Energy Agency
ID	: Identity
IR	: International Relations
ISRO	: Indian Space Research Organization
IT	: Information Technology
MW	: Megawatt
MWe	: Megawatt electrical
NAL	: National Aerospace Laboratories
NATO	: North Atlantic Treaty Organization
NGO	: Non-Governmental Organization
NPT	: Nuclear Non-Proliferation Treaty
NRC	: Nuclear Regulatory Commission

NTNU	: Norwegian University of Science And Technology
OECD	: Organization for Economic Cooperation and Development
PhD	: Doctor of Philosophy
R&D	: Research and Development
SEZs	: Special Economic Zones
STEM	: Science-Technology-Engineering-Math
TRACES	: The Research Technology in Retrospect and Critical Events in Science
UNESCO	: United Nations Educational, Scientific and Cultural Organization
UK	: United Kingdom
UN	: United Nations
US	: United States
USA	: United States of America
USD	: United States Dollars
WHO	: World Health Organization
WIPI	: World Intellectual Property Indicators
WIPO	: World Intellectual Property Organization
WNISR	: The World Nuclear Industry Status Report
WTO	: World Trade Organization
WW I	: 1 st World War
WW II	: 2 nd World War

LIST OF TABLES AND FIGURES

Tables

Table 2.1.	List of Aerospace Exporting Countries in 2018.....	44
Table 2.2.	List of Top 50 aerospace companies by revenue 2018 (\$ millions)....	45
Table 2.3.	GCI Most Committed Countries Globally in 2018	48
Table 2.4.	Level of commitment for cybersecurity (High).....	49
Table 2.5.	Level of Commitment for Cybersecurity (Medium).....	50
Table 2.6.	Level of Commitment for Cybersecurity (Low).....	50
Table 2.7.	Rainbow Code of Biotechnology.....	58
Table 2.8.	Market Share of Biotechnology Companies 2019	58
Table 2.9.	Share of Total Pharmaceutical R&D 2016.....	59
Table 2.10.	Nuclear Reactors Under Construction (as of 1 July 2019).....	63
Table 3.1.	Biotech Companies in China.....	90
Table 3.2.	Industrial Robots: Countries with most Installations.....	100
Table 3.3.	Hi-Tech Competition Between China and India.....	106

Figures

Figure 2.1.	Geographical Commitment to Cybersecurity	49
Figure 2.2.	Number of Installed Robots per 10.000 Employees in the Manufacturing Industry 2016.....	53
Figure 2.3.	Number of Installed Robots per 10.000 Employees in the Manufacturing Industry 2016 (Continued).....	53
Figure 2.4.	Annual Installations of Industrial Robots by Regions.....	54
Figure 2.5.	Number of Operable Nuclear Reactors 2019	61

TABLE OF CONTENTS

DECLARATION PAGE	iii
ABSTRACT.....	v
ACKNOWLEDGMENTS	vi
ABBREVIATIONS	vii
LIST OF TABLES AND FIGURES.....	ix
TABLE OF CONTENTS	x
INTRODUCTION	1
CHAPTER 1.....	4
TECHNO-POLITICS: AMALGAMATION OF TECHNOLOGY AND POLITICS	4
1.1. What is Technology?	4
1.1.1. Science-Technology Distinction.....	6
1.1.2. The History of Technology.....	9
1.1.3. The Philosophy of Technology.....	15
1.1.4. Techno-optimism vs. Techno-skepticism.....	17
1.1.5. Social Involvement and Organization in Technological Advance	19
1.1.6. The Future of Technology	20
1.1.7. International Relations (IR) and Technology	22
1.2. What is High Technology (H-T)?.....	23
1.3. What is Politics?	24
1.4. What is Techno-Politics.....	31
1.4.1. Techno-Politics and Globalization.....	34
CHAPTER 2.....	40
HI-TECH AND ITS REFLECTIONS IN ASIA	40
2.1. The Hi-Tech and Its Main Fields	40
2.1.1. Aerospace.....	40
2.1.2. Cyberspace.....	46
2.1.3. Mechatronics: Robotics	51
2.1.4. Biotechnology	55
2.1.5. Nuclear Technology.....	59
2.2. The Hi-Tech Reflections in Global Politics.....	64
CHAPTER 3.....	70
HI-TECH COMPETITION BETWEEN CHINA AND INDIA.....	70
3.1. China and Hi-Tech.....	70
3.1.1. Aerospace in China	83

3.1.2. Cyberspace in China	85
3.1.3. Mechatronics: Robotics in China.....	86
3.1.4. Biotechnology in China	88
3.1.5. Nuclear Technology in China	90
3.2. India and Hi-Tech	92
3.2.1. Aerospace in India	96
3.2.2. Cyberspace in India	98
3.2.3. Mechatronics: Robotics in India	99
3.2.4. Biotechnology in India.....	101
3.2.5. Nuclear Technology in India	104
CONCLUSION	107
BIBLIOGRAPHY	111



INTRODUCTION

For many of us, technology mostly means gadgets from smart phones to rockets launched into their orbits at space or gene maps at best. Of course, these examples are extensions of technology. Historically, the very first technological examples have been simple tools used in prehistoric times found in archeological excavations. Thus, one of the features distinguishing humans from other living things is its ability to make superior tools. However the ability to make tools is not a unique human feature since some animals can also devise tools in simple sense.

Technology is often described as an art used to achieve a goal or desire. Thus, it has a vital value in this respect. Likewise, politics is defined as an art of possibilities in Bismarck's words¹. In Aristotle's words² "man is a political animal" emphasizing both social and coercive aspects of us. In short, politics is not only processed in parliaments or at party rallies but appears in every aspect of life. In all relations, one may observe humans acting either seeking power or keeping power. Thus, behaving politically is a natural feature of man. These features make politics and technology go hand in hand to provide us easing our lives.

The concept of techno-politics is a relatively new compared to technology and politics. However, it has recently become one of the important factors determining world politics. Techno-politics is composed of technology policies or policies influenced and directed by technology, is directly related to technological developments, political events, international relations, and so forth.

Problematique and Limitations

This study examines techno-politics composed of two important fields of technology and politics together, with reference to Asia, the most populous continent in the world focusing on China and India. To this end, a brief history of technology and politics will be examined, and related theories will be put forward firstly. Then techno-politics will be explained not only in domestic politics but also with reference to international relations. In particular, high-tech competition in the Asia will be emphasized through China and India within the scope of ownership and the relevant

¹ "Politics is the art of the possible." (Originally in German: "Die Politik ist die Lehre von Möglichen.") Otto Von Bismarck (1815-1898)

² "Man is by nature a political animal." Aristotle

policies. High-tech is mostly comprehended through aerospace, cyberspace, biotechnology, mechatronics, robotics, and nuclear technologies. Last but not the least, globalization as a process and its concomitant relations with technology will also be discussed.

One may say that techno-politics has the ability to determine future of politics in general and international relations in special not only in Asia but also globally. So what will be the future of H-T competition in Asia? This question is closely related with its connotations in the world for sure. Will either China or India dominate the whole world? Will technology globalize us further and to what extent? To what end H-T competition could lead world? This study aims to answer such questions.

Regarding technology there is no limit for improvements and innovations. Thus, study proposes the following hypotheses:

1. Techno-politics is one of the most important areas of competition in international politics and will continue to be so in the future through turning international politics into global governance.

2. Hi-tech competition between China and India is at the center of a new rivalry in the field of international politics not only regionally specific to Asia but also globally through its ramifications.

3. Hi-tech is not only global but also globalizing in essential terms.

This study is to contribute to literature through research on the role of techno-politics in international relations (IR). Analyzing the H-T competition between China and India will be accompanied by review of related literature and data gathering about competitive countries' technological advances and innovations. This study will employ qualitative methodology through analyzing technological innovations to help us determine current situation about techno-politics in Asia. The qualitative method will be based on discussing the subject matter through data collection based on books, journal articles, thesis, official and non-governmental organizations' statistics as well as online sources discussing techno-politics in Asia.

Of course, there are some limitations before this study. First of all, we focus on political preferences in production and use of technology. Another limitation is the difficulty reaching a clear picture of some particularly H-T issues. It should be kept in mind that countries may have secret projects carried out in areas such as nuclear or

cyber warfare technologies as well as secret projects run by some private companies either under state supervision or not. Thus, we compiled all data and information from public reports and indexes published by governments, companies, research institutions as well as international organizations. Another limitation is the five main topics we chose to review in high technology as aerospace, cyberspace, biotechnology, mechatronics: robotics, and nuclear technology. These topics have been chosen since they are the most politically and strategically important technology areas for states. Accordingly, this thesis will examine the abovementioned concepts in the following chapters:

The first chapter focusing on the theoretical and historical aspects of technology will also analyze high technology as well as politics. The second chapter will discuss main fields of high technology as aerospace, cyberspace, mechatronics, robotics, biotechnology and nuclear technology covering their effects in global politics. The third chapter evaluates high technology policies of China and India. Then in conclusion we will make a general inference about the hypotheses of this study.

CHAPTER 1

TECHNO-POLITICS: AMALGAMATION OF TECHNOLOGY AND POLITICS

1.1. What is Technology?

Technology is probably one of the most popular terms frequently used from daily talks to scholarly papers of our age. However technology mostly means gadgets from mobiles to navigators and/or internet surrounding our lives. Before discussing the results of technology we need to comprehend its historical and epistemological origins. When we look at the course of the term in history we observe the of usage frequency has changed dramatically in the last two centuries.

Technology, used in the same sense in most of the world languages, is undoubtedly a global term (Buchanan, 2019: 2) having firstly appeared in English sources in the 17th and 18th centuries. Jacob Bigelow's *Elements of Technology* is considered as the first book in English covering "technology" in its title (Volti, 2009:4) prepared in a glossary format including technical terms for the ones studying mechanics, chemistry, mineralogy, engineering, architecture, economics and even fine arts. Bigelow (1829:12) finds "technology" as an inclusive term that meets practical aspects of all these sciences and arts previously found in some dictionaries .

Origins of the technology go back to ancient Greek etymologically as the term is composed of "techne" (Greek: τέχνη) and "logia" (Greek: λόγια). While "techne" means "art and skill" and "logia" is the diminutive form of "logos" meaning "word or saying". In short, technology means "the knowledge of art and skill." According to *The Meriam-Webster Dictionary*, technology means "the practical application of knowledge especially in a particular area," "a manner of accomplishing a task especially using technical processes, methods, or knowledge" or "the specialized aspects of a particular field of endeavor". For Carroll (2017:6) who had made a comprehensive definition of technology from a pragmatical perspective, technology is "something created through ordering exhibiting organization, whose aspects function with a purpose that can provide some benefit," or "something that is organized (implying creation of order) whose aspects function with a purpose that can provide some benefit". Bain however argues that, "technology includes all tools, machines, utensils, weapons, instruments, housing, clothing, communicating and transporting

devices and the skills by which we produce and use them” (1937:6). French philosopher Stiegler gives us two definitions. The first one is “the pursuit of life by means other than life,” and the second is an “organized inorganic matter (1998:22). However, Stiegler makes an exception and put that “biotechnology” can not be defined as “organized inorganic matter” anymore because it is “organic” so it must be defined as “the reorganization of the organic. (Demoule & Stiegler, 2008:23). Technology mostly refers tools and machines solving our practical problems via easing our lives. Thus, Arthur defines technology as a tool for fulfilling a human purpose (2009:28).

According to Schatzberg, science historian, technique and technology had two distinct meanings in continental Europe until the 1930s. The former had already focused more on methods, procedures, practices and applications while the latter was more concerned with the theory behind these practices, or rather the principles. However, this critical distinction disappeared when social scientists led by the American sociologist Thorstein Veblen who popularized technology in the 1930s without taking the earlier distinction into account (Schatzberg, 2006:486).

Some scholars, such as Brey working on the philosophy of technology, have made the distinction between natural and technical. According to him, although difficult to define technology, people will be able to easily understand whether something is natural or technological when it occurs (1997:56). However, it has remained unclear whether we will separate between “technological and natural” or “artificial technology (man-made) and natural technology.” According to Carroll, objecting Brey, we have two possibilities. First, if something is natural, it is not technology or vice-versa. Second, if something develops spontaneously it is natural technology and if it is human-made, then it is artificial technology. In this case, under a superordinate definition of technology, there are natural and unnatural (human-made) subcategories of technology (Carroll, 2017:2).

On the other hand, according to science historian Fara, the term “technology” use has increased in the 19th century since it has earlier meant sense of handicraft rather than mechanical activities before the Industrial Revolution. In other words, technology meant more “craft” at that time (Fara, 2009:63). Experts advocating the emergence of ancient technology triggered and especially after some critical turning points such as the ability to use hands caused to consume more protein and finally

become the main reason to have a larger brain. Humans are not the only creatures using tools because some chimpanzees, vultures, or some insects will pick up a stick or stone to reach food. However, only humans could not survive without tools and could not become what they have become throughout history (Headrick, 2009: 1-17).

Carroll discusses that, technology has always been a concept of intelligence so only humans or other intelligent creatures can grasp it. It is also something designed and discovered while serving a particular purpose from a purely secular perspective. Technology is a phenomenon revealed through minds with serious benefits and serves a purpose such as easing our lives or other practical benefits (Carroll, 2017:18).

Volti is one of those who define technology without complicating it. At first, he refers to the need for “organization” and “system” for creating new technology. Because he thinks that technology is a combination of devices, skills, and organizational structures so it looks like a “system.” Moving from this point, he defines technology as “a system created by humans using knowledge and organization to produce objects and techniques for the attainment of specific goals.” Then he makes an addition to this definition and implies that sometimes technology does not only meet the current needs; but it also can create new needs for its development (Volti, 2009:6). Thus, we can leave the definitions here and move on to other technology-related issues.

1.1.1. Science-Technology Distinction

The difference and the distinction between science and technology is one of our concerns. Many definitions of technology imply that it is generally based on the application of knowledge, while science is accepted as the theory and principles behind applications (Volti, 2009:58). However, it should be noted that historically, there has not always been a deterministic relationship between technology and science. Because while some technologies have developed in time, scientific theories behind them have put into practice unconsciously. For example, although the architectural, astronomical, and agricultural practices in ancient Egypt and Greece were highly developed, we can see that there has not been a lot of scientific studies in current sense (Fara, 2009:17-66). According to the historians of science, science and witchcraft were not two separate fields in the first periods of history. Alchemy and chemistry, astronomy and astrology, physics and metaphysics, medicine and witchcraft were intertwined. It is known today that even Isaac Newton conducted alchemy experiments. This complex

relationship between science, magic, occultism, and alchemy actually shows that practices and scientific principles develop side by side in a non-parallel way. While the contribution of Romans to scientific knowledge was limited, they were highly skilled in engineering and architecture as they have built magnificent aqueducts and bridges. On the other hand, during the scholastic orientation in Europe in the Middle Ages, architectural and engineering works still fascinates everyone even when the value given to scientific knowledge was at the lowest level. For example, blacksmiths of the period used a superior steel technology in the Middle East compared to Europeans. Traditional iron craftsmen were able to produce this steel using traditional methods. The metallurgical secret of this solid steel type, called Damascus steel, was only fully understood in the 20th century. Thus, science and technology have not always developed hand in hand. This rift between technology and science has continued for many centuries.

The 16th and 17th centuries were the years when scientific development accelerated. However, technological breakthroughs would have to wait another two hundred years. Perhaps our age is one of the rare periods in which science and technology are progressing together. Today, the production of scientific knowledge and technological developments continue at great speeds (Volti, 2009:59).

At this point, it is necessary to mention a period that has profoundly affected the history of science. During this period, called the Scientific Revolution, advances in basic sciences such as mathematics, physics, astronomy, biology, and chemistry transformed humanity's views on nature and are considered to be a series of events that determined the emergence of modern science in the early modern period. The Scientific Revolution took place in Europe at the end of the Renaissance and influenced the intellectual movement called the Enlightenment, which coincided with the second half of the 18th century. It is generally accepted that the scientific revolution began with the publication of Nicolaus Copernicus's *De Revolutionibus orbium coelestium* (On the Revolutions of the Heavenly Spheres) in 1543. Important scholars of this period include Nicolaus Copernicus (1473-1543), Galileo Galilei (1564-1642), Johannes Kepler (1571-1630), René Descartes (1596-1650), Tycho Brahe (1546-1601), and Isaac Newton (1642-1727). Also in this period, empiricism and research have been accepted as the main approach in the scientific point of view

with the influence of philosophers such as Hobbes, Berkeley and Hume in terms of philosophy of science (Fara, 2009).

In a research called Project Hindsight, conducted by the US Department of Defense in the mid-1960s, the role of scientific research in the development of the twenty most important weapon systems was questioned. In the development of the weapon systems selected for this research, important scientific findings were examined step by step backward, and it was revealed that only two of the 710 cases recorded were obtained as a result of basic scientific research. This rate is as low as 0.3 percent. On the other hand, the invention rate that emerged within the scope of a military project was determined as 6.7 percent. 2 percent was the result of studies for such commercial purposes and non-military needs. The remaining 91 percent of the discoveries are based on the existing concepts and principles rather than scientific research. This research shows us that some technological advances have little to do with basic scientific research (Sherwin & Isenson, 1967:1571). Similar results were obtained in another study conducted in the UK. The technology companies have won the Queen's Award for Industry were analyzed and the results of this research confirm the Hindsight Project. In other words, very few industrial innovations and achievements were found to be related to scientific research. Utterback, who conducted the research, says: "Basic research does not seem to be significant as a direct source of innovations (Utterback, 1974: 622)". These two studies prove to us that there is not always a direct relation between science and technology. However, another research conducted against the findings of Project Hindsight states that different results could also be reached. The research *Technology in Retrospect and Critical Events in Science (TRACES)* argues that many products of current technology are based on previously unearthed scientific findings. However, there is still no linear relationship between the two. Thus, there is a two-way and non-linear interaction between technology and science (IIT Research Institute, 1969:6).

To summarize, science is often concerned with whether something is right or not in Aristotelian sense. In comparison, technology is about whether something functions or not. Because technological obstacles, mostly technical, can be overcome by a very little understanding of the principles lying behind the problem. Let us conclude this section with Volti's summative statements. Volti argues it is obvious that

technology uses scientific information widely today. However, scientific knowledge enters technological applications quite indirectly. At the same time, most scientific advances result from previous successes in technology. Science and technology have often evolved in separate ways, but these ways often intersect. They also contributed to each other at these intersections. It provides the best progress when both science and technology are in close contact. However, it should not be denied that they are different enterprises (Volti, 2009:72).

In short, we can understand that it is possible to have some technological developments without advancing much in the scientific field. The practical work and organizational aspect of technology make this possible. For this very reason, some nations in history have been able to have some technologies through their practical applications and have come to the fore. Ancient Egyptians are the best example of that we will be able to see this more clearly when talking about the history of technology in the following section.

1.1.2. The History of Technology

The limitation of the studies on the evolution and development does not yet allow a clear narrative of history. Our main question is: What are the most critical developments in the history of human technology?

Unfortunately, it is difficult to give a clear answer to this question. However, it is still possible to make a list. First of all, *Homo Sapiens*, described as a modern human being, is believed to have left his homeland in Africa 60,000 years ago and destroyed all other humanoid species in 40,000 BC (or 25,000 BC) including Neanderthals and Java man. At that time, there was the Ice Age that affected all living things. Moreover, the influence continued until the 14,000s BC (Morris, 2010:94). The transition from the *Homo Erectus* (1.8 million years ago) to the *Homo Habilis* making the first sharp-edged stone tool is considered as the first for the history of technology. On the other hand, *Homo Erectus'* ability to control fire is also an example of the use of technology to protect himself from wild animals, surviving in cold, and consuming more protein by cooking the meat he hunted and thus accelerating brain development. *Homo sapiens*, means "wise man" and being "wise" has become a *sine qua non* for the development of science and technology (Headrick, 2009:3).

According to archaeologists, the Neanderthals, lived around 70,000 BC, were the first to make and use instruments systematically. Later on, Cro-Magnons (35,000 BC) introduced more complex tools. Neolithic period (6000 BC) in which the techniques for pottery making were developed and Iron Age people (3000 BC) using metal tools are the early examples of advanced technology of its time. (Buchanan, 2019: 5-6)

One may observe that ancient humans were all about producing primitive and simple technologies; pioneering to produce higher technologies. Then what has transformed the ancient *Homo Sapiens* into modern humans? Headrick (2009:6) states that their bodies and brains were identical, so the change must have been purely cultural. Headrick adds that currently and before, all people expressed their ideas in both language and works. The sudden change in *Homo Sapiens'* life may have occurred when he learned to speak. If so, it is understood why people all over the world suddenly began to express themselves with symbols and also act creatively. They learned languages, symbols, and abilities from each other. The cultural evolution, dependent on biological evolution for millions of years, has become free to go forward. With the advent of symbolic expression, human culture has never slowed down but always found new ways to do things more subtly (Headrick, 2009:6).

The discovery Agricultural Revolution is considered a turning point in the history of science and technology. Humanity discovered agriculture at the end of the Neolithic period, or the period of the New Stone Age, dating back to 10,000 years ago. Humankind, hunter and gatherer until then, experienced a huge population explosion with the agriculture and received the opportunity to move from nomadism to settled life. The earliest agricultural societies lived in Egypt and Mesopotamia, the Fertile Crescent. However, there are some views arguing that simultaneously, farming also began in places like Central America and China (Harari, 2014). According to Harari (2014), agriculture led people to produce more food than they needed and thus could feed more individuals. The domestication of animals, along with agriculture, increased both agricultural and transportation opportunities. The combination of surplus food with new transport opportunities has led more and more people settling in villages, towns, and even the early forms of cities. In the meantime, trade movements emerged, paving the path to record-keeping and the development of writing. Harari attributes all

these developments to the human ability to communicate and to collaborate acting as a community. Besides, the ability to talk about things and the ability to produce fiction made humankind unique. According to Harari, fiction has enabled us not only to imagine something but also to do it collectively. Unlike animals, man can cooperate flexibly with an infinite number of strangers. For this purpose, it can establish villages, cities, states, companies, so achieve great works (Harari, 2014).

When we talk about agriculture and transportation, the invention of wheel, one of the earliest examples of technology, is a major part of our lives today, worths to be mentioned. According to archaeologists, around 4,000 BC, the wheel was invented simultaneously in Mesopotamia and Central Europe. Undoubtedly, the invention of wheel led to a revolution in trade and war technologies (Anthony, 2007:65). The dog was probably domesticated before 14,000 BC. Nevertheless, it was necessary to wait 8000 years to tame the horses with cattles (Morris, 2010:62). With the agricultural society, the concept of civilization has emerged. The period that Headrick dates from 4000 BC to 1500 BC is also called Hydraulic Civilizations. Historians and anthropologists generally define civilization as multi-populated communities living under a system or organization (state). Thus, civilizations emerged in Egypt, near the Nile; in Mesopotamia, around the Tigris and the Euphrates; in China, around the Indus river, and in the Americas famous for its rains (Headrick, 2009: 17). During 1500 - 500 BC, it was an era dominated by iron, horses, and empires. The civilizations around Assyria, Persia, Rome, China, and India became great empires thanks to their iron processing skills and their ability to use horses. For example the Roman Empire was such a hydraulic civilization, through the cities and aqueducts they built as unique. Population growth, war technologies using iron and the development of agricultural technology allowed these empires to feed more people so they could establish larger armies and dominate larger areas in return. With the taxes collected, they could build roads, cities, and so forth. This was a period of highly developed engineering and architecture (Headrick, 2009: 41).

There is an important point that the philosopher Karl Jaspers points out about this period. He points out that Buddha (563-483 BC), Confucius (551-479 BC), and Socrates (469-399 BC) lived very far from each other but as the most important thinkers of the period he called "Axial Age" (800-200 BC). Jaspers describes this age

as "a deep breath that allows consciousness to surface in its most vibrant form (Jaspers, 1953:51)." He argues that philosophers living in that era have revolutionized the thought schools of Indian, Chinese, and European civilizations.

During 500-1400 AD is the period of post-classical and medieval revolutions. When Chinese and Arabs came to the forefront, especially in agriculture and irrigation techniques beside their far traders. This level of prosperity also led Arabs to make groundbreaking discoveries in the fields of mathematics and chemistry. For the European continent, these periods are called the dark ages. The Dark Age is a periodization of history traditionally referring to the Middle Ages and suggesting that a demographic, cultural, and economic deterioration occurred in Western Europe after the collapse of the Western Roman Empire. However, the development of horseshoe techniques in Europe and the breeding of larger and stronger horses also led to a serious development in agriculture and later in warfare techniques (Headrick, 2009: 51-58). According to Fara (2009: 82), the early seeds of science emerged in Europe in the 15th century, when aristocratic feudalism evolved into capitalism. Islamic civilization also has played a major role in the development of the modern science. From a Western perspective, science entered Islamic culture for the first time in the 8th century when the caliphs ruling Baghdad began to pour money into science. At that time, the Arabic language had become a language of science along the Mediterranean coast and up to China. In the 12th century, this dynamism of the Arabs in science passed to Europe with translations of ancient Greek texts from Arabic to Latin. Muslims' groundbreaking research in mathematics, astronomy, medicine, and optics has evolved into Scientific Revolution in Europe that would end up with the Renaissance (Fara, 2009: 75-112).

As Western seamen sailed with developing navigation techniques, geographical discoveries and colonization began in the world. Light, maneuverable, and fire powered ships made Western sailors the sole hegemony in the oceans. Simultaneously, the idea of reformist Christianity developed in Europe following the medieval scholastic thought triggered scientific developments since the Catholic Church has lost its political power blocking such innovations and scientific research. It can be said that the Renaissance, meaning rebirth, has a direct relationship with technology rather than the Reform. With its symbolic scholars like Da Vinci and

Galileo, the Renaissance flung the flag of science and technology to fluctuate for a long time in Europe (Buchanan, 2019: 26-27).

The paper and printing techniques, one of the main reasons for the rapid dissemination of knowledge and thus technology, first appeared in China. The Chinese used paper money for the first time in 1024 and they also became the first and largest bureaucracy in the world. Muslims continued to use manuscripts until the early 18th century. Printing started with Gutenberg in 1453³ in Europe and spread rapidly in the following centuries. Technologies such as maritime, navigation, firearms, paper, and printing have been widely used in Europe as well as in the Middle East Islamic world and China. On the Asian side, however, technological innovation compared to Europe would have stood for centuries. Historians of science, such as Headrick (2009), attributes this to the destructive Mongol raids. Indeed, the Mongol raids beginning in the 13th century had destroyed the Middle East and China and burned down the knowledge of the centuries (Headrick, 2009: 87). During 1300 and 1800 AD was the time of momentous developments and discoveries; the relations between people were both the result and reason of the basic technological innovations of the period. A surprisingly large amount of these innovations was born in China, spread throughout the Islamic world, and then reached Europe. In the 15th century, the technological creativity of China and the Islamic world slowed down. However, thanks to the competitive nature of European society, technology has developed rapidly. In particular, technologies in the naval and military fields have improved a lot, vital for exploration and trade. In addition, great innovations were experienced in plants and animals, paper and printing technologies as well as many other technologies (Headrick, 2009:89).

The era between 1750 and 1869 is generally called the first period of the Industrial Revolution (Headrick, 2009:91) centered in England. The Industrial Revolution, beginning with the use of steam power in mass production led to rapid mechanization and evolved into the second phase of Industrial Revolution with the active adaptation of electricity. These dizzying developments quickly led great

³ This date coincides with the conquest of Constantinople by the Turks. After the conquest, the scientists escaped from here took refuge in Europe.

discoveries in the fields of medicine, chemistry, physics and engineering. Along with electricity, communication triggered through telegraph, telephone, and ultimately radio and television and of course after the steam train vehicles such as cars and planes have become a part of daily life.

The Industrial Revolution has rapidly changed and transformed the world in a few decades. In less than a hundred years, humankind has discovered ways to develop products quickly and inexpensively. However, industrialization has also given nations that hold it the opportunity to gain power over others (Headrick, 2009: 109-110).

The social impacts of the Industrial Revolution are also worth mentioning. With the industrialization that showed its first effects in Britain, concepts such as labor force, crowded cities, a need for a more efficient transportation system, child workers and the difficulties of work-life entered the agenda of societies. These problems, which we see vividly in the works of the British writer Charles Dickens, who also had to work in the factory at a very young age, were the subjects of the lives of the workers and the poor class who lived in heavy working conditions in England and were oppressed on the streets of London. Describing the difficulties of being a child in the streets of London with *Oliver Twist*, a character created by Dickens, working under poverty and difficult conditions throughout his life and, *David Copperfield*, another character of Dickens, who is crushed under class differences, difficulties of life, Dickens has opened the way for the social reforms of the Victorian society with his narratives (Oshi, 2015: 53-84).

With the industrial revolution, the rivalry between societies grew with the need of controlling more resources and producing more for larger communities, the way to WW I was opened. In WW I, new war technologies also developed rapidly. With innovations, combat techniques have changed dramatically. In this period, especially in the field of weaponry, biological weapons such as tanks, submarines, warplanes and poisonous gases started to be used, and with the use of smokeless gunpowder, there was a breakthrough in weapon technology. Indirect fire systems which allow shooting at an unseen target, the joining of new war vehicles to armies both in sea and air, the development of communication tools such as typewriters, carbon paper, radio and telegraphs easing to manage large armies, and the introduction of trains instead of

horses in terms of logistics, etc. points the technological aspect of WW I (Tucker, 1998: 11-16).

It is a historical fact that wars and military needs contribute to the development of technology. Before 1940, nuclear physics was a theoretical branch with little practical application. However, the claims that the Germans were developing a nuclear bomb during the WW II led to the start of a secret nuclear study in the USA under the Manhattan Project. The USA transferred 2 billion \$ to this project, and 43,000 people took part in it including the world famous Einstein in the early steps. As a result, one of the most painful consequences of technology the atomic bomb was produced and the USA used two of these bombs against Japan, killing tens of thousands of people in Hiroshima and Nagasaki resulting in the retreat of Japan from the WW II. During the WW II, a device accepted as the first computer was developed in Germany produced only for military purposes. WW II has also accelerated rocket technology. German physicist Hermann Oberth produced the first rocket sample in 1927, the V-2 rocket, produced in 1942, first climbed to an altitude of over 100 kilometers and was used in the bombing of London. Another technology produced during the WW II is antibiotics that are widely employed in pharmacology. After the first successful use of penicillin in mice in 1942, then in 1943, the British and American armies used antibiotics to protect most of their soldiers from infection (Headrick, 2009: 130-134).

1.1.3. The Philosophy of Technology

We have stated that science and technology have developed independently in history while practical needs sometimes lead to technological developments without scientific knowledge. However essentially science and technology are interconnected areas. In this respect, when discussing the philosophical aspect of technology, one needs to talk about science. Thus knowledge is one of the most fundamental subjects of philosophy. The word “episteme” (Greek: ἐπιστήμη) means "knowledge" in Greek while “logos” (Greek: Λόγος) is literally "word" so epistemology is a theoretical branch of philosophy that studies knowledge (Cevizci, 2007:54).

There are four sources of knowledge: Rationalism, Empiricism, Rationalist Empiricism, and Intuitionism. Rationalism asserts that intelligence is the sole source and test measure of knowledge, while experientialism refers to experience rather than

reason when explaining the source of knowledge. On the other hand, the rationalist empiricism view that reconciles them thinks that both have joint contributions at the source of knowledge. The opposing view of knowledge based on reason and experience is intuitionism, which claims that the source of knowledge is our intuition (Cevizci, 2007: 55-57).

When it comes to the philosophy of science, it is necessary to talk about the separation of scientific branches from philosophy. According to Cevizci (2007), the process of separation of sciences from philosophy began with the Scientific Revolution (SR) initiated in the 17th century by Galileo, Kepler, and Copernicus. Charles Darwin's book *The Origin of Species*, written in 1859, separated biology from philosophy. In the early 20th century, psychology was separated from philosophy. Here we see that in defining the universe, science first replaced religion and then philosophy. Let us remember the distinction between "techne" and "logos" that we mentioned in the first definitions of technology.

Auguste Comte, the founder of positivism, did not rely on religious and philosophical systems or metaphysics, but only on knowledge based on experience and considered natural science as the real paradigm of knowledge (Cevizci, 2007: 66).

According to Harari, our success in science brought ambition and greed, and our new achievements led us set more daring goals. Since technology ensures us living in harmony with unprecedented levels of prosperity and health, humanity's new goal will be immortality, happiness, and ultimately divinity. He argues that we have reduced deaths caused by hunger, disease, and violence, we can now try to overcome aging, even death and even we can elevate people to the level of God and turn *Homo Sapiens* into *Homo Deus* (Harari, 2016: 32). This level of knowledge and technology, where Harari raises the bar considerably, is called H-T today.

When we look at some of the philosophical trends about technology. Technicism is based on the idea that the use of technology will lead to better societies (Breslin, 2011:2). Accordingly, humanity will be able to overcome all problems using technology. Transhumanism and singularitarianism arguing that technology is generally good for society and human beings. Ones discussing that the singularity in technology will be achieved, claim that people can produce divine artificial intelligence for the benefit of humanity (Grossman, 2011:6). On the other hand, not all

philosophical views on technology are optimistic. Skeptics claim that technological societies are inherently flawed. According to them, it is inevitable for such a society to be deprived of their liberty and psychological health at the cost of being more technological. In the early 19th century, Luddism became one of the anti-technology philosophies having trended in Britain breaking machines to protest. Today, some Neo-Ludists are also skeptical of technological development. Some of the famous dystopias include Aldous Huxley's *Brave New World*, Anthony Burgess's *A Clockwork Orange*, and George Orwell's *1984* books are popular items that critically look at a technological future.

1.1.4. Techno-optimism vs. Techno-skepticism

Two main approaches emerge in the development and use of technology affecting people and the planet. These can be classified as “techno-optimism” and “techno-skepticism”.

The main assumptions of the techno-optimism are:

- The general direction of technological development is always towards the right and positive.
- The benefits of technology are more than its risks.
- Progress will correct problems caused by existing or past technologies.

Conversely, techno-skepticism supporters express the following views:

- Technological development is a flawed concept.
- Technological development to be under the management of powerful companies and states is anti-democratic.
- Technological solutions to be always produced for social and environmental problems is a dangerous illusion (The Open University, 2016:17).

Techno-optimist viewers think that technology is generally neutral and historically inevitable. This brings us to the relationship between techno-optimism and technological determinism that has emerged through advances in biological and social sciences in the 18th and 19th centuries hand in hand with the widespread belief in modernity and development. The technological determinism positions human and

social factors as a mediator of inevitable technological developments (The Open University, 2016:18).

Subsequently, the softened versions of this view is that human and social factors influence or direct the timing of technological developments. As a result, human development is seen as dependent on technological development. Believing that technology will find solutions to all the problems of humanity, whether personal or social, makes people feel comfortable and free. A coffee machine, a smartphone or an electric car are examples of technologies easing life. However, it should not be forgotten that technology can also become a tool of control, oppression, and exploitation. That's why there are those who object to chip ID cards or Big Brother-style CCTV cameras reminding us of those like in Orwell's *1984*.

The human factor has a say in the design and function of technology and thus guides it. However, as the idea of technological determinism gains power, this is seen as an illusion and the effect of human and social factors are mostly ignored.

Apart from technological determinism, there are also other views. One of them is the socio-technical perspective that gained popularity after the 1960s (Mumford and Ward, 1968:46). This view in parallel with the transformative power of technology, as in the technological determinism, the importance of variations in the context of the development and application of technology is emphasized further. The impact of the social dimensions in the establishment of technology and technical systems is also emphasized. These view holders, who could not oppose the view that technology with its transformative power is inevitable, only made a contextual addition to technological determinism with a human-centered approach. This is interpreted in the sense of finding a middle ground with technological determinism.

The owners of social construction and social shaping perspectives include a more fundamental challenge to the technological determinism than the socio-technical approach view. Accordingly, social processes determine the form and content of technological knowledge and change. Thus, no development is purely technological but has also social and technical phases. Thus, they examine relations between the technological and the social and try to explain these relations. More importantly, technological development is not inevitable for them so they try to socially understand why some technologies are developed, for example, why bicycles, washing machines,

or computers are produced. They investigate the power relations in society and their control on the use and development of some technologies (Knights and Murray, 1994: 21).

It is possible to accept that social and technical processes as well as technology and policy affect each other. That is, there is a way between technological determinism and social construction. Because this is a dynamic process while technology keeps its own social course and politics has its own technical course. These two fields guide and change each other. The correct approach could be the middle way in between views.

1.1.5. Social Involvement and Organization in Technological Advance

According to Buchanan (2019:3), there are three points compulsorily at including social involvement in technological innovation: Social needs, social resources, and a sympathetic social ethos. Buchanan states that social needs must be strongly felt or people will not devote resources to technological innovation. For example, military needs have always stimulated technological innovations. Social resources should be ready for scientific innovation expenditure. Many technological developments in history have not taken place because the material or human resources to realize them are not available. Da Vinci, for example, had dozens of mechanical projects, but very few of them could be realized. So there must be a society to back up the ideas as well as available social resources and finally a sympathetic ethos, an environment open to new ideas to realize technological advances (Buchanan, 2019:3).

According to Volti (2009:324), technology leads to the formation of an organization while it is the result of an organizational structure simultaneously. Therefore, there is a direct and bilateral relation between organization and technology. People work as organized in laboratories or factories. Each individual brings his/her cultural and personal values to the organization affecting the organizational structure so the technology (Volti, 2009: 325). Volti (2009:326) also suggests that organizations can influence technological change and drive the need and demand for a specific technology. The production preferences of a few companies dominant in a technological field can affect all production processes, demands and supplies in that field. Thus, it will not be difficult to say that there is a symbiotic relationship between technological innovation and organizational structures. Volti also reminds us that state,

also shape technology and they often decide what kind what amount of technology its citizens should receive. It is of great importance for governments to distribute patents, to give technological incentives and to develop appropriate policies for technology production (Volti, 2009: 339).

In this sense, it is possible for states to hold the power of the society and to direct its organizational force and financial possibilities to certain areas of technology with political preferences in terms of technology. Here, the political preferences of the states will come to the fore, and we will examine what kind of factors they can be affected by the technology policies in the following sections. One needs to talk about the vital role of multinational corporations holding power in the development of technology. But ultimately, multinational companies cannot be totally independent from states' policies.

One of the main conditions of technological development is social participation and organization. Thus without a social infrastructure, perhaps scientific success could only be achieved at individual level but without organization and cooperation of many individuals it will not be possible to have technological developments and innovations. A theoretical physicist or rocket scientist may know the principles of a rocket, but one cannot fire a rocket unless a large organization combining from finance to human resources and effectively managing them.

1.1.6. The Future of Technology

It is challenging to predict the future of technology. In the late 19th century the Western Union rejected the phone as an unnecessary invention and Lord Kelvin claimed that machines heavier than air could not fly. In 1943, the IBM CEO was very serious when he said that the world market could handle only five computers (Fara, 2009: 471).

In the last three hundred years, a scientific ideal to make the future better has prevailed throughout the world. According to this ideal, technology will lead finding new drugs, the Internet will become much more functional, genetic techniques will ease life, and technology will be much cheaper to reach all people in the world. For now, however, we seem to be far from achieving general prosperity all over the world. It is still questionable if these ideals can be achieved. On the other hand, there are also

pessimistic views since natural resources are decreasing day by day while technological effects such as global warming are becoming more noticeable, infectious diseases are multiplying and slum cities in nefarious conditions are increasing rapidly. The differences in the standards of living between the rich and the poor in societies are increasing day by day, and this may increase further with several concomitant, according to the pessimists.

Today states pursue a policy of linking their citizens' hopes for the future to science and technology. Despite all adversities, science and technology seem to have no alternative in creating a better future. Thus technology and political power are interdependent in this sense (Fara, 2009: 476).

Fara (2009) says that the issue is not about whether scientific technology is good or bad, but that science has the potential to be used as a tool of domination. This brings us to Volti's (2009) concept of “democratic control of technology” or, more directly, the democratization of technology.

Regarding the future of technology, Volti (2009) argues that we need to be open to big surprises since developments in transportation and communication will bring people together more. The Internet puts increasing information at our fingertips while paving the path for many objects be redesigned with new materials and microprocessors. Along with artificial intelligence work, play, and learning are seriously affected. Moreover, genetic engineering will lead to redesigning human beings resulting deep social changes (Volti, 2009: 354). As a result, Volti emphasizes that technology is our creation and its ultimate source is knowledge. Thus we need to adapt not only technical knowledge but also the ethical, philosophical, sociological, political, and economic dimensions of knowledge to technology (Volti, 2009: 355).

At this point, we need to pay attention to Harari (2016), who looks at the future of technology and humanity from a very different point of view. According to him, we cannot predict the future because technology is not deterministic. However artificial intelligence and biotechnology will certainly change the world. Harari argues that in the short term humanity will probably focus on the turmoil in the Middle East, the refugee problem in Europe, and urgent problems such as the slowing Chinese economy. In the long run global warming, increasing inequality and the disintegration of the labor market will gain importance for us. Even if we finally have the opportunity

to look at life from an extensive window, all the problems and developments will be overshadowed by the next three phases: 1. Science will move towards becoming a dogma convincing the whole world that organisms are algorithms and the process of data processing is the whole life, 2. Intelligence will get disintegrated with consciousness, 3. Unconscious but highly intelligent algorithms will soon know us better than us (Harari, 2016: 414). The main point Harari wants to draw attention to is the fact that the inorganic forms of artificial intelligence and algorithms can do better work than humans and replace real life. Artificial intelligence in return, capable of making astronomical calculations in nanoseconds will be more prominent than human, though it does not have what we call consciousness. This will degrade the meaning of consciousness and life to insignificance. The question whether to rely on these high-intelligence algorithms to make decisions about ourselves will be before us. Perhaps this choice will determine the future of international relations (ir) and technology.

1.1.7. International Relations (IR) and Technology

Between 1990 and 2007, science and technology were covered by merely 0.7 % out of more than 21,081 published in 13 major IR journals (Mayer et al., 2014: 14). More importantly, an even tinier fraction genuinely deals with theorizing or conceptualizing technologies. Although technology is frequently mentioned in ir, they have developed as two separate research fields. While conducting more research on technology in areas such as sociology, geography, history, and anthropology, the lack of this topic in IR draws attention. In short, IR theories related to modern science and technology are very few and inadequate. Technology have a wide range and complex structure and IR scholars evaluate it as “the subject of another branch of science”. Thus this thesis aims to pay attention to technology and politics within the same framework through their interactions and intersections.

The fact that some scholars observe science and technology as neutral fields and this approach has prevented them from being interested in these topics in terms of politics. However, at the point we have reached today, important items of the agendas of politicians are generally related to technology. In this sense, the concept of “techno-politics” is an important concept in terms of improving this reductionist perspective and vocabulary of IR in the field of technology. In brief, techno-politics is, in a sense,

an umbrella concept (Mayer et al., 2014:14). Instead of giving a single definition, Mayer et al. proposes a number of different conceptualizations of technology and science. It is worth noting that techno-politics is conceptualized under different headings. These are:

"Constructivist studies of technology", in which the idea of techno-politics in this field challenges the instrumentalist idea that social actors can simply attach meaning to technological artifacts and express social norms. The other is the "assemblage approaches", in which complexity prevails and observers cannot distinguish between social and material. "Critical and subaltern approach" emphasizes the scientific and technological dimensions of basic IR issues such as security, war, anarchy and capitalism. "Approaches to technology-based power" highlights techno-political power shifts, diversity and paradoxes in influence and control. "Infusing coceptualizations of technology" examines technological macro processes and micro practices that will create and stabilize the world economy (Mayer et al., 2014:20).

These examples, are not meant to map the general subtitles of techno-politics fully. Instead, it shows how techno-politics can include different approaches as an umbrella concept within the IR.

1.2. What is High Technology (H-T)?

High technology or its short-form H-T also called frontier technology means the most advanced technology that humanity has reached (Cortright & Mayer, 2001:15). There is also a concept called low tech. In contrast, low-tech symbolizes traditional technologies of the past. Although the concept of low tech is generally used to design a product as simple as possible, it is also used for outdated technologies. H-T's concept content is constantly changing. In this respect, H-T is dynamic not only in terms of its field but also its products.

Those who have pacific views on technology generally oppose the view that "high technology is always better". According to this view, as high technology becomes complex it becomes problematic, dysfunctional, or too expensive. Accordingly, H-T is a type of technology generally difficult to obtain, use, and maintain with features neccesarily not needed. The low tech products are preferred more by some users in this regard. For example, kitchen appliances based on some

prehistoric times used are preferred more than H-T products, although electronic ones are produced instead. Or, despite dozens of electronic devices and applications used in compiling information, some people still prefer to organize information with paper, pens and stationery. Despite advanced lighting technologies in architecture, designs that use maximum daylight are still preferred (Spacey, 2016:2).

H-T is a type of technology tried to be owned by all states and targeted for economic and political power. In this study, we identify the main H-T areas as Aerospace, Cyberspace, Mechatronics:Robotics, Bio-Technology and Nuclear Technology since they represent areas of technology affecting human life and inter-state relations in the broadest sense.

1.3. What is Politics?

Politics is a part of our lives, perhaps the most important. People are involved in politics both in their personal and social relations. In addition, humanity living in communities and state order is governed by politics. So what is politics? When politics is mentioned, state, government or elections come to mind first. Of course, these are directly related to politics. Contrary to popular belief, however, the policy exists in our homes, workplaces, and almost everywhere people are together.

The term “politics” originates from the same Greek word from the title of Aristotle's book *Politics*. In ancient Greek, “Politika” (Greek: Πολιτικά) means simply “affairs of city.” The first use of the word in English was around the mid-15th century. According to the *Merriam-Webster Dictionary* (2019), politics means “the art or science of government” or “the total complex of relations between people living in society.”

According to the *Cambridge Dictionary* (2019), politics means “the activities of the government, members of law-making organizations, or people who try to influence the way a country is governed”, “the job of holding a position of power in the government”, “the study of the ways in which a country is governed” or “a person's politics is that person's opinions about how a country should be governed”.

As can be seen, politics can be defined as both the science and/or the art of government. In addition, the same term represents inter-communal relations and reflects the individual opinions of a single person on governance.

“Man is a political animal...” belongs to Aristotle, one of the founding fathers of politics as a discipline. Undoubtedly, Aristotle's book “*Politics*” is one of the most important works of political theory. According to Aristotle, political animals are a subclass of herding or gregarious animals that "have as their task some single thing that they all do together." Thus bees, wasps, ants and human beings are all political animals in this sense (Aristotle, 384-322 BC. Translated by Reeve, 1998).

Aristotle emphasizes that humans, like some other animals, live in communities and are more political than all other animals because they are the only animals capable of speaking⁴. In addition, Aristotle sees the city-state as a natural entity, which corresponds to the present-day state structure in ancient Greece. Therefore, he considers a stateless person as either superhuman or inferior. This reveals his perspective on politics (Aristotle, 384-322 BC. Translated by Reeve, 1998).

Plato, who preceded Aristotle, quoted the views of his teacher Socrates in his book *The Republic*. Plato, as well as his teacher Socrates, has totalitarian views on politics. Socrates, quoted by Plato, makes heavy criticisms of democracy and sees democracy as a great danger because of its understanding of unlimited freedom. Plato argues that only the philosopher-kings can rule the state in the best way. The society is divided into three classes as producers/workers, soldiers, and philosopher-kings. Here, the class of philosopher-kings is seen as the most intelligent, rational, wise and the only group of people capable of making decisions on behalf of society without taking their personal interests into consideration (Plato, 380 BC / 1970).

Plato, in his book, sees politics as an art. Comparing politics with the art of medicine, Plato argues that the real goal of the physician is to heal the patient, although he earns money, that is not his main goal. Thus, he argues that the ruler practicing the art of politics will use his power not for his own interests but for the interests of his people. Whatever he does and says must be in the benefits of citizens and must also practice the art of rule for them (Plato, 380 BC / 1970).

Aristotle describes the city-state as a political structuring designed for the good and happiness of people. He sees the city-state as the highest stage of human

⁴ Similarly, the Turkish words "mantık" (logic) and "nutuk" (speech) which were both derived from Arabic has the same root. Not surprisingly, logic studies begin with the translation of Aristotle's ideas in the Arab world.

communities after the construction of houses and villages. Although Aristotle identifies people as political animals, he also reminds us that man can be more savage than animals. While classifying society, he defines some people as “natural slaves” and others as “natural leaders”. He asserts that slaves are not capable of making the right decision for themselves and think they must obey their masters. He applies the master-slave relationship to the relationship between the state ruler and society and argues that society must be obedient to the king ruling them. Aristotle claims that the rulers are virtuous and therefore, should rule. Aristotle, who defines the state as a “father-king” figure, has described the concept of “citizen” to a greater extent. He argues that most people living in city-state have the potential to gain virtue in order to participate in the administration and differs from the Platonist view claiming that very few can participate in the administration (Aristotle, 384-322 BC. Translated by Reeve, 1998).

Plato has more of normative approach rather than an objective one in his book *Republic*. However, Aristotle sent his students to a large number of Greek city-states and collected data from them and with these data he constructed his book *Politics*, which combined both descriptive and normative approaches (Roskin, Cord, Medeiros and Jones, 2017:22).

While transitioning from the Greek city-states to the great empire of Rome, the understanding of politics also transformed. During the rise of the Roman Empire, famous historians kept important records of the history and state structures of both Rome and other nations. During this period, important thinkers such as Cicero, Horatius, and Seneca, and politicians, such as Julius Caesar, provided information about Rome’s understanding of government and state relations. Politics as science in this period was mostly limited to understanding history, methods of government, and defining the state functions. Cicero’s works “*On The Republic*” (De re Publica) and “*On The Laws*” (De legibus) were written during this period.

After this period, the influence of religion, in this case, Christianity in Europe began to be effective also in the understanding of the state concept. Politics was approached from a highly normative perspective, and more concerned with what should be in the name of God. In politics, the wishes of God were more important than people. However, in the Renaissance, the Italian thinker Niccolo Machiavelli has put

forward an approach that some people call a turning point for modern politics⁵. The approach was to focus on power. Machiavelli's *The Prince* was all about obtaining and using power in politics (Roskin et al., 2017: 22). Machiavelli explains how the source of principality depends on power relations. According to him, the principality is usually caused by either the people or the great ones. Sometimes great ones succumb to popularity and they transfer their strength to one person and make him a ruler. So there is peace and tranquility under his power. On the other hand, when people are forced by their enemies, they transfer all their powers to a single person and make him a king to defend themselves in a better way (Machiavelli, 1883:41).

Shortly after Machiavelli, thinkers such as Hobbes, Locke, and Rousseau, today known as contractualists, explained why the political system should exist. Although they diverged in many respects, these thinkers agreed that all people should, in principle, agree on a common framework called the “*social contract*”.

Before the establishment of civil society, Thomas Hobbes argued hypothetically that state of nature was terrible. In such a situation, every human would be an enemy against each to survive and there would be constant war. In this way, people would live under the risk of fear, danger, and death in a wild environment without art, literature, and society. To get rid of this fearful environment, people came together with a rational decision to form a civil society. Thus, according to Hobbes, society emerged from fear⁶. People would prefer to be subject to a king and be free from anarchy even if he was a bad king (Hobbes, 1651/1881). Thus, people transferred their right of using violence to the state mechanism in exchange for security.

John Locke was more optimistic than Hobbes. According to him, the natural state of people was not as wild as Hobbes imagined. People could live together with tolerance. But the real problem was that people could not protect their property. The right to property was not guaranteed because there was no law. In order to secure this, they established society by making a contract among themselves. Thus, the right to “life, freedom, and property” was guaranteed. Here, Locke replaces Hobbes' equation

⁵ This approach of Machiavelli can be compared to the efforts of the natural philosophers in Ancient Greece to try to explain everything with physics rather than metaphysics.

⁶ Hobbes wrote his book *Leviathan* in the context of the effects of the British civil war period.

of fear of death with the right of property and pays attention to cooperation (Locke, 1689/1998).

Jean-Jacques Rousseau, the father of the social contract idea, initiated an intellectual breakthrough that went back to the French Revolution. Unlike Hobbes and Locke, for Rousseau, the state of nature was beautiful. People have lived as “noble savages” for a long time. However, according to Rousseau, it is the society itself that corrupts people. Nevertheless, according to Rousseau, society can develop and eventually undergo a process of development, leading to freedom. In order to be a just society, everyone must sacrifice their own interests and pay attention to the interests of society and put forward a will for it. Only in such a society can people gain freedom and dignity. If people are cruel, this is because society is cruel. A good society heals people and forces them to be free. Thus, Rousseau argues that people have sacrificed their rights by signing a social contract to live together, and in return, they receive peace, freedom, and security (Rousseau, 1762/2002).

Europeans are not the only ones who have a say in politics. The communities of China, India, and North Africa have also raised important political thinkers. This reveals that the political nature of man is similar regardless of culture or geography.

Confucius (551–479 BC) from China, in his advice to the kings, expresses that good government is based on two things: the family and the good moral rulers. According to him, in order to set an example for the society in the highest authority, the ruler should display good morality and good administration. Confucius' political views are similar to Plato's ones. Confucius' views on the state have been practiced in Chinese civilization for nearly two thousand five hundred years and guided dozens of dynasties (Roskin et al., 2017: 22). About two thousand years before Machiavelli and Hobbes, the Indian writer Kautilya has reached similar conclusions. In his book *Arthashastra* (Economics), Kautilya (375-283 BC) stated that a stateless structure would cause anarchy, while the good kings would protect homeland and people from anarchy and provide the welfare and happiness. In the 14th century, Ibn Khaldun (1332-1406), one of the most important thinkers of Islamic society in North Africa, presented important views on politics and society. Ibn Khaldun stated that the economic situation would lead to social and political changes, and the geography factor played an important role in the fate of the societies. He also demonstrated that civilizations act

in the cycles of ascension and decline long before many thinkers like Marx and Toynbee (Roskin et al., 2017: 23). On the other hand, politics is the ongoing competition between people, usually in groups, to shape policy in their favor. In order to do so, they want to direct policy to indirectly shape the beliefs and values of the individuals who make up the community. This definition includes not only state politics but also the dynamics of politics that address all areas of life (Roskin et al., 2017:23). In describing politics, Heywood (2004:6) divides it into three categories: political science, political theory, and political philosophy. He argues that although these three are used interchangeably, there are important distinctions between each other. Heywood states that he is interested in politics as a theory rather than politics as a science or philosophy, and touches the challenges facing political theory. According to Heywood, scientific methods are used for political analysis, and a clear line is drawn between facts and values. While policy theory requires an analytical study of ideas and concepts, both normative and descriptive, political philosophy aims to refine our understanding to comprehend these ideas and concepts, and thus to advance political wisdom (Heywood, 2004:14).

Traditionally, R.G. Gettell (1910) and J.W. Garner (1910), Bluntschli, and many others argue that politics is state science. (Gettell, 1910: 3). Garner argues that political science starts with the state and ends with the state. (Garner, 1910:15). Seeley argues that we needed historical knowledge to understand politics and adds: "Without political science, history has no fruit. Without the science of history, political science has no roots. (Seeley, 1896: 4-18)" Some political scientists, such as Paul Janet and George Catlin, also express that state's policy is about states and governments (Block, 1863:65). Catlin expresses that politics is either the activities of political life or the study of these activities. According to him, these activities are usually the activities of various organs of power (Catlin, 1930:44). Bridel (1950), on the other hand, defines politics as a descriptive study that brings together the definition and history of national political organizations, ideological principles, their functioning, the forces that guide them, the effects they have had, their results, and their influence on the country's life and relations with neighboring states (Bridel, 1950: 65).

Modern political theorists evaluate political science from different perspectives. Of these, Lasswell and Dahl treat politics as a matter of power, influence,

and authority. According to them, the issue of power has come to the fore in political thought.

Lasswell characterized politics as “*Who Gets What, When, How*” (Laswell, 1951:146) Dahl (1961) classifies people's development from civilians to political ones (Dahl, 1961:225). According to Dahl, political activity is directly related to gaining and maintaining power (Dahl, 2006:55)". Miller (2003:2) sees politics as a means of conflict resolution. According to Miller, people should cooperate with each other to know who will have a relationship with whom, who will own property, and what will happen if someone breaks the rules, and they need a state to solve these issues (Miller, 2003:4-5).

In summary, the political realities of the world we live in do not overlap with the philosophy of politics. Often philosophical subjects remain only in books and theories and cannot find a reflection in the real world.

On the other hand, according to the approaches that put power on the basis of politics, the main problem of politics is the distribution and consolidation of power. This power can be either in a state we know or in a hypothetical power. Thus, we conclude that there are two basic approaches to defining politics. The traditional approach takes politics in the equation of state, power, and national institutions. The modern approach requires a more in-depth analysis of politics. Therefore, not only the state and power but also the forces, processes, and informal structures that make politics dynamic is added to the equation. In the most general sense, by combining these two definitions, we can define politics as a systematic examination of issues such as state, power, political institutions, power, influence, authority, political processes, and political forces.

It is precisely here, the presence of non-state actors in the world today should be mentioned. In today's political world, a large number of international power centers have a word in politics besides nation-states. These are numerous institutions such as international organizations, multinational companies, non-governmental organizations, and even terrorist organizations. This reveals the fact that the idea of putting only the state in the center and the public opposite of it in the new paradigm is now outdated.

1.4. What is Techno-Politics

Technopolitics comprises politics directed by technology or simply politics related to technology. It would not be correct to say that there is sufficient theoretical work on techno-politics, a hybrid concept that emerged from the combination of technology and politics. Within the common history of technology and politics; It can be stated that the concept of techno-politics meets the competing political actors' ability to use technological instruments in implementing their political goals (Gagliardone, 2014: 3).

According to Lebkowski (1997:502), techno-politics is used to identify all broad-based coalitions that did not have any particular agenda, except for constitutional integrity, or with the contribution of minimal party conflicts. Of course, this is a rather restrictive definition than explanatory and does not reflect the true spirit of techno-politics.

According to Edward and Hecht (2010:256), techno-politics is seen as a structure, the hybrid of technical systems and political practices and by combining these two, it produces new forms of power and agency. This approach seems more accurate and inclusive as it combines technology and politics as two dynamic and even co-constitutive processes.

The coexistence of technology and policy and the use of technology for political purposes corresponds to a very large area. What Hecht shows clearly is that she understands techno-politics and puts the concept of power in its center and sees it as a political force. Indeed, technology can be seen as a tool for politics, but it also has a policy-making feature. This symbiotic relationship exists and structures each other in Hecht's approach. Accordingly, technology is a tool that empowers political actors. However, according to Hecht, technology is not a tool of political power by itself but gains meaning with political actors using it and determining its function. Practices such as using technology in a political process or using it to achieve a political result give rise to techno-politics (Edwards and Hecht, 2010: 256-7).

A similar approach exists in Hughes (2006:285) focusing on nano-biological technologies. He thinks that ethical issues cause political controversies. These technopolitical conflicts will be discussed through access to development, regulation, and human development technologies, thereby creating fundamentally different

concepts regarding citizenship, rights, and governing. According to Hughes, new technologies witnessed a struggle between the two movements that were techno-conservative and techno-progressive in the 20th century.

Winner's (1980:121) approach is somewhat different. He sees some technologies as empowering and others as weakening ones. Thus, some types of technology have the potential to add strength to the power of governments, while others may lead to a shift against the government in contrast to the concept of empowerment. Here, the emphasis is placed on techno-libertarian or techno-democratic approaches. Thus, a political divergence occurs on some regulations in the application of technology to political life and, consequently, human life. In this respect, political agendas and problems such as the strategic selectivity of policymakers and the suitability of new technologies for political agenda can be mentioned. Kellner (2001:14) sees techno-politics as a strategic way to empower citizens. He particularly emphasizes the development of information and communication technologies and the vital importance of the internet for the development of different political views and democracy. Here, technology can be seen as a means of strengthening opposition rather than strengthening the government. This is also a political situation but against the ruling power.

According to Rasmussen (2007:5), it is impossible to distinguish between politics and technology. However, it does not arise from the fact that the two concepts are inseparably interrelated and intertwined; rather, it is an unexpected political force resulting from the use of technology in politics. The internet has been an unclaimed space that has witnessed a struggle amongst powerful actors since the very first time it entered our lives. Thus, the control and use of the internet is a political arena in itself.

Technology history generally focuses on political preferences influenced by political, social, and cultural factors and their impact on technology design and development. However, the role and other dimensions of technology in policymaking are often lacking in these studies. Technopolitics, in this sense, corresponds to a hybrid mix of power, politics and technology. While explaining this hybridity, Gabriel Hecht defines technology as the strategic practice of designing and using technology to achieve political goals during power use through technology (Hughes et al., 2001:14).

In contrast, Mitchell's (2002:42) techno-political definition relates to the unexpected and unintended effects of technological designs and practices on power use. In other words, according to Mitchell, the effects of technology on politics are mostly unintentional and untargeted indirect effects. Even more obvious, the use or development of technology does not have a purpose for policymaking or influencing it; however, the process can make it inevitable. Thus Hecht argues that political, social, and cultural preferences affect the design and development of technological systems. Her area of interest is how technology defines niches in national policy-making and how political choices lead to technical practices and technological products.

In the study titled "*Crude Ecology: Technology and Politics of Dissent in Saudi Arabia*" by Toby Jones (2011) about the Shia rebellion in Saudi Arabia in 1979, Jones explains how Saudi Arabian American Oil Company's (Aramco) technological and economic power was used by the Saudi government to consolidate its power in the east of the country against Shiites. In the study of Sonja Schmid's (2011) "*Nuclear Colonization?: Soviet Techno-politics in the Second World*", Soviet techno-politics was elaborated from the perspective of the transfer of nuclear technology to Eastern Europe. The issue is that the Soviets were trying to increase the region's dependence on the Soviet Union by establishing nuclear facilities here in East Germany and Czechoslovakia. This can be considered as a good example of techno-politics. While Hecht explains these, she discussed the power balances in nuclear network design and the distribution of power in her work "The Power of Nuclear Things" and examined the global nuclear regimes in a post-war world from a technopolitical framework (Hecht, 2011:10). As a result it is possible to say that the concept of techno-politics is understood in different ways from different definitions. It is possible to talk about techno-politics in every field where technology and policy meet. Both politics determining technology's direction and policymakers' direction of technology's design and development are included in techno-politics. Conducting policies with technological tools, using technology to achieve political goals, gaining power by using technology, and thus gaining political power, directing, limiting, or developing technology for the sake of political purposes stand out as the factors to be included in the concept of techno-politics.

1.4.1. Techno-Politics and Globalization

We live in a time when H-T and globalization prevail in every aspect of our lives. It will not be difficult to say that technology has a globalizing effect due to the internet and advanced communication and transportation channels. It is not a coincidence that the phenomenon of globalization develops simultaneously with transportation and communication technologies.

According to Merriam-Webster Dictionary (2021) globalization means “the development of an increasingly integrated global economy marked especially by free trade, free flow of capital, and the tapping of cheaper foreign labor markets”. Globalization is defined as the “intensification of social relations around the world bringing the distant localities closer together shaped with events that are miles away” (Giddens, 1990: 21), “the integration of the world economy (Gilpin, 2001: 364), “de-territorialization or supra-territorial relations between people...” (Scholte, 2000: 46) or “time-space compression” (Harvey, 1989:135). Globalization, is the increased communication between human communities living in different parts of the globe and states they constitute, the world becoming smaller even a global village⁷ (Yaman, 2019:422). This perception of globalization is getting stronger day by day.

Those who were trying to explain globalization talk about three interrelated factors, namely technical (technological change and social organization), economy (market and capitalism), and politics (power, interests, and institutions). Anthony McGrew (2002:343) refers these as “the engines of globalization”. According to him, technology is at the center of globalization because a global system with the infrastructure of modern communication and a global economy could not exist without technological opportunities. Capitalism plays an active role in the economic engine. The constant impulse of capitalist understanding to make new markets and profit has made globalization of economic activities inevitable. In the policy aspect of the business, if the technology is the physical infrastructure of globalization, politics is the

⁷ Global village describes the phenomenon of the entire world becoming more interconnected as the result of the propagation of media technologies throughout the world. The term was coined by Canadian media theorist Marshall McLuhan in his books *The Gutenberg Galaxy: The Making of Typographic Man* (1962) and *Understanding Media* (1964).

normative infrastructure. Global powers have been important factors that feed globalization and make them critical actors of the process. (Baylis, 2008:69)

Thus the development of technology and globalization in the same era is not a coincidence. The communication and transportation dynamics having simultaneously accelerated globalization, could not develop without technological developments. The globalizing effect of technology is seen as inevitable. Because societies with access to widespread communication and transportation opportunities through technology cannot be isolated from the social, cultural, economic, and, ultimately, the political effects of globalization. One could observe such changes in eastern societies such as China, Japan, which are claimed to have closed cultures, and in conservative countries such as Saudi Arabia and Iran. All these countries have been affected more or less by the capitalist economy and other cultural factors brought by globalization. Since these countries do not have the option of rejecting technological developments, they are inevitable to be severely affected by the globalization trend despite all political measures. The borders and differences between more than 190 countries in the world may have meant in the past, but this meaning is weakening in our age. The world order of state-centered and boundaries are being questioned now. Therefore, it is possible to create a new world politics considering the effects of globalization.

Although globalization does not completely eliminate the state-centered political structure of the world, it seriously transforms it. Therefore, there is a need for a conceptual and radical revision and shift in our thoughts about world politics. Global politics is now a differentiated arena in which different actors are active. There is power asymmetry, there are new actors beside the state, international companies, international organizations, non-governmental organizations (NGO), and all transnational formations. Even terrorist organizations are included among these actors (Baylis, 2008: 37).

One handicap of technology implementation and dissemination in terms of state administration is that it opens doors more than strong power will tolerate such as techno-capitalism and transparency, freedom, and democracy. The findings of Kellner (2001) are of great importance in this regard. According to him, techno-politics to adopt and spread technology necessarily leads to globalization and strengthening of

capitalism, but at the same time, it also helps to make the voice of anti-capitalist minorities more organized (Kellner, 2001: 14-34).

If we consider the situation in Asia-specific, for example, China, which is governed by the Communist Party, seems to try to protect borders of the government while watching a techno-politics that cannot say no to technology but only by establishing a more closed internet system. In India, which has a more open democracy environment, but also attaches importance to its traditional culture, technology is more widespread in every sense. What is striking here is that China operating as a non-liberal but enjoying liberal economy, can accept globalization in its own way in the technopolitical sense.

If we examine the issue in Asia in particular, Paul's (2019:50-63) article states that intense globalization, especially economic globalization, connects many countries in a way that never happened before. The South Asian region is also not out of this equation. It is stated that two major actors in the region, such as China and India, have tried every way to attract relatively smaller countries to their side. Small countries in the region sometimes approach both countries economically and militarily in order to benefit from the rising power of China and India, but not to be clearly involved in a confrontation. This competitive environment provides a kind of maneuvering area for small countries. According to these findings, China is pursuing a peaceful and economically centered strengthening and promotion strategy in the region. Thus, China has recently attempted not to fall into a military dispute with any neighboring country. China is known to support infrastructure development in Pakistan, Sri Lanka, Nepal, and Bangladesh. On the other hand, as an example of soft power, China is opening Confucian institutes all over the world. The institutes in the region are currently located in Nepal, Sri Lanka, Maldives, Pakistan, and Bangladesh (Hazarika and Mishra, 2016: 144-145).

However, according to Yang (2017:17), currently, India lacks adequate resources to provide further assistance for regional development in South Asia. Thus, China fills this gap. However, while China's influence on South Asia has so far been limited only to economic areas, India has retained its strategic advantage in terms of geographical, historical, and cultural ties (Bhasin, 2008:10). Thus, technology and globalization stand out as an important tool in China and India's competition on the

Asian continent. Thanks to the blessings of globalization and technology, the two great powers are trying to gain positions by using technopolitical methods to have a say in the region.

On the other hand, one of the most important points we mentioned was the linear relationship between the development of technology and social organization. What we call science can be developed through individual efforts, with exceptions, while technological advances from science are teamwork.

It is precisely at this point that technology and politics intersect very vitally. For such a long time in the history of states, such technological organizations could be realized with the financial and bureaucratic power of the states. Although we count international corporations and organizations as new actors in international relations today as well as states are still the main actors that comes to mind when we talk about power for many parts of the world.

States play a vital role, as they can deliver the labor and financial strength required for technological development and technology products. We already emphasized that the main difference between people and other animals using tools is their ability to be organized. This social organization factor is the point where technology meets politics.

The techno-politics representing the relationship of states with technological developments, has many options, such as directing technological developments of the states (in many aspects such as design, functionality, product feature), deciding what will happen to them, developing or preventing their development in line with policies. States have technology policies. Even if the technology is introduced through private companies, the preferences of governments to direct, encourage, and support this technology are also political choices.

The preferences and direction of the states play a vital role, especially in essential areas such as war technology, health and industrial technologies. However, there is also a part of the technology that affects politics. This lies in the power of technological developments to transform states and societies. One of these is the phenomenon of freedom and independence emerged as a result of the globalization of internet and communication technologies.

We witness that even very closed societies do not have much to do against the transformative power of globalization. At this point, techno-politics has to control and direct this unlimited and endless area must use it at the same time. In other words, it both wants to expand and limit it. This balance is the techno-politics itself and one of the most important decision-making areas of techno-politics.

War and defense technology can also be considered as one of the areas where technology and policy get very close. In fact, the opinion that technology was developed mostly to defeat the enemy in times of war is shared by many political scientists. Whether during the WW II or during the Cold War or even earlier in ancient times, technology has emerged as a determinant between the countries. Today, technology is already decisive in areas such as defense and attack technologies, nuclear deterrence, arms race. Therefore, it can be said that this is one of the areas where techno-politics gains importance. While techno-politics is such an important determinant, it is possible to say that techno-politics is important in the technological competition between the two largest countries in the world, such as China and India.

Especially since these two countries have great human resources and workforce, their proper management will provide both economic and political power. When they combine the technological opportunities with such human resources hand in hand with the proper policies, two superpowers emerge and become rival to each other with equal conditions. Or is it really equal? First, let's see technopolitical fields and branches of H-T. Later we will pay attention to the current situation in these fields of these two rival countries.

The sections about techno-politics on the internet, social media, communication technologies, and its role in democratic systems correspond theoretically outside the H-T and policy relationship as our research topic.

Toret (2013:41) explains techno-politics as the strategical application of technological tools for management, communication, and common action. It is the ability of interrelated communities to constitute and alter social activities. Of these, Kellner (2001:14-34) also rather than providing a clear definition, defines techno-politics as a strategic way of public strengthening. He ascribes an exact logic of reluctance in using communication technologies. In particular, the Internet and communication technologies are essential for democratization as they open 'new fields

of a political fight for different thoughts and communities excluded from the mainstream communication instruments and thus enhances the potential for insurgency and interference by opponent cliques. In the following section we will shed light to the main fields of H-T and their reflections in Asia.



CHAPTER 2

HI-TECH AND ITS REFLECTIONS IN ASIA

2.1. The Hi-Tech and Its Main Fields

The H-T elements can be evaluated in five general categories: Aerospace, Cyberspace, Mechatronics: Robotics, Biotechnology, and Nuclear Technology.

2.1.1. Aerospace

The word aerospace is a combination of aeronautical and spaceflight terms. Aerospace can be defined as the scientific, engineering, and business activities humanity does to fly in and above the world atmosphere and the space surrounding it. Here, the atmospheric studies are called “aeronautics”, space-oriented studies are called “astronautics”.

Aerospace organizations conduct, design, manufacture, operate, and maintain aircraft or spacecraft for such purposes. Aerospace activities are a very diverse type of operation including many commercial, industrial and military applications. Technically, aerospace and airspace differ from each other. While airspace is the mass of air above the earth, aerospace is about the space above it. The beginning of space is defined as 100 km above the ground (FAI, 2021).

In many industrialized countries, the aerospace industry is a combination of the public and the private sectors. Many countries have government-funded civil aviation programs. Examples of these include the National Aeronautics and Space Administration (USA), European Space Agency, the Canadian Space Agency, Indian Space Research Organization, Japanese Aeronautics Exploration Agency, the Russian Aviation and Space Agency, China's National Space Administration, Pakistan Space and Upper Atmosphere Research Commission, Iranian Space Agency, South Korea's Aerospace Research Institute, Turkish Space Agency and UK Space Agency. In addition to these governmental organizations, many private companies also produce technical devices and components such as spacecraft and satellites. Some famous companies producing and working in space and aviation are Boeing (USA), Cobham (UK), Airbus (European), SpaceX (USA), Lockheed Martin (USA), United Technologies (USA), MacDonald Dettwiler (Canada), and Northrop Grumman (USA).

The main research areas of aerospace industry are to develop, research, and produce flight vehicles, rockets and missiles, space launch vehicles, and manned or unmanned spacecraft. Thus, this industry is essentially the product of the most advanced technology and science. The aerospace systems produce high added value and complex products. If a country own an aerospace industry is considered economically and politically prestigious in this regard. Countries producing aerospace products both meet their own military and civilian needs as well as keep other countries as their customers. Other important buyers are airline companies operating around the world (Weiss and Amir, 2019).

Of the nearly 50 countries that have at least one or more institutions operating in the aerospace area, the USA is home to the world's largest aerospace, industrial complex. Some of these institutions operate only in the aerospace area, while others operate also in different fields. American institutions are the world's largest suppliers of both military and civilian equipments, and the government is the main consumer of these products. The rest of the world is struggling with the USA to get more shares in this big global market. Russia is the second biggest market in this industry thanks to its domestic size. Recently Russia has managed to enter American and European markets (CentreForAviation.com, 2020). Western Europe's aerospace industry is also taking firm steps towards becoming a strong player. In this sense, the European market is dominated by France, the UK and Germany. The aviation companies such as Airbus and a series of European space launch vehicles such as Ariane have a solid place in the Aerospace industry.

On the Asian Pacific coast, Japan stands out as the most developed and leading country in the industry. However, its capacity is limited compared to the USA, Europe, and Russia. China, on the other hand, has been producing Soviet-designed aircraft since 1950. Local productions are also developed in accordance with Soviet designs. In recent years, China has also been developing partnerships with many foreign companies in the fields of aircraft and spacecraft. The country also produces space launchers, small satellites, and spacecraft suitable for crewed flights.

Countries with a small but well-developed aerospace industry are as follows: Canada, Czechia, India, Argentina, Israel, Italy, Switzerland, Taiwan, Australia, Brazil, Spain, Netherlands, Indonesia, Poland, and Taiwan. Countries with emerging

aerospace industry are listed as follows: Austria, Uzbekistan, South Korea, Belgium, Chile, Turkey, Colombia, Romania, Portugal, Finland, the Philippines, Hungary, Pakistan, Iraq, Egypt, Lithuania, Norway, Nigeria, New Zealand, and Malaysia (Weiss and Amir, 2019:10).

In the USA, the Department of Defense and the NASA are the two largest consumers of aerospace technology and products. The largest producers in the USA are Boeing, United Technologies Corporation, SpaceX, Northrop Grumman, and Lockheed Martin. Companies operating in the field of aerospace in the EU are EADS, BAE Systems, Thales, Dassault, Saab AB, and Leonardo S.p.A. At the same time, the European Space Agency (ESA) is the most important buyer. In India, Bangalore is the center of the aerospace industry hosting the Hindustan Aeronautics Limited, the National Aerospace Laboratories, and the Indian Space Research Organization (ISRO). ISRO as an agency launched Chandrayaan-1, the country's first lunar orbit, in October 2008. Pakistan has a developing aerospace industry with its institutions such as The National Engineering and Scientific Commission, Khan Research Laboratories, and Pakistan Aeronautical Complex operate. The Kamra city is home to Pakistan Aeronautical Complex and has many factories here. Pakistan has the capacity to manufacture manned or unmanned aircraft.

Russia is home to two large companies, Oboronprom and the United Aircraft Building Corporation. In China, Beijing, Xi'an, Chengdu, Shanghai, Shenyang, and Nanchang are very important research and production sites in the aerospace area. China is capable of producing military aircrafts, rockets, missiles, and spacecrafts (M&A Statistics, 2019). UK is among the countries that can make its own military and civilian aircraft. However, it is mainly an importer in the aerospace area due to its massive need while owning major aerospace companies such as BAE Systems. Countries such as Canada and France also have facilities to manufacture their own aircraft with the companies like Boeing Canada, Bombardier Aviation, BTR Aerospace Group of Canada and Lagardere and Airbus of France.

The scale of the products produced in the aerospace industry is quite wide because there are lots of parts needed by flight vehicles. In addition, there is a need for a large number of systems to support these complex devices. Military fighter jets have the largest market share in terms of sales. The space systems, civilian aircraft, and

missiles follow them. The customers range from private individuals to large companies, airlines, telecommunications companies, armies, and other government institutions.

In the aerospace industry, the following products are the most common ones: Civil aircraft, military aircraft, helicopters, unmanned aerial vehicles, missiles, space launchers, spacecraft, airships, and secondary and tertiary aerospace systems.

As of 2018, the total export sales amount in terms of aerospace products reached \$ 331.8 billion worldwide. Thus, the export of the aerospace industry has increased by 2.1 percent since 2014. When we look from the continental perspective, North America was the continent that exports the most aerospace industry with 45.3 percent in 2018. While Europe was the second with 42.8 percent, Asian companies took third place with 9.6 percent market share. These exports included aircraft, spacecraft, and satellites (Workman, 2019).

As Table 2.1. clearly shows us the USA is dominating the aerospace industry by having the % 41.9 of the export share in 2018. Among the top exporters, the fastest-growing aerospace products exporters since 2014 were: Malaysia (up 139.6%), Ireland (up 75.1%), China (up 74.2%), and South Korea (up 56.9%). Those countries that posted declines in their exported aerospace products sales were led by Japan (down -19.7%), Italy (down -18.1%), Canada (down -14.8%), France (down -10.1%), and Germany (down -5.3%).

As we can see in Table 2.1, China is in the top 10, but at the end of the list with its 4.3 billion US Dollars market share. China could only export 1.4% of the total amount of export during 2018 while India is in even a worse position. India's share from the total amount of aerospace exports is only 0.6%, with its 2.1 billion US Dollars export revenue.

Table 2.1. List of Aerospace Exporting Countries in 2018

RANK	EXPORTER	AEROSPACE EXPORTS (US\$)	% WORLD TOTAL
1.	UNITED STATES	\$139.1 billion	41.9%
2.	FRANCE	\$51.8 billion	15.6%
3.	GERMANY	\$41.4 billion	12.5%
4.	UNITED KINGDOM	\$19 billion	5.7%
5.	CANADA	\$10.6 billion	3.2%
6.	SINGAPORE	\$7.4 billion	2.2%
7.	SPAIN	\$6.6 billion	2%
8.	IRELAND	\$5.8 billion	1.8%
9.	ITALY	\$5.1 billion	1.5%
10.	CHINA	\$4.6 billion	1.4%
11.	JAPAN	\$4.3 billion	1.3%
12.	BRAZIL	\$4 billion	1.2%
13.	SOUTH KOREA	\$2.6 billion	0.8%
14.	ISRAEL	\$2.2 billion	0.7%
15.	MALAYSIA	\$2.1 billion	0.6%
16.	INDIA	\$2.1 billion	0.6%
17.	NETHERLANDS	\$2 billion	0.6%
18.	SWITZERLAND	\$1.8 billion	0.6%
19.	AUSTRALIA	\$1.7 billion	0.5%
20.	AUSTRIA	\$1.5 billion	0.5%

Source: worldstopexports.com, 2019

Companies serving in the aerospace field reflect the current situation in this technology field very well. According to a list published for 2018, the most income-generating aerospace companies are shown in Table 3.2. In this list, where the top 50 companies are shown, the weight of US companies is remarkable. On the other hand, only one Chinese company (26th AVIC) and one Indian company (36th Hindustan Aeronautics) are among these top 50 companies. AVIC's revenue is \$ 5.4 billion, and Hindustan Aeronautics is around \$ 3 billion. It is noteworthy that the American Boeing (\$ 101 billion) and French Airbus (\$ 75 billion), at the top of the list, have surpassed these companies. Thus, Asian countries have a very small share in the industry compared with their American and French counterparts. Another striking issue is the huge difference between the revenues of the two largest companies in China and India.

Table 2.2. List of Top 50 aerospace companies by revenue 2018 (\$ millions)

RANK	COMPANY NAME	COUNTRY	SALES (REVENUE) 2018
1.	BOEING	UNITED STATES	\$101,000
2.	AIRBUS	FRANCE	\$75,100
3.	LOCKHEED MARTIN	UNITED STATES	\$53,800
4.	UNITED TECHNOLOGIES	UNITED STATES	\$36,030
5.	GENERAL ELECTRIC	UNITED STATES	\$30,600
6.	NORTHROP GRUMMAN	UNITED STATES	\$30,100
7.	RAYTHEON	UNITED STATES	\$27,100
8.	SAFRAN	FRANCE	\$25,200
9.	ROLLS-ROYCE	U.K.	\$15,000
10.	LEONARDO	ITALY	\$14,400
11.	HONEYWELL	UNITED STATES	\$12,900
12.	BAE SYSTEMS	U.K.	\$12,800
13.	L-3 TECHNOLOGIES	UNITED STATES	\$10,200
14.	TEXTRON	UNITED STATES	\$9,620
15.	ROCKWELL COLLINS	UNITED STATES	\$8,670
16.	GENERAL DYNAMICS	UNITED STATES	\$8,460
17.	PRECISION CASTPARTS	UNITED STATES	\$7,770
18.	ROSTEC STATE CORP.	RUSSIA	\$7,390
19.	BOMBARDIER	CANADA	\$7,320
20.	SPIRIT AEROSYSTEMS	UNITED STATES	\$7,220
21.	UNITED AIRCRAFT	RUSSIA	\$7,190
22.	THALES	FRANCE	\$6,820
23.	mitsubishi	JAPAN	\$6,140
24.	DASSAULT AVIATION	FRANCE	\$5,990
25.	ARCONIC	UNITED STATES	\$5,890
26.	AVIC	CHINA	\$5,420
27.	MTU AERO ENGINES	GERMANY	\$5,390
28.	EMBRAER	BRAZIL	\$5,070
29.	GKN AEROSPACE	U.K.	\$4,710
30.	IHI	JAPAN	\$4,460
31.	KAWASAKI	JAPAN	\$4,290
32.	TRANSDIGM	UNITED STATES	\$3,810
33.	ISRAEL AEROSPACE INDUST.	ISRAEL	\$3,680
34.	TRIUMPH GROUP	UNITED STATES	\$3,370
35.	HARRIS	UNITED STATES	\$3,330
36.	HINDUSTAN AERONAUTICS	INDIA	\$2,960
37.	KOREA AEROSPACE INDUST.	S. KOREA	\$2,530
38.	MEGGITT	U.K.	\$2,470
39.	CAE	CANADA	\$2,450
40.	SAAB	SWEDEN	\$2,410
41.	PANASONIC AVIONICS	JAPAN	\$2,360
42.	PARKER HANNIFIN	UNITED STATES	\$2,320
43.	ATI (ALLEGHENY TECH.)	UNITED STATES	\$1,970
44.	ST ENGINEERING	SINGAPORE	\$1,960
45.	HEXCEL	UNITED STATES	\$1,910
46.	EATON	UNITED STATES	\$1,900
47.	AEROJET ROCKETDYNE	UNITED STATES	\$1,890
48.	MOOG	UNITED STATES	\$1,780
49.	DIEHL AVIATION	GERMANY	\$1,740
50.	COBHAM	U.K.	\$1,690

Source: Flight Global, 2019

2.1.2. Cyberspace

Cyberspace is widely used to describe interconnected digital technology. Although this concept has entered our lives as a popular cultural element created by science fiction art, it has become a reality nowadays. It is now used by technology strategists, security experts, governments, military institutions, industrial leaders, and investors to define the area covered by the global technology environment. According to the *Oxford Dictionary*, cyberspace is simply a communication network where computer networks are connected (Oxford Dictionary, 2020). This concept had become popular since the early 1990s, when the internet, web networks, and digital communication networks, in general became widespread to express all new ideas and phenomena (Strate, 1999:382-383). Our experience has shown that individuals use this global network in interacting, exchanging ideas, sharing information, providing social support, conducting business, taking action, creating artistic products, playing games, having fun, participating in political discussions and so forth. In fact, cyberspace has gone one step further than the reality earlier experienced for some individuals who live mostly in cyberspace and called cybernauts in popular culture.

Cyberspace has become a concept that meets everything related to the internet and its culture. The American government has announced in 2003 that it sees the infrastructures of interconnected information technologies as one of the most critical infrastructures for the American people. Cyberspace has become so established in our lives that even a concept of cyberethics has emerged as accepted moral rules among users. The most prominent feature of the Cyberethics concept is the right to privacy (White House, 2003).

According to Morningstar and Farmer (2003:664-667), the cyberspace meets social interactions rather than technical implementation. In their view, the total function of cyberspace is to increase communication between real people in a different dimensions through the “augmented reality”. Thus, people communicate with each other while affecting each other. Accordingly people are looking for richness, complexity, and depth in this virtual world, what they already search in real life.

The cyberspace first came to life in the 1960s in an art activity called *Cyberspace Atelier* by Danish artists Sussanne Ussing and Carsten Hoff. The couple

prepared an exhibition hall where people can interact directly with art long before the computers entered our lives. This actually created cyberspace in the real world rather than the digital world (Lillemose & Kryger, 2015). Its first involvement in science fiction was in the short stories of William Gibson's *The Sprawl* trilogy published in 1984, 1986 and 1988. After this date, the concept has become permanent in our lives as a general concept that expresses online computer networks (Gibson, 1984:69).

In this regard, the Canadian government uses the definition of “global commons” for cyberspace, while German counterpart limit this concept to the internet only excluding other types of computer networks. The UN International Telecommunications Union defines cyberspace as “all of the systems and services directly or indirectly connected to the internet, telecommunications and computer networks” (Mayer et al. 2013:6). The Pentagon, on the other hand, defines the concept of cyberspace as follows: "The national environment that enables the transmission of digitalized information over computer networks" and "An information environment consisting of interconnected information technology infrastructure networks including internet, telecommunication networks, computer systems, and integrated operating and control mechanisms"(Mayer et al. 2013:7). Cyberspace, as a source of power, has been described most commonly by Kuehl (2009:12) as “the power to use the cyberspace field to create an advantage and influence events in power tools and other operational environments.” In this regard, it is possible to make a power comparison among countries in the context of cyber power in terms of international relations. In a report called “Cyber Power Index” prepared for G20 countries, five indicators were used: Government commitment to cyber development, cyber protection policies, cyber censorship or lack of surplus, political efficacy, intellectual property protection. According to these indicators Germany, the USA, the UK, France, and Japan ranked in the top five, while India ranked 14th and China ranked 18th (Economist Intelligence Unit, 2013).

Cyberspace is related to cybersecurity so cyberwarfare has recently gained utmost attention as in the international arena. Cyberwar gives the opportunity to demolish states, their cyberinfrastructures and therefore their economies without the need for any real weapons. So, to be strong in this area, you also need to have a very serious security network otherwise, you are open to all cyber attacks.

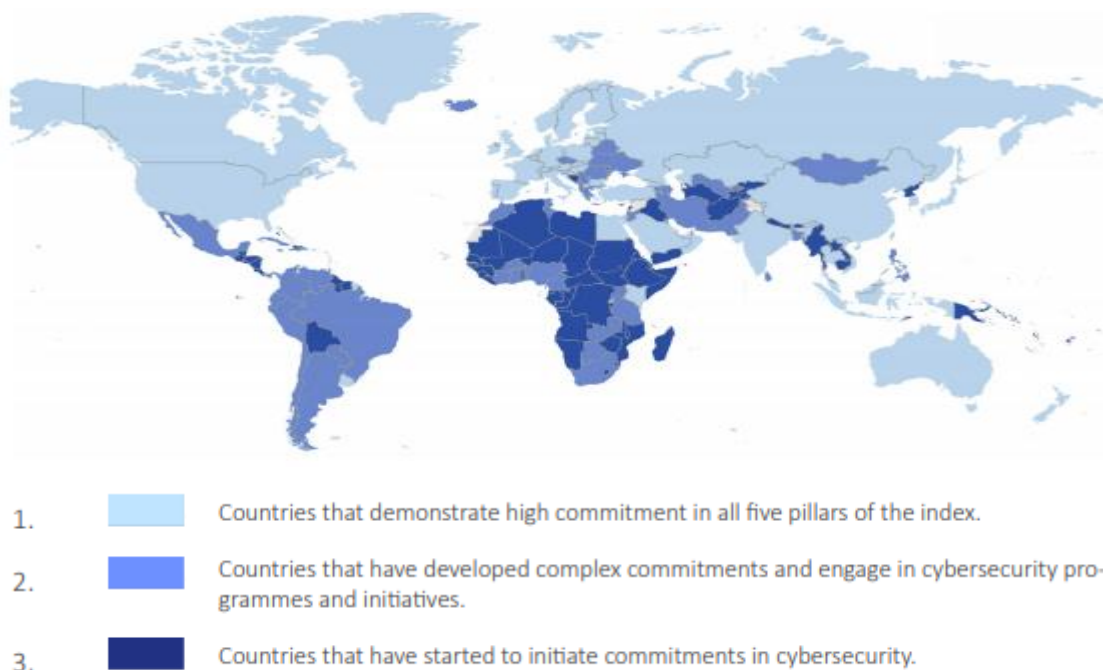
China has the most advanced cyber army in Asia with about 100.000 cyber soldiers in estimation while China also benefits cyber experts in the private sector vis a vis cyber attacks while China has organized cyber attacks against Canada, France, India, Russia and the USA (Mason, 2019).

The Global Cybersecurity Index (GCI), published annually, is an important indicator determining the strongest countries in the field of cybersecurity. The index evaluates performances of countries under five main titles: Legal, Technical, Organizational, Capacity building, and Cooperation (GCI, 2018). According to the GCI 2018, the USA and European countries rank first in the field of cybersecurity according to their performance.

Table 2.3. GCI Most Committed Countries Globally in 2018

Rank	Member States	GCI Score	Legal	Technical	Organizational	Capacity Building	Cooperation
1.	UK	0.931	0.200	0.191	0.200	0.189	0.151
2.	USA	0.926	0.200	0.184	0.200	0.191	0.151
3.	France	0.918	0.200	0.193	0.200	0.186	0.139
4.	Lithuania	0.908	0.200	0.168	0.200	0.185	0.155
5.	Estonia	0.905	0.200	0.195	0.186	0.170	0.153
6.	Singapore	0.898	0.200	0.186	0.192	0.195	0.125
7.	Spain	0.896	0.200	0.180	0.200	0.168	0.148
8.	Malaysia	0.893	0.179	0.196	0.200	0.198	0.120
9.	Norway	0.892	0.191	0.196	0.177	0.185	0.143
10.	Canada	0.892	0.195	0.189	0.200	0.172	0.137

The level of commitment tables below lists the countries that have maintained high, medium, and low GCI scores. Scores were obtained using the 99 percentile: High countries within this range (1.000-0.670) are ranked (1-51), a total of 54 countries, medium country scores (0.669-0.340), range in rank from 52-99 totaling to 53 countries. Low country scores (0.339-0.000) range in rank from 100-175, with a total of 87 countries. Source: Global Cybersecurity Index, 2018

Figure 2.1. Geographical Commitment to Cybersecurity

Source: Global Cybersecurity Index, 2018

Tables of 2.4., 2.5 and 2.6. show degrees of commitment of countries on cybersecurity. Countries are listed as high, medium, and low according to their commitment levels.

Table 2.4. Level of commitment for cybersecurity (High)

High		
United Kingdom	Oman	United Arab Emirates
United States of America	Qatar	Macedonia
France	Georgia	Thailand
Lithuania	Finland	New Zealand
Estonia	Turkey	Ireland
Singapore	Denmark	Israel
Spain	Germany	Kazakhstan
Malaysia	Egypt	Indonesia
Canada	Croatia	Portugal
Norway	Italy	Monaco
Australia	Russian Federation	Kenya
Luxembourg	China	Latvia
Netherlands	Austria	Slovakia
Saudi Arabia	Poland	Bulgaria
Japan	Belgium	India
Mauritius	Hungary	Slovenia
Republic of Korea	Sweden	Rwanda
Uruguay	Vietnam	

Source: Global Cybersecurity Index, 2018

Table 2.5. Level of Commitment for Cybersecurity (Medium)

Medium		
Uzbekistan	Kuwait	Sri Lanka
Moldova	Bahrain	Mongolia
Ukraine	Belarus	Cote d'Ivoire
Azerbaijan	Brazil	Iceland
South Africa	Czech Republic	Botswana
Cyprus	Romania	Ghana
Nigeria	Colombia	Zambia
Philippines	Jordan	Cameroon
Serbia	Liechtenstein	Dominican Republic
Tanzania	Tunisia	Morocco
Iran	Greece	Jamaica
Montenegro	Bangladesh	Pakistan
Albania	Armenia	Argentina
Mexico	Benin	Peru
Brunei Darussalam	Cuba	Burkina Faso
Uganda	Malta	Panama
Paraguay	Chile	Samoa
Ecuador	Venezuela	

Source: Global Cybersecurity Index, 2018

Table 2.6. Level of Commitment for Cybersecurity (Low)

Low			
Gabon	Afghanistan	Mali	South Sudan
State of Palestine	Barbados	Timor-Leste	Saint Kitts and Nevis
Senegal	Myanmar	San Marino	Sao Tome and Principe
Sudan	Saint Vincent & the Grenadines	Marshall Islands	Djibouti
The Gambia	Congo	Somalia	Solomon Islands
Ethiopia	Cambodia	Vanuatu	Tuvalu
Malawi	Mozambique	Angola	Guinea-Bissau
Tajikistan	Bahamas	Saint Lucia	Cabo Verde
Iraq	Grenada	Niger	Lesotho
Algeria	Bolivia	Burundi	Haiti
Nepal	Sierra Leone	Togo	Honduras
Seychelles	Eswatini	Lao	Micronesia
Kyrgyzstan	Guyana	Fiji	Central African Republic
Guatemala	Papua New Guinea	Guinea	Equatorial Guinea
Antigua and Barbuda	Nicaragua	Trinidad and Tobago	Kiribati
The Syrian Arab Republic	Belize	Zimbabwe	Vatican
Costa Rica	Namibia	Lebanon	Eritrea
Tonga	El Salvador	Bhutan	Democratic People's Republic of Korea
Libya	Turkmenistan	Yemen	Dominica
Liberia	Andorra	Comoros	Bosnia and Herzegovina
	Suriname	Congo	Madagascar
	Mauritania	Maldives	Nauru
		Chad	

Source: Global Cybersecurity Index, 2018

When the table showing the level of commitment for cybersecurity is analyzed, it can be clearly seen that the development level of countries that attach importance to cybersecurity is quite high. In other words, the level of development of the countries and the importance attached to cybersecurity are correctly proportional.

2.1.3. Mechatronics: Robotics

Mechatronics or mechatronics engineering, is a multidisciplinary field focusing on electrical and mechanical systems together as well as containing elements from robotics, electronics, computers, telecommunications, systems, control, and production engineering. The reason for evaluating the mechatronics and robotics titles together in this study is the inclusiveness of mechatronics and the specific importance of robotics science for the future.

The development of mechatronics as a scientific field is actually creating a design solution that can bring these sub-branches together. The mechatronics was first registered in Japan in 1969 by an engineer named Tetsuro Mori as a trademark of Yaskawa Electric Corporation but later became universal with the use of the concept (Lennon and Mass, 2008:23). The mechatronics is mostly seen as a combination of automation, robotics, and electromechanical engineering (Kamm, 1996:11). It is a top set of robotic technologies or an inclusive superset. This discipline covers interactions between mechanical systems, electrical systems and control systems and their managements.

Robotics emerged as a combination of computer science and engineering in which robot systems are designed, constructed, operated, and functioned. The goal of robotics science is to create smart machines to help people in their daily lives and production processes for different purposes. Military and similar uses are included in these completely different purposes. The development of robotics science is in direct proportion to the developments in other disciplines such as information engineering, computer engineering, mechanical engineering, electronic engineering.

According to the *Oxford Dictionary (2020)*, the word robotics is based on the word robot, derived from the word “robota”, which means “servant/worker/work” of Slavic origin and was used for the first time in 1920 in the play by Czech writer Karel

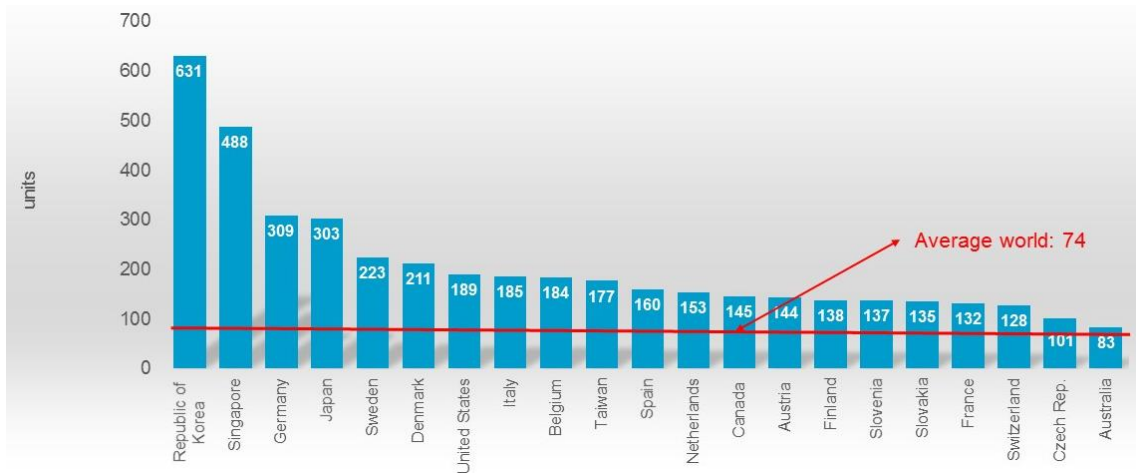
Capek's *Rossum's Universal Robots*. The famous science fiction writer Isaac Asimov firstly used the concept of robotics in May 1941, in his short story named "Liar!". Asimov also mentioned the three laws of Robotics, which became the general rule of science fiction today in his short story *Runaround*. According to these laws, a robot cannot hurt people, obey all orders of people unless it contradicts the first law and it is obliged to protect its existence until it contradicts the first law. Of course, although these three laws and Asimov's thoughts are limited to science fiction, it would not be correct to say that it has no effect in robotics science (Asimov, 1950: 40).

Norbert Wiener's formulating of cybernetic principles in 1948 is accepted as the beginning of robotic science (Wiener, 1956). The emergence of fully autonomous robots was only possible in the second half of the 20th century. Today, industrial robots are very common, and these autonomous robots do many things that people have done before. Robots are mainly employed in manufacturing, assembling, packing, packaging, mining, transportation, ground and space exploration, surgeries, weapon industry, laboratory research, security, and mass production of industrial and consumer products.

Robot density in the world is an important indicator of mechatronics as robotics power of the countries. In recent years robot density rose globally. The automation of production has accelerated globally since 74 robot units per 10,000 employees has become the average of global robot density in the manufacturing industries in 2018 while in 2015, it was 66 units. By regions, the average robot density in Europe was 99 units, in the Americas 84, and in Asia 63 units during 2018 (IFR Press Release, 2018).

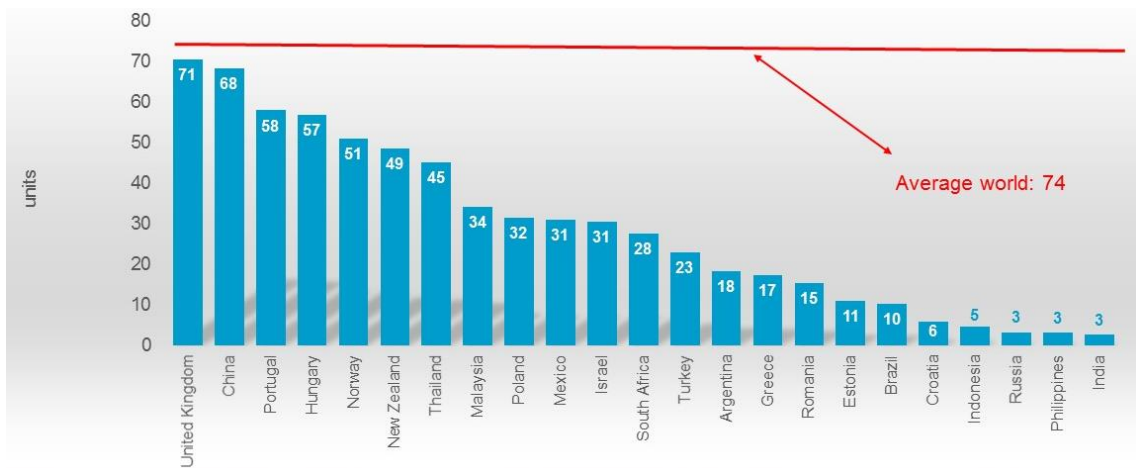
Figures 2.2. and 2.3. show us the number of installed industrial robots per 10.000 employees in the manufacturing industry in 2016.

Figure 2.2. Number of Installed Robots per 10.000 Employees in the Manufacturing Industry 2016



Source: World Robotics, 2018

Figure 2.3. Number of Installed Robots per 10.000 Employees in the Manufacturing Industry 2016 (Continued)

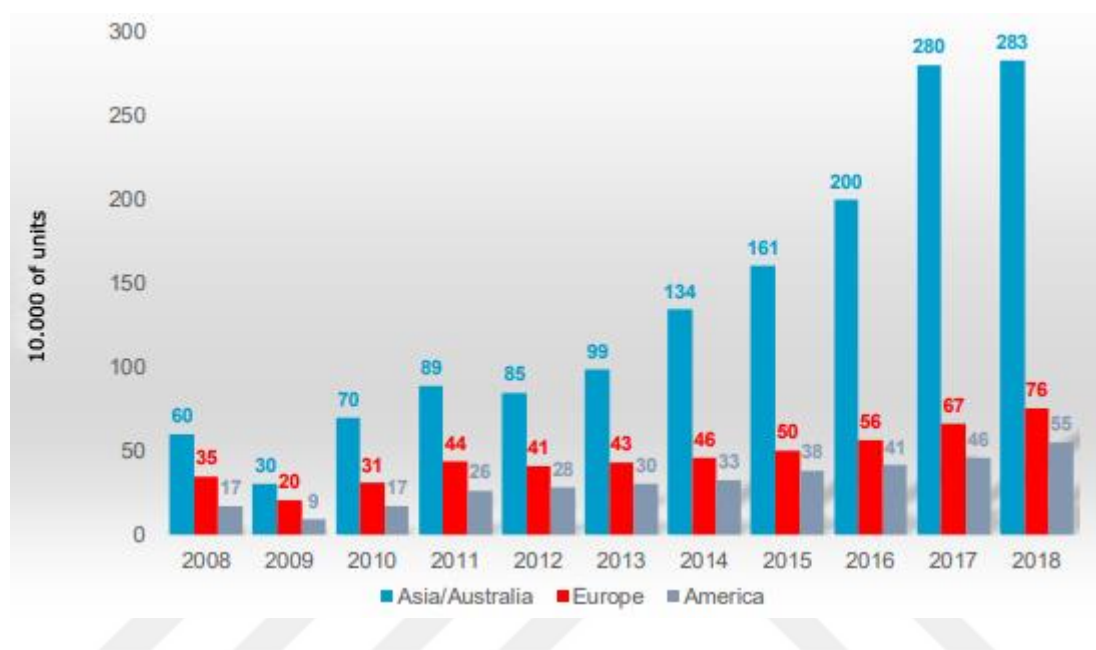


Source: World Robotics, 2018

The world's top 10 countries in robotics are listed as follows: South Korea, Singapore, Germany, Japan, Sweden, Denmark, USA, Italy, Belgium, and Taiwan (IFR Press Release, 2018). According to Junji Tsuda, the President of the International

Federation of Robotics, robot density is an important indicator for comparing countries. The rate of increase was 9 percent in Asia, this rate was 7 percent in the American continent and 5 percent in Europe (IFR Press Release, 2018)”,.

Figure 2.4. Annual Installations of Industrial Robots by Regions



Source: World Robotics, 2019

According to the IFR’s *World Robotics 2018* global robot installations have increased 6 percent and reached approximately 423 thousand units worth of 16.5 billion dollars. Asia remains the largest robot market since two out of every three robots installed are in Asia. Between 2013 and 2018, robot installments have increased by almost 23 percent each year. In Europe, the second-largest robot market, the rate of increase is around 14 percent, and a total of 76 thousand robots have been installed. On the American continent, as of 2018, this number is around 55 thousand, and this corresponds to an increase of 20 percent. According to the report, there are five major markets for industrial robots. These are China, Japan, the USA, Korea and Germany. China has been the world’s largest robot market since 2013. In 2018, about 155 thousand robots were installed in China alone. Although there has been a decrease of 1 percent compared to 2017, the number of industrial robots that China has installed alone is still more than Europe and America combined (130,772 units) (World

Robotics, 2019). Annual installations of industrial robots by regions can be seen in Figure 2.4.

In 2018, the average robot density in the manufacturing industry was around 99 robots for every 10,000 workers. Europe has the highest rate of robot density as 114 robots work for 10000 workers in Europe, while this ratio is 99 robots to the American continent and 91 robots in Asia and Australia. Asia ranks first in this regard as the rate of increase. In Asia, the increase in robot density was 16 percent annually between 2013 and 2018, while this rate was 9 percent in America and 6 percent in Europe (World Robotics, 2019).

2.1.4. Biotechnology

Biotechnology is a hybrid concept of biology including living systems and organisms and the broader area of biology to develop or produce a product. Thus, biotechnology means modifying living organisms for some purposes, historically the development of these organisms by applying artificial selection and hybridization through processes such as the domestication of animals and breeding of plants is relevant.

Modern reflections of biotechnology are genetic engineering and cell and tissue culture studies. The American Chemical Society (ACS) defines biotechnology as the application of biological organisms, systems or processes by various industries to learn about life and develop organisms and materials such as pharmaceuticals, crops, and livestock. For the first time in 1996, the American Food and Drug Administration (AFDA) approved a biotechnology product and afterwards dozens of products were approved. Biotechnology companies and institutions develop solutions to biomedical problems using chemistry, biochemistry, biology and genetics. It is possible to produce a biotechnology product after years of research and experiments and chemists, biologists, crystallographers, molecular modeling specialists, and other science experts work together (ACS, 2019). On the other hand, the European Federation of Biotechnology (EFB) has defined the concept of biotechnology as the integration of natural sciences and organisms, cells, and related parts and molecular analogs for products and services (EFB, 2019).

In the simplest sense, the Norwegian University of Science And Technology (NTNU) states that making and baking bread is a biotechnology business. Because, by definition, biotechnology means using biological systems and living organisms and their parts to produce a different product. Accordingly, making bread needs using yeast, a living organism so it is a biotechnological activity. From this point of view, biotechnology history can be taken back to the early days of humanity using the methods of fermentation, living organisms, domestication, and plant breeding for a long time (NTNU, 2020).

While these traditional methods of biotechnology use living organisms in their natural form or by breeding, modern biotechnology generally benefits more advanced modifications of the biological system and organisms. With the development and spread of genetic engineering in the 1970s, research in biotechnology and related areas of medicine and biology have also accelerated. Because the DNA can be altered. Today, biotechnology includes different subdisciplines such as Animal Biotechnology, Medical Biotechnology, Industrial Biotechnology, Environmental Biotechnology and Plant Biotechnology. Biotechnology is widely used in medicine (new therapy and drug production), agriculture (genetically modified plants, biofuel production, and biological treatment) and industrial research (chemicals, paper, textiles, and food products) (NTNU, 2020).

Biotechnology is based on biological sciences such as molecular biology, biochemistry, cellular biology, embryology, genetics, and microbiology, and it also develops methods to be used in and support basic research in biology. For example, bioengineering is the application of natural sciences principles to tissues, cells, and molecules (Abramovitz, 2015:10).

Agriculture is undoubtedly the most wide field of biotechnology. The first example is the first farmers chose the most productive seeds and the most productive crops and improved the crops for feeding people. Today, industrial agriculture uses biotechnological methods to produce efficient enough to feed the growing population. In agricultural studies, great success has been achieved in improving seeding technics and neutralizing pests with some biotechnological products. As the first biotechnological product, fermentation of beer and similar drinks can be given as an example. The domestication and breeding of plants and animals were known for ages,

and these studies contributed to Darwin's development of the “*natural selection*” theory (Cole-Turner, 2003) Thus, examining the artificial selection processes called domestication and breeding, Darwin reached the idea of “natural selection” that exists in nature.

One of the most important contributions of biotechnology is the development of antibiotics. In 1928, Alexander Fleming discovered the Penicillium bacteria paving the path for antibiotic technology. Modern biotechnology started in 1971 with the success of Paul Berg's genetic studies. In 1972, Boyer and Cohen managed to transfer genetic material to a bacterium, and the resulting product could also be reproduced. This was made revolution in biotechnology. Later, research in this field gained weight and applied in different fields and in various branches (Thieman-Palladino, 2008:322).

Bioinformatics approaches biological problems with numerical and computational methods. Blue biotechnology covers industrial applications of water resources. Biofuel production uses photosynthetic micro-algae as an example. Plant breeding, productivity, and micropropagation are further examples of green biotechnology. Reduction and treatment of wastes through microorganisms are also included in this field. Red biotechnology describes the use of biotechnology in medicine, pharmaceuticals, and health protection. Areas such as all kinds of vaccine production, antibiotics, regenerative therapies, artificial organ production, new diagnosis and treatment methods, hormone development, stem cells, antibodies, RNA research are within this scope. Today, studies to produce vaccines against the COVID-19 pandemic are also in this field of biotechnology. White biotechnology covers industrial biotechnology and studies are carried out through the redesign of organisms to produce useful chemicals. It is possible to produce useful chemicals and destroy harmful chemicals using enzymes and industrial catalysts. Yellow biotechnology is about what is used in foodstuffs. All types of wine, cheese or beer production through fermentation are included in this field. In addition, biotechnological tools produced to destroy pests are evaluated in this field. Gray biotechnology is an area with environmental applications covering the studies on the maintenance of biodiversity and the reduction of environmental pollution. Brown biotechnology is a field for managing inefficient land and deserts including production of developed seeds to enable agriculture in these areas. Gold biotechnology deals in bioinformatics,

computers science, chip technology as well as nanobiotechnology. This includes search for primers, sequencing of peptides, search for alternations in DNA. Violet biotechnology deals with legal, ethical and philosophical aspects while dark biotechnology, on the other hand, involves destructive activities on living creatures using bioterrorism, biological weapons, microorganisms such as biological warfare, disease-causing toxic biotechnological products (Edgar, 2004:4).

Table 2.7. Rainbow Code of Biotechnology

Red	Medicine and human health
White	Industrial processes involving microorganisms
Green	Processes improving agriculture
Blue	Marine biotechnology
Yellow	Food and nutrition
Gray	Environmental biotechnology
Gold	Bioinformatics, computer science
Brown	Biotechnology of dessert and dry regions
Violet	Law, ethics, philosophy
Dark	Bioterrorism, biological warfare

Source: Edgar, 2004:4

In the field of biotechnology the USA is still dominant since 48.2 percent of firms are U.S.-based companies. Asian Pacific countries have the highest market share after the USA. Asian Pacific countries' market share is 24 percent. Asian Pacific is followed by Europe with 18.1 percent and the Middle East countries with a small share of 1.8 percent. The rest of the world shares 7.9 percent of the market (Marketline Industry Profiles, 2019).

Table 2.8. Market Share of Biotechnology Companies 2019

Rank	Country/Region	Market Share
1.	United States	% 48.2
2.	Asian Pacific	% 24
3.	Europe	% 18.1
4.	Middle East	% 1.8
5.	Rest of the World	% 7.9

Source: Marketline Industry Profiles, 2019

Biotechnology Research and Development (R&D) expenditures show us the USA being ahead of its rivals. 58% of the Pharmaceutical R&D expenditures made in the field of biotechnology belong to American companies. The closest competitor of the USA is Japan, with 13 percent (ABPI, 2016).

Table 2.9. Share of Total Pharmaceutical R&D 2016

Rank	Country	Share
1.	USA	58%
2.	Japan	13%
3.	UK	7%
4.	Switzerland	7%
5.	Germany	6%
6.	France	5%
7.	Italy	1%
8.	Canada	1%
9.	Spain	1%
10.	Sweden	1%

Source: ABPI, 2016

The OECD report published in 2010 emphasized that Singapore, Brazil, China, India, and South Africa are the rising stars of biotechnology (OECD, 2010). A study by Ernst and Young published in 2017 has confirmed this data since China, Taiwan, Singapore, Japan, and South Korea have made a huge breakthrough in this area by a total investment of \$ 2.5 billion (Ernst & Young, 2018).

2.1.5. Nuclear Technology

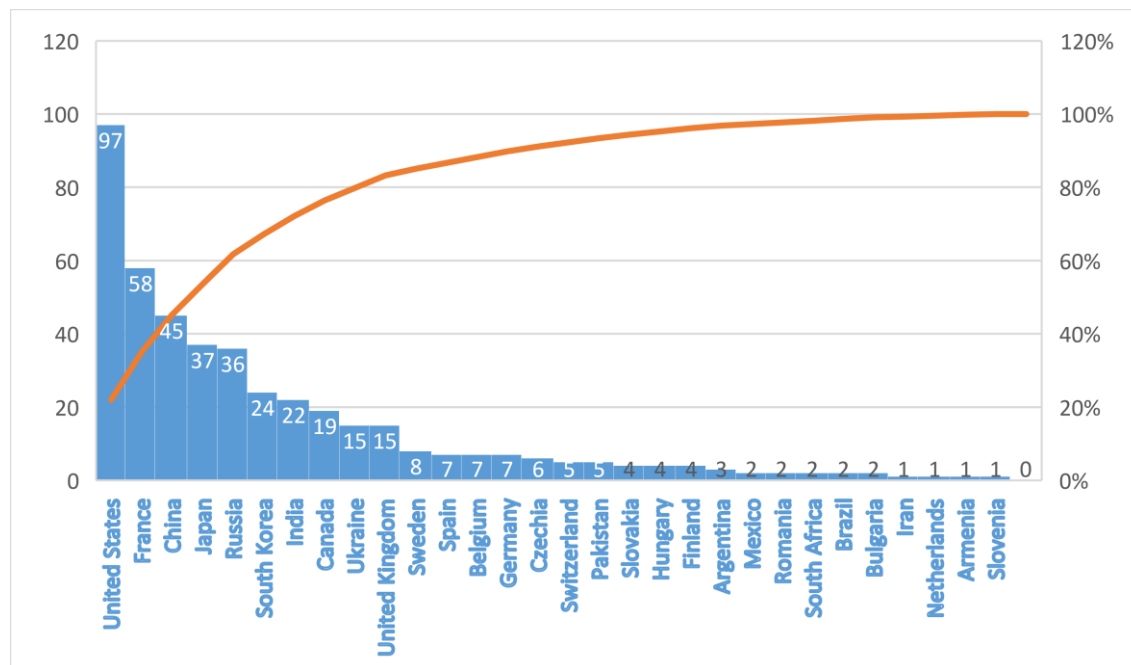
Nuclear technology is the science that deals with reactions of the atomic nucleus in the most general sense. Among the most important nuclear technologies are nuclear energy, nuclear medicine, and nuclear weapons. The basis of this technology is the principle of breaking down or combining natural or artificial elements and using the high energy released as a result of the reaction. The resulting energy is huge and used as a weapon, it can have devastating effects as atomic or hydrogen bomb.

However, using it in a controlled manner, it provides great benefits as in the case of nuclear power plants.

In 1932, Ernest Rutherford discovered that when lithium atoms were disintegrated, they released an enormous amount of energy in accordance with the law of mass-energy equality. However, Niels Bohr and Albert Einstein, pioneers of nuclear physics did not think that it would be possible to control and use this high amount of energy. In the same year, Rutherford's doctoral student James Chadwick discovered the neutron particle and found it to be ideal for nuclear experiments because there was no electric charge. Experiments with neutron bombardment led Frederic and Irene Joliot-Curie to explore the concept of induced radioactivity and the creation of radium-like elements. Enrico Fermi's subsequent works also contributed to the process. After experiments carried out by German chemists in 1938, the nuclear chain reaction resulting from fission reactions was discovered paving the way to nuclear energy. Since 1939, the USA, the UK, France, Germany, and the Soviets have supported government-based nuclear research and sought to develop a nuclear weapon during the WW II (Rhodes, 2012:318).

In the USA, Fermi and Szilard worked on the construction of the first nuclear reactor. In the study carried out as part of the Manhattan Project, the main purpose of Allied Forces was to create an atomic bomb during WW II. The U.S. tried its first nuclear weapon against Japan in July 1945 on Hiroshima and Nagasaki. Hundreds of thousands of people died as a result. The electricity production from nuclear energy was first achieved in 1951 in a nuclear reactor in Idaho, USA. In 1953, the then US President Dwight Eisenhower made his speech "*Atoms for Peace*" at the UN and stated that the use of nuclear energy for peaceful purposes should be encouraged. Atomic Energy Act was signed for the first time in 1954 leading the rapid spread of reactor technology (Hoddeson et al., 1993). This spread has accelerated much enough a nuclear reactor was opened almost every 17 days in the 1980s globally (Thorpe and Gary, 2015:120). The Atomic Energy Commission (AEC) and Nuclear Regulatory Commission (NRC) were established in the USA in response to the increasing nuclear energy opposition in the 1970s. Thus, the first regulations on nuclear energy were introduced and later more than 120 nuclear reactor projects were canceled in the 1980s (Cook, 1985:2).

Figure 2.5. Number of Operable Nuclear Reactors 2019



Source: Statista, 2019

The Chernobyl disaster in 1986 also caused many countries around the world to reduce their nuclear reactor construction activities (Rudig, 1990:164). The biggest nuclear accident after Chernobyl occurred in Fukushima Daiichi Nuclear Power Plant in 2011 after an earthquake (Westall and Dahl, 2011). As of 2019, there are 450 nuclear reactors in 30 different countries around the world. Most of the reactors (97) are located in the USA. France, with its 58 reactors is the biggest owner in the European continent. In Asia China, Japan, Korea and India has a total of 128 reactors. As of 2018, it is planned to build around 150 nuclear reactors around the world, and 50 of them are already under construction (Statista, 2019). Figure 2.5. shows us the number of operable nuclear reactors as of June 2019, by country.

The new reactor construction is mostly seen in Asian countries such as South Korea, India, and China. As of January 2019, while 45 reactors were operational in China, 13 new reactors are under construction. China plans to build 43 new reactors.

After these constructions, China is to be producing the most of its electricity from nuclear energy (The Economist, 2019).

After Hiroshima and Nagasaki, it became clear what the tragic consequences of nuclear armament would be before humanity. Thus, after WW II, several steps were taken towards non-proliferation. The Baruch Plan (referring to Bernard Baruch, the first American representative of the UN Atomic Energy Commission) included the inactivation and destruction of the US nuclear weapons in general. Accordingly the US had set two conditions: The first is the establishment of an “international atom development authority” and the other is to impose automatic sanctions against nuclear armament that even the UN cannot veto (Gerber, 1982:69). The concept of “nuclear ethics” entered the literature with the Baruch Plan. Although it was not initially accepted at the UN due to the opposition of the Soviet Union, these efforts fruited in 1957, and the International Atomic Energy Agency (IAEA) was established. The proliferation of nuclear weapons was not possible until the 1960s. The US, Russia, UK, France, China, India, Pakistan, North Korea, and Israel still have nuclear weapons. The number of nuclear weapons estimated to be 70,300 in 1986, decreased to 3,700 active weapons as of 2019, and there are a total of 13,890 nuclear warheads. 90 percent of these nuclear warheads are kept by the USA and Russia. While China has 290 nuclear warheads, India is estimated to have around 130-140 nuclear warheads. (Sipri Yearbook, 2019).

According to The World Nuclear Industry Status Report (WNISR), in 2018, nuclear energy production in the world rose by 2.4 percent in total, with the effect of 19 percent growth in China. In 2018, nine new reactors were started to produce energy. Seven of them belong to China, while 2 of them belong to Russia. In the first half of 2019, four units started operating and two of them were again in China. The number of reactors under construction has been steadily declining for the past six years. While the number of reactors under construction was 46 in 2013, as of the first half of 2019, this figure was 46. Again, 10 of them are built in China. The share of nuclear energy in the world's total energy production continues to decline slowly but steadily after its historic peak of 17.46 percent in 1996. In 2018, this number dropped to 10.15 percent. The share of nuclear in global commercial energy consumption has remained stable at around 4.4 percent since 2014. Since there are no major nuclear constructions other

than China, the average age of existing nuclear reactors has also risen considerably. As of the first half of 2019, the average age of nuclear reactors was 30.1 years and, for the first time, passed the 30-year limit. Currently, 272 reactors have been in service for 31 years or more. 80 reactors have been producing energy for 41 years and more⁸ (WNISR, 2019). Table 2.10. shows us the nuclear reactors under construction as of 1 July 2019.

Table 2.10. Nuclear Reactors Under Construction (as of 1 July 2019)

Country	Units	Capacity (MW net)	Construction Starts	Grid Connection	Units Behind Schedule
China	10	8.800	2012-2017	2020-2023	2-3
India	7	4.824	2004-2017	2019-2023	5
Russia	5	3.379	2007-2019	2019-2023	3
UAE	4	5.380	2012-2015	2020-2023	4
South Korea	4	5.360	2012-2018	2019-2024	4
Belarus	2	2.218	2013-2014	2019-2020	1-2
Bangladesh	2	2.160	2017-2018	2023-2024	0
Slovakia	2	880	1985	2020-2021	2
USA	2	2234	2013	2021-2022	2
Pakistan	2	2.028	2015-2016	2020-2021	0
Japan	1	1.325	2007	-	1
Argentina	1	25	2014	2021	1
UK	1	1.630	2018	2025	0
Finland	1	1.600	2005	2020	1
France	1	1.600	2007	2022	1
Turkey	1	1.114	2018	2024	0
Total	46	44.557	1985-2019	2019-2025	27-29

Source: WNISR, 2019

⁸ Most nuclear power plants have operating lifetimes of between 20 and 40 years (IAEA, 2021). However there are some efforts for extending the lifespan of a nuclear reactor up to 80 years (Energy.gov, 2021).

2.2. The Hi-Tech Reflections in Global Politics

We live in an era where human life is shaped by technology, and almost every subject is somehow technological. States could not remain uninterested in technology which touched human and social life so much and determined their future. First, technology meant both economic and technical strength. Second, technology also meant an interactive society and a political tool with its use in daily life for expressing and transferring ideas.

Current IR theories have difficulties in addressing this multidimensional field that combines technology and politics. There is a lot to be said in this field but there is little said. The aim of this study is to contribute to these hybrid concepts expressed in the concept of techno-politics and to draw more attention to this area that will determine our future. The crucial points of techno-politics correspond to state, power, international security, war, and foreign policy. Starting with WW II, the possibilities of nuclear war actually directed the IR discipline to think about technology and politics together. The Cold War period, space technologies became an important subject of politics. It should be seen that technology is always effective in politics and actually more effective than we think today. Technology is janus-faced. One is dark, the other one is bright. And both sides are somehow reflected in politics. In the WW II, we saw its dark side in Hiroshima and Nagasaki. During the Cold War, we witnessed a constructive and bright face in a sense as space technology developed. But in our age, technology has to be integrated with politics like never before. Technology is always thought to provide economic development and consequently, human well-being. This optimization has an aspect reflected in the war and conveyed by Mayer et al. (2014:4) from Rasmussen. According to Rasmussen (2014), NATO's advances in military technology, its active use of satellites, radars, and defense technologies will be important in ensuring the global security. However, Arkin (2010:332) and Kaag and Kaufman (2009:585) criticize technology to enable autonomous and unmanned war processes and question it in this sense. The fact that most of the dystopias are technology-centric makes it possible to say that this fear also affects the IR. In this sense, technological developments have caused different effects in history. For instance, it can be claimed that geographical discoveries, colonialism, and imperialism have strengthened marine and navigation technologies. Moreover, the development of

communication technologies and most importantly, internet, capitalism, globalization, and imperialism have gained power. On the other hand, it is possible to argue that the free environment of technology transfer and internet emphasize local cultures, local values.

From a skeptical point of view technological developments are one of the great myths of the postmodern age. Although disasters related to modern weapon systems brought by technology were evident, the myth of "technological development" remained strong as perception. According to Schlosser (2013:33), the idea of the absolute weapon to destroy the enemy actually contained mass destruction and existential risks for humanity. Throughout the history many nuclear accidents had occurred globally. When the effects of disasters such as Chernobyl and Fukushima are added, it is understood that these fears are not unfounded.

Looking from a skeptical point of view technological development can never be neutral and peaceful. It often even expresses irrational and inhuman ambitions (Feenberg, 2012:156). Some political scientists attribute technologies used by Nazis for the Holocaust in WW II to this destructive feature of technology (Bauman, 2013:134). Closer examples of the techno pessimist skeptical approaches are developed against the World Wide Web (www) system. While many optimists consider the Internet as a tool of freedom and cultural interaction, pessimists prefer to see it as a means of state repression, censorship and destructive surveillance device against private life and personal freedom (MacKinnon, 2013:6).

The same is true for biotechnology. While for many, biotechnological research means positive things such as developing medicines for human health or finding more environmentally friendly solutions than traditional industrial agriculture, some are cautious when it comes to playing with genes or making biological weapons. However, despite all this skepticism, the positive aspects of technology receive broad acceptance in IR literature (Mayer et al., 2014:6). In this regard, the perception of globalization is getting stronger day by day corresponding H-T and widespread internet and communication. However, dialectically that each thesis constituting its own anti-thesis has been valid for globalization too, and in a sense, a phenomenon of localization as a subfield of globalization has emerged in response to globalization since local is global any further or vice versa.

Ince (2009:259) argues regarding the contradiction of globalization and localization, that modernity has brought about a localizing effect as well as globalizing structurally. At this point, Altunoglu's (2005:70) “global capitalism includes the local and reproduces itself over the local” goes hand in hand with the globalization is itself as localization and from time to time it is in the transformative nature of the capitalist system.

The dynamics between the global and the local have eventually created a new concept: “*Glocal*”. Regarding dialectical approach this synthesis originates from the coexistence of global and local. It is possible to argue that especially unlimited areas such as advanced communication technologies, internet, and information power called big data will lead to loss of democratic control over information, or on the contrary, contribute to the democratization of information. The second one is more likely to happen.

One of the areas transformed by technology is war. The most feared one, the nuclear war in warfare technology, is no longer the only focus. Robotic technologies, unmanned aerial vehicles, and cyberwar have already replaced this fear. Of course, the effect of war technology affects the approach of states on the subject. States are doing their best to access the best fighter jets, defense weapons, rockets, drones, cyber defense systems, and some of the nuclear power. Thus, it is not in vain that Morgenthau (1964:1386) argues that we cannot understand geopolitics and geoeconomic facts without understanding technology. However, scholars generally focus on how technologies shape policies and do not adequately address how policies shape technologies. Thus, this interrelation and interaction between technology and politics are often neglected (McCarthy, 2017: 224-225). States use technology as a tool, and are also influenced by it. Thus, they shape technology through techno-politics in designs as well as the direction.

When we look at each area of H-T (aerospace, cyberspace, mechatronics: robotics, biotechnology, and nuclear technology) today all these are areas of strategic value and are directly related to states' security policies as well as their economic and social policies especially observable in education. For example, the USA has a dominant image in almost all areas of high technology as well as a voice in world

politics, and its hegemony as a superpower is related to the technopolitics applied especially in education in all layers and fields.

Power and its analysis are not just about analyzing who can do what and who has power over others. In addition it is necessary to answer how social conditions become appropriate for creation of the internet, the atomic bomb or the AK-47 rifle. Technological determinism ignoring the human factor in creating new technologies prevented us from asking such question especially in terms of IR (McCarthy, 2017: 296). Therefore, it is necessary to approach this issue from this point of view and to question the environment creating these social conditions.

Another discussion about the use of power related technology is the legitimacy problem. According to McCarthy (2017:296), this is already one of the basic questions of political theory, and this takes us to the humanity old question of “*Is the power of the rulers legitimate?*”. Thus, we need to ask the same question about the use and development of technology. However, technology and its development have also a social and political infrastructure. Because when actors directing technology disappear, the legitimacy question become meaningless. So states and social structures shape policies and ultimately governments actively steer technology policies. Was it legitimate to produce the atomic bomb? Are China's restrictive policies on the internet legitimate? What social and technical reasons do these decision-makers rely on when making these decisions? These are all theoretical questions asked about technopolitics.

We have already mentioned that the approach to technology is the midpoint of determinist and constructivist approaches. According to Herrera (2006:28), technological determinism may correspond neorealism and social constructivism may correspond to constructivism in IR. However he reminds us that constructivism examines the formation of social identities and how these identities shape political actors. He also states that technological constructivism focuses on social forces shaping the evolution of technology without concern of social effects of these technologies. The determinist view recognizes technological profound and deep effect on politics. Accordingly technology cannot be changed by human intervention because it is a natural phenomenon as Negroponte (1995:220) pointed out, “The digital age cannot be rejected or stopped as a force of nature.” In opposite, the social construction

of technology is the dominant view (Mackenzie and Wajcman, 1999:178). According to the technological constructivist theory, technology and its effects are created through human interests and creativity as well as through political and economic powers. Technology producers make choices about how to develop it. They do or do not target or exclude some special interests and specific purposes. Thus, they decide which technologies to be developed or not, and thus, they give direction. Therefore, these developments and directions are feasible factors. Accordingly, social structure is not natural but formed resulting from human will and interest. The best example is nuclear weapons. Nuclear fission may be a natural phenomenon, but producing nuclear weapons is entirely a human preference and a political choice. Therefore, technologies we have are not inevitable. They are not independent of social, economic, and political forces (Herrera, 2006: 32).

According to Headrick (1981:144), it is true that some technologies have explicable political effects but these are filtered by political and social actors' interests, behaviors, institutional constraints and opportunities. In other words, it is not completely independent of them or they cannot be accepted as pure effects of technology. Technology, like other social structures, can set limits or offer opportunities for human behavior. Thus, technology has social origins (constructionism) as well as social effects (determinism) and they are shaped by human will and interest (constructionism), but they can resist some intentions (determinism).

According to Herrera (2006:34-35), this dilemma can be solved by defining technology as a sociotechnical system. This shows that technologies may not be political or social on their own, but they can often be put into a political analysis when they become operational and are a social and political tool and cause concomitant results. Likewise, it is possible for technologies to become politicized within the process they emerged. In other words, technology may not be about politics at first, but it can turn into a political tool when necessary conditions arise.

Therefore, it is necessary to examine each technology within itself and to look at its sociological and political effects according to conditions of emergence and usage. Therefore, we will examine the five areas we consider to be the most sociologically and politically effective in H-T. These areas are aerospace, cyberspace, mechatronics: robotics, biotechnology, and nuclear technology. So, in the next section, we will

examine techno-policies implemented by China and India, the effects of these applications in the region and world politics and consequently their activities in these H-T fields. But before, we need to ask two main questions. 1. Why do countries wish to be powerful in H-T fields? 2. Why do they sell or transfer their technologies to some other countries? The H-T is important in several ways as it adds economic, strategic and political power to states. The H-T means a stronger defense industry, army and economy as well as states owning high technologies take psychological advantage over others.

Regarding the second question, four answers below are available:

1. Achieving economic interest: H-T is an expensive technology and has a high added value. Therefore, H-T exporting countries earn an enormous income economically.

2. Strategic concerns: For macro-political reasons making a country in the region stronger than others may come from these strategic concerns. For example, the American export of military technology to Saudi Arabia against Iran and equipping its army is an example of these strategic concerns.

3. Building Alliances: Sometimes, governments may also export technology to gain allies. This can be either financial support or technology transfer. During the Cold War, the Marshall Plan consisted of financial and similar supports to strengthen countries against the Soviet influence in the region. For the same purpose while the USA supports India's nuclear industry, China is supporting Pakistan in nuclear arena.

4. Creating technologically dependent countries for itself: H-T exports also make countries technologically dependent because H-T costs high for maintenance and newer technologies are always at the door. Therefore, the technology importing countries develop a sense of commitment to the country it exports from.

In this respect, it would be appropriate to look at the situation and activities of China and India in the region regarding H-T.

CHAPTER 3

HI-TECH COMPETITION BETWEEN CHINA AND INDIA

3.1. China and Hi-Tech

China's population has reached almost 1.4 billion. This is a larger figure than the total population of North America, South America, Australia, New Zealand, Scandinavia, and all of Western Europe combined. According to the Chinese government, about 16 percent of the population lives in 15 major cities, each with a population of more than 10 million. There are only 47 cities in the world with this population density. As of 2018, China has 18.6 percent of global Gross Domestic Product (GDP). It exports 41 percent of computers, 34 percent of air conditioners, and 70 percent of mobile phones globally (Tiley, 2020). China has literally become a global economic power center. Understanding its mechanism is very important to understand Chinese seat in H-T. During WW II, China and America were allies against Japanese imperial aggression. In this period, China, like America, focused on mass production on a large scale. But after fighting against the Japanese, China was shaken by a ferocious civil war between the US-backed nationalists led by Chiang Kai-shek and the Communist army and its leader Mao Zedong. In 1949, Mao achieved victory resulting in the foundation of the People's Republic of China. Mao's motto was everyone should have an equal share of wealth and this collective community would be represented by the state. In addition, China had to be completely self-sufficient in terms of finance, food, and goods. There was no longer any more stock market or diplomatic or economic relations or maybe a very limited relation with the capitalist West. China and the 542 million population at that time would be isolated from the rest of the world. In 1952, in order to modernize his nation, largely dependent on agricultural production, Mao encouraged millions of peasants to leave their farms and work in factories. He initiated a cultural revolution in which he punished his opponents by sending to reeducation camps. Paramilitary groups attacked bourgeois intellectuals. Many cities were caught chaos. At least one million people died (Tiley, 2020). Meanwhile, China suffered from widespread famine, bad infrastructure, and a dominant economy. It was largely ignored by the rest of the world. In 1960, the Chinese economy was worth \$ 59 billion. Meanwhile, the US economy was worth \$ 543 billion (Tiley, 2020). However, in the early 1970s, the USA decided that it was

time to overthrow Mao, taking advantage of the disagreements between his Communist counterparts in the Soviet Union. Richard Nixon became the first American President to visit China. After 25 years of isolation, Mao seemed ready to re-establish ties with America. Nixon hoped to promote an American-style democracy in China. But when Mao died in 1976, his autocratic system kept functioning. It just slipped in a new direction. Deng Xiaoping took control of government at the end of 1978. Deng made it clear that his party would not give up power, but would consider opening up to the West if the Chinese people are to profit from that. This was the reason for Deng's visit to America. He sent a signal to the world that Communist China is ready for business. In 1979, they began by starting an economic reform program, creating four special economic zones (SEZs). SEZs were allowed to play with rules different from the rest of communist China. Here, factories could export goods to the West and importers could trade with capitalist countries. The idea was to make these regions attract foreign direct investment (FDI) and serve as mini-economic engines for the rest of the country. This idea worked very well and Chinese leaders stated that these SEZs were only trials on global trade. They also declared their commitment to Communism and Mao's ideals. One of the first SEZs was the Shenzhen fishing village, with a population of 59,000 in 1980. By 2016, its population increased to 12 million. Its GDP per capita rose surprisingly by 24569 percent. This explains why China started to build more of these development zones in the next 30 years. As of 2005, China built neighborhoods of Rome size every two weeks. Between 2011 and 2013, China used more cement for these constructions than the USA used in the entire 20th century. In these early SEZs, factory managers used Chinese massive workforce to fuel large amounts of low-cost exports. And productivity increased tremendously. Chinese socialism transformed since China met large consumer demand for cheap goods in the West. Economically, China has made a huge leap. Between 1980 and 1990, the Chinese economy almost doubled though it was still behind America. (Tiley, 2020).

However Chinese leaders opening doors to capitalism, encountered a problem. Young people were increasingly demanding more rights than profit. In the 1989 spring, students in Beijing's Tiananmen Square started daily protests for democracy, freedom of expression, and free press. But on June 4, the ruling Communist Party sent a clear message to students: Economic freedom is one thing, political freedom is another.

Tanks and troops sent to the squares, and a fire was opened to the demonstrators. The Chinese government never releases an official death toll. However, the incident would be known internationally as the *Tiananmen Square Massacre* (Tiley, 2020).

Chinese leaders did not compromise authority, but they continued to expand economically. In December 1990, they reopened the Shanghai Stock Exchange (SSE). China was still a Communist nation, but its transformation into a market economy seemed almost complete. In the late 1990s, China's economic success was everywhere. The memories and freedom fight of civilians killed in Tiananmen Square were almost forgotten as the wages and life quality increased. And foreign businesses were rushing to set up stores to reach millions of consumers in China. Luxury items from abroad became symbols of popular status. However, most Chinese citizens could not buy expensive branded goods from overseas. Thus, there was a huge demand for counterfeit goods. This new situation, corresponding to 8 percent of GDP, created a new boom for Chinese manufacturers. Recently, Chinese-made counterfeit products have spread worldwide. And those who produced the real ones of these fake products were not happy with this situation. The point is that China wanted to join the World Trade Organization (WTO) to consolidate its status on the world stage while the then American President Bill Clinton had support in this regard. However, these fake products had become a real problem. The USA insisted that Chinese leaders hinder fake production and China has promised to provide it. However, as of 2019, 85 percent of counterfeit products in the world are estimated to still come from China. In the 1990s, the rest of the world wants China to open its state-controlled markets to more competition from the outside. They say that it is unfair for the Chinese government to block imports to China, though already it has seized other countries with its exports. China has promises to balance its trade again and in November 1998. America has agreed to support China's entry into the WTO in response (Tiley, 2020).

Clinton hoped that Beijing's authoritarian government would be more democratic when he started doing more business with the West. But such optimism has blinded foreign powers to the aggressive rise of the Chinese economy. In 1999, the Chinese economy broke a record reaching \$ 1 trillion in size (BBC News, 1999). But America's economy was still at \$ 9 trillion levels. Then, in 2008, the global financial crisis having started in the USA was the worst economic disaster since 1929.

More than 2.6 million people lost their jobs in the USA, 1.8 million businesses closed, and 10 million homes were foreclosed in less than two years. In that December, China was also affected as exports to the US dried up. People did not buy goods as before so many Chinese factories were closed. However China's new leader, Hu Jintao used the state budget to compensate for all losses. The Chinese government has quickly announced a \$ 586 billion bailout package and the Chinese factories quickly turned from producing goods for export to domestic consumers. Then the 2008 crisis was turned into a slight shock for China. They rose again shortly and started quietly investing in developing countries in Africa and Asia. In 2015, China announced one of the most ambitious policies the Belt and Road Initiative, a wide range of infrastructure projects worldwide. These projects including a 12,000 km railroad from Yiwu, located on the shores of China, all the way to London and massive highway network connecting East China to Pakistan's ports. Moreover 1,833 km pipeline that can transport natural gas from Turkmenistan to the Chinese border via Central Asia. China has invested more than \$ 1 trillion in infrastructure projects in dozens of countries worldwide (Tiley, 2020).

This latest strategy of China's newest leader Xi Jinping really makes the West think about its future. Supporters of China's international investments say that these infrastructure projects will save millions of people from poverty and create jobs in emerging countries. Critics say this is a land takeover using a checkbook instead of a sword (Tiley, 2020). In both cases, these investments increase China's total wealth at an astronomical rate. According to the best estimates, by 2025, China will become the world's number one economic superpower. Less than 50 years ago, China was seen as a tough third world country. Today, the rest of the world is struggling to catch up with China. Most people agree that state-sponsored capitalism is perhaps better than America's messy democratic system when it comes to making a profit (Tiley, 2020).

Science and technology in China have evolved and progressed at the speed of light since the 1990s. The Chinese government has focused on the development, reforms and social status of science and technology for the country's socio-economic development and national prestige. With rapid developments in education, infrastructure, H-T production, academic publishing, patents, and commercial applications, China has become more noticeable in some of these areas. China

especially focused on innovation and erased its remaining weaknesses in these areas (Tiley, 2020).

China has been an important center in science and technology since the Ming dynasty years. Inventions such as paper, printing, the compass and gunpowder are among the Chinese innovations. Having experienced a decline in science and technology in the 14th century, China returned to the technology race in the second half of the 1990s. The “*Decision on Accelerating Science and Technology Development*” program published by the then Chinese government in 1995 is considered to be a milestone for the technological development that we talk about today. However, China earlier saw great losses in the 19th century against the Japanese and Western civilizations. Thus, there was a need for strengthening and renewal in the country. With the Communist victory in 1949, science and technology were structured according to the Soviet socialist principles and system in China (US Embassy Report, 1996). Thus, science and technology in China were guided by a bureaucratic organization and science and technology was shaped within the framework and goals of the central government. Researchers worked with a collective understanding rather than individual studies, and studies on practical applications gained weight. Meanwhile, there were serious restrictions on the distribution and dissemination of information, data and knowledge. However, there was also the transfer of Soviet technology (Worden et al. 1987:403).

With the death of Mao Zedong, some reforms in the field of science and technology have been carried out to date. One of them is the Chinese Economic Reform, carried out in 1976 under the direction of Deng Xiaoping. Because of this economic reform, science and technology have gained great importance in the political agenda along with the Cultural Revolution. Thus, the Soviet-based system was gradually reformed and publications emphasizing science, technology, scientific development and scientific thought were made in the Chinese media (Worden et al. 1987:199).

If we come to the “*Decision on Accelerating Science and Technology Development*” program in 1995, science and technology were determined as the key factors of China's economic development, social evolution, national strength, and rising living standards. Thus, in addition to the institutions acting with the Soviet

system, university and private sector were encouraged to carry out research and development studies. Afterwards Chinese government institutions have expanded their research and development fields by establishing joint ventures with the private sector and even foreign companies. The intellectual property started to be respected and original research was encouraged. The technological and scientific competition was encouraged through projects while information exchange was ensured. According to this program, Chinese officials are also obliged to improve their perspectives on science and technology. Society, Communist party members, youth organizations, trade unions, mass media are organized to promote respect and care for information and human ability in general (US Embassy Report, 1996).

If we look at the last 30 years of China, we observe country's attachment into great importance to physical infrastructure in general. By following an economically smart policy, China has stipulated that foreign companies should make technology transfer to reach the Chinese market. During this period, China established an innovation infrastructure and established more than 100 science and technology parks in many cities. Moreover, besides public institutions, entrepreneurship and individual investments are also encouraged. According to Yip and McKern (2016:189), China-based companies have reached world standards with their innovation capabilities and have reached an assertive position both in the national and global market.

Speaking of the Chinese market, China's current population is estimated at 1.4 billion (as of May 15, 2021: 1,444,185,526) corresponding to 18.47 percent of the world total population. China is the most populous country despite the population growth rate of China implementing one-child policy⁹ has decreased from 2.2 percent annually in 1952 to 0.39 percent by 2020. While 60.8 percent of this population of China is urban and the average age is 38.4 (Worldometers, 2021). Population density and young population are seen as one of the biggest advantages of China as a workforce and human resources.

⁹ The one child policy is a population planning policy implemented in China. The one child policy was put into practice in 1979 to prevent overpopulation. From the mid-1980s, the policy was changed to allow rural parents who has a girl as the first child, to have a second child, and then it took another thirty years before the government announced the return to the two-child limit in late 2015. The policy also allowed exceptions for some other groups, including ethnic minorities. Hence, the term "one child policy" can also be seen as "misnomers". Because in about 30 of its 36 years of existence (1979-2015), nearly half of all parents in China faced the two-child limit instead (Scharping, 2003).

The techno-nationalism movement has a big share in the rise of China. Although the concept of “*techno-nationalism*” emerged in the 1980s USA, Chinese ambition to rise with technology after its humiliating situation in the 19th century against more advanced nations backs of China's adventure. Chinese leaders also observed technological development as a source of economic power, national security, and national prestige. They also evaluated the absence of local technological innovation as a key national problem (Reich, 1987: 62). Thus, in the 21st century, Chinese government established an initiative to develop many “*local innovation*” on a national scale. These include the National Medium and Long-Term Program for Science and Technology Development (2006–20), the Strategic Emerging Industries initiative, the Internet Plus initiative, and the Made in China 2025 Program (OECD, 2017).

The Chinese state has been able to intervene in the economy in many different ways to promote national technological development and reduce dependence on other countries. In this sense, some prior industries and companies are protected and guided by policy. Systematic efforts have been made to substitute local technology and intellectual property instead of foreign counterparts. Foreign companies are also given extraordinary incentives to transfer technology and move R&D units to China. While doing this, the technological capacities of local companies have been supported in various ways including cheap financing from state banks, tax breaks, subsidized electricity, and subsidized land (Kennedy, 2013: 909-930).

On the other hand, as a reflection of this techno-nationalism movement reports showed that in 2019 the Chinese government ordered all foreign technology, such as hardware and operating systems used in governmental institutions be replaced with indigenous technology within the next couple of years. The R&D expenditures, one of the most important factors in the development of technology in China, have been significantly increased. According to the Medium and Long-Term Plan for the Development of Science and Technology (2006-2020), China has taken an important step by aiming to allocate 2.5 percent of its GDP to R&D by 2020. In this sense, this ratio has been gradually increased from 1.13 percent to 1.98 percent from 2003 to 2012, and it is thought that the target 2.5 percent will be reached in 2020. According

to the data of the UNESCO Institute of Statistics, China devotes an average of 5 percent of its total research budget to basic research. (Liu et al., 2011:919).

China's biggest advantage in science and technology is undoubtedly its human capital. Giving scientists, earlier working under difficult conditions, after the mid-1980s the opportunity to build their own careers paved the way for scientific and technological developments in China (Worden et al. 1987: 401-402).

The modernization and rapid economic development model adopted by China after 1980 was predominantly based on foreign technologies. In this sense, China has developed very effective economic policies through joint ventures to attract foreign capital and technology to the country. The primary goal of China's economic planners was to transfer technology in strategic areas such as electronics, telecommunications, electric energy production and transmission, transportation equipment, and energy-saving devices. Therefore, government incentives and loans were mobilized to attract foreign technology to the country (Worden et al., 1987:86)

Chinese institutions and their national programs are also among important components of the country's development in technology. The State Council is the highest administrative agency in the country and there are several ministries and organizations that are linked to several aspects of science and technology. The State Council Science and Education Leading Group, consisting of the prominent actors of the scientific institutions, are in control and able to organize the national policies about technology and science. The Ministry of Science and Technology is the organ responsible for strategy and policy about science and technology and also administers the national research programs. Other ministries such as the Ministry of Industry and Information Technology, the Ministry of Health, and the Ministry of Agriculture of the People's Republic of China also have responsibilities in science and technology. The Chinese Academy of Sciences is considered as the most prestigious science organization managing many research institutes, programs with its influential effect on decisions about the national strategy of technology (English.Gov.Cn, 2021).

Human resource with undergraduate and postgraduate education is an important factor in development and innovation. Although the proportion by population on educated human workforce in China seem low compared to the USA and Japan, an upward trend is observed for China. In 2009 alone, more than 10,000

doctoral students graduated in China. In addition, students studying in China's diaspora have contributed greatly to the development of science and technology. Between 1978 and 2011, 2.25 million Chinese students have trained abroad and the vast majority of them returned to their country. According to a 2009 study, only 10 percent of Chinese students who went to the USA for education stayed in this country. Graduates who study abroad and return to China are mostly in executive positions in H-T companies (Wadwa et al., 2011:3). The citizens of China in the diaspora also contribute greatly to the development of their country through commercial activities and non-profit cooperation. The Chinese government has also made the necessary arrangements to ensure that qualified people trained outside of China return to their countries.

There are some claims about Chinese intelligence about industrial espionage regarding especially foreign military technology. Some private corporations have also been accused of espionage. China takes technology transfer issue very seriously. Technology transfer to China is partly through increased levels of investment and the acquisition of US companies. China participated in ~16% of all venture deals in 2015 up from 6% average participation rate during 2010-2015. China is investing in critical future technologies that will form the basis of future innovations for both commercial and military applications. These include fields such as artificial intelligence, robotics, autonomous vehicles, augmented and virtual reality, financial technology and gene editing (Brown & Singh, 2018:3).

In addition to the technology and R&D transfer China made through multinational companies in the 1980s, it has also made great advances in innovation. According to a report published in 2016, rising labor costs and expanded market opportunities in the global economy are the main driving forces behind innovations in China. The study also found that although state-owned firms received more subsidies, they innovated less than private firms. This led the Chinese government to increase incentives for private companies (Wei et al., 2016:87).

The Chinese government, a major consumer of H-T products, wanted to develop highly controversial policies demanding companies from which it purchased goods in 2009 encourage Chinese innovation and that the products sold do not have foreign intellectual property. Although the most controversial parts on this issue were

later canceled, local Chinese governments continue to use foreign product supply to promote domestic innovation (Foreign Affairs, 2010).

The Chinese state is highly criticized for its perspective about intellectual property rights. There are quite a lot of complaints how property rights are annulled. Allegedly, according to Chinese law, companies had to provide detailed information about the way some technologies work for national security reasons and the Chinese government share this information with the Chinese civilian industry. According to the latest data from the World Intellectual Property Indicators (WIPI), the Chinese patent office accepted 1.54 million patent applications in 2018. This figure is quite high and represents almost half of the patent applications worldwide. Moreover, the number of these patent applications is more than double the USA. Looking at the international table or patent sent with the Geneva-based World Intellectual Property Organization (WIPO) score, China passed the US as the top source of international patent applications filed through the WIPO in 2019. While China-based applications were 58,990, the number of applications from the USA was 57,840 (WIPO, 2019). Although China is rising fast, it still lags behind the USA, Japan, and the EU regarding the number of patents. According to the WIPO, the USA had 230,085 equivalent patent applications abroad in 2018 followed by 206,739 applications from Japan, 106,753 from Germany, 69,459 from the South Korea and 66,429 from China. China is behind South Korea, Japan, and Switzerland in terms of patent applications by population. South Korea continues to lead with 3,148 equivalent patent applications per million population, followed by Japan (2005), Switzerland (1.081), and China (1.001) (WIPO, 2018). Thus, in order to promote innovation and avoid foreign property rights, China strives to improve local technical standards. China also attaches importance to academic publishing. In 2017, China surpassed the USA for the first time in the number of scientific publications (Tollefson, 2018). By 2019, China overtakes the UK in the 'highly cited researchers' table and ranks second after the USA, according to Web of Science's annual list. The USA remains first by far in the number of Highly Cited Researchers with 2,737, or 44%. China, at second, has 10.2% of the group, followed by the UK (8.3%), Germany (5.3%), Australia (4.4%). These five nations account for 72.2% of the world's Highly Cited Researchers, a remarkable concentration of top talent (Adams et al., 2019:9).

China is below the average in the quality of these patents, although it is ahead of the patent volume it provides to the world. According to the WIPO, China provided approximately 40 percent of global patent applications in 2016. In three key sectors: automotive, aerospace, and advanced electronics, China holds 85, 49, and 18 percent of patents worldwide, respectively. However, the share of high and medium strength patents in these sectors is only 4 to 11 percent, while for non-China patents, this rate is 14 to 27 percent. China has a vital need for the technological inputs and expertise of foreign enterprises to address this quality problem. China's international incentives have made a vital contribution to the dynamic development of innovation and the start-up ecosystem. 60 percent of Chinese companies have managers with international experience and their value exceeds that of companies relying solely on local talent. China's Thousand Talent programs have reached their first goal, and more than 7,000 experts have shown interest in this initiative (Woetzel et al., 2019:130).

China has achieved great success in integration with the world recently and has become a global giant. However, China could not achieve the same success in some fields such as finance. China's economic and technological future seems to depend on resolving its finance problem.

Achieving to be the world's largest economy in terms of purchasing-power-parity in 2014, China has been a global power in terms of size but is not always very successful in global integration. In 2013, China had become the largest country in the world in terms of goods trade. However, although China has 110 companies among the Global Fortune 500 companies, these companies still earn more than 80 percent of its revenues only in their own country. So China is not global enough. China's banking, securities and bond markets are among the top three globally in terms of size.

China's relationship with the world has a variable feature. According to the McKinsey Global Institute China-World Exposure Index (Woetzel et al., 2019), its opening to the world in terms of trade, technology and capital is falling slightly. This shows Chinese orientation towards domestic consumption is rising. Since 2015, domestic consumption has been effective in 60 percent of the total GDP increase in 11 out of 16 quarters. Chinese technology seems to be integrated with the world on a global scale. According to the same report (Woetzel et al., 2019), 90 percent of the technologies applied in China in 81 technological fields in 11 categories seem to

comply with the global standards. The research revealed that technology companies in China had grown very rapidly but they are still importing very critical components. The most important of these are reduction gears used in robotics technology, electric vehicles used in the field of power electronics, and semiconductor equipment. A simulation made in this report (2019) shows that \$22 trillion to \$ 37 trillion of economic value (equivalent to about 15 to 26 percent of global GDP by 2040) could be at stake according to the engagement level between China and the world in five main areas: (1) growth as an essential goal; (2) liberalization of services; (3) financial globalization; (4) cooperation on global and public goods and (5) spread of H-T and innovation. If China and the world have a lesser integration level, it could cause higher tariffs, more restricted trade and tech flows and constant inabilities in solving the key global problems. But with more cooperation and engagement, China will be importing more from the whole world causing a bigger flow of technology in two ways: first the Chinese services sector will be more competitive and second solving global problems would be much possible.

According to the same report (Woetzel et al., 2019), China's R&D expenditure has risen highly. China's spending on indigenous R&D rose from about \$ 9 billion in 2000 to \$ 293 billion in 2018, which is the second-highest figure in the world, right behind the USA. However, China still is depending on imported goods of some essential technologies, such as semiconductors and optical devices, also intellectual property from foreign countries. In 2017, China spent \$ 29 billion for importing intellectual property while earning only \$ 5 billion for exported intellectual property (it is only 17 percent of its imports). China's technology import came from mainly three countries as 31 percent from the USA, 21 percent from Japan, and 10 percent from Germany (Woetzel et al., 2019).

China is the world's most crowded country in terms of internet users, almost 850 million people. Despite the recent growth, its crossborder data flow has still limits. China is in the global top eight in terms of data flows in bandwidth but these data flows are tiny compared with the large scale of its digitized economy, at only 20 percent of whole US data flows (Woetzel et al., 2019). China cannot develop without a strong technological foundation of continuous innovation in the long run. Thus, Chinese political elite knows the importance of accessing technology. China also benefited

from joint ventures and appropriate technology policies to take advantage of the technology flow of companies. Any decrease in technological flow may cause China's momentum in its claim to be the first-class digital and innovative economy.

Chinese companies have made very important contributions to global innovation to date. Chinese firms alone accounted for 38 percent of the growth in R&D spending and 80 percent of the growth in patent applications between 2010 and 2015. Since 1978, China received seven million graduates and became the world's largest scientific article producer in 2016 (426,000 studies published compared to 409,000 in the USA). The OECD estimates that by 2030, it can meet 37 percent of science, technology, engineering, and mathematics (STEM) graduates in OECD and G-20 countries. China also accounts for about a third of global digital executives and produces dynamic business models specifically related to the digital economy. In developing technologies, China is taking firm steps towards reaching global milestones (Woetzel et al., 2019:130). At the beginning of 2019, China's Chang'e 4 spacecraft became the first spacecraft in the world to land on the dark side of the moon, a new step for the space exploration. As China becomes an increasingly important technological innovator, it can contribute in terms of know-how to both developing and developed markets. For example, China recently signed an agreement to support the establishment of the Egyptian Space Agency (Atalayar.com, 2021). Greater involvement in these areas can help facilitate global innovation and increase productivity and economic growth.

Chinese pharmaceutical companies continue to innovate to find solutions to critical diseases. The number of applications from local firms that started clinical studies rose from only 21 in 2011 to 88 in 2016 and achieved annual growth of 33 percent. These trials led to important inventions, such as the first fully domestic mainstream cancer treatment approved for commercialization in 2018. In the same year, some foreign pharmaceutical companies received approval for their medicines in China before the Western countries for the first time. However, China's dependence on imports remains much higher in some vital products than in other major economies. For example, integrated circuit and optical device imports are four to five times bigger than the domestic production. In some H-T sectors, China accounts for more than 20 percent of global trade and less interaction can mean less access to Chinese technology

exports, potentially leading to higher costs that eventually limit global innovation (Woetzel et al., 2019:131).

3.1.1. Aerospace in China

China has placed great emphasis on the aerospace industry and is moving rapidly towards becoming a global leader in this regard since aerospace development functions as a key factor of the country's continuous economic growth. The Chinese government reflects development in this area through production technology so dependence on the USA and other countries will come to an end.

It is also necessary to look at the activities of the Chinese in critical areas. One of these areas is Satellite and Launch Services. In 2014, the Chinese government opened the launch and small satellite industries to private investments resulting in a broad civil-military national strategy. Selected private companies have gained access to state technologies though with limited access while their investments have increased in this area. The iSpace company has recently enjoyed significant success as the first Chinese private company to place a successful satellite into orbit. Two other companies, Landspace and OneSpace, are also progressing rapidly in this race. These two companies have previously attempted launch but have not been successful (Spacenews.com, 2020). There is great competition in China's rocket market. In China, this type of launch is only possible in military areas, so private firms have to work closely with the military and the public aerospace authorities. However, this also gives them access to state technology and infrastructure. Landspace's Zhuque-2 rocket with engines running on liquid methane-liquid oxygen, will carry out a scheduled test flight in 2020. This rocket has a 4,000-kilogram load capacity and 200-kilometer earth orbit access (Spacenews.com, 2020). iSpace is working on a reusable Hyperbola-2 rocket and will make its first test flight in 2021. The rocket, capable of accessing a 500-kilometer orbit, will be able to carry 1.1 metric tons of cargo. If it is to be used again, it can carry 700 kg (Spacenews.com, 2020). One of the new companies in this field, Galactic Energy, is working on a rocket called Pallas-1. Its flight was planned in 2020 but this plan was delayed due to the Covid-19 outbreak. China Rocket-Co is working on the Jieolong-1 rocket, which can take 150 kg of cargo into 700 kilometers of the orbit (CNSA, 2019).

Another important area in the aerospace area is Spacecraft technology. China has the second-largest budget after the USA, a budget of \$ 8 billion as mentioned. Chinese Chang'e 4 spacecraft had great success in this field by landing it on the dark side of the moon. China's next target will be to send a probe vehicle to Mars. China getting prepared through Mars base simulation in the Gansu desert. China is also planning to construct a base on Mars in the future.

In terms of defense technologies, 8 of the 25 largest defense companies in the world are Chinese companies. The Aviation Industry Corporation of China (AVIC) has grown in this area by selling \$ 25 billion in 2018. The AVIC manufactures its fifth-generation J-20 fighter and China's claim that these aircrafts are superior to the F-35s. These planes include air-to-air missiles and short-range air-to-air missiles technologies. These weapons are said to have superior maneuverability and target shooting capabilities. However, the details on this matter are not yet known. The Chinese government keeps this information secret and does not disclose it (Engineering.com, 2019).

Another combat technology from AVIC is the Hong-20 stealth bomber. This seems to be similar to the B-2 bomber and expected to be ready in 2025. The aircraft, with a maximum weight of 200 tons and a weapon carrying capacity of 45 tons, can fly 5,280 miles at a time. The aircraft can also carry hypersonic rockets and reach subsonic speed. It is known that China is also investing in hypersonic weapons.

The Commercial Aerospace area draws attention as an area where China follows technology from the back. However, it expects China to become the largest passenger flight market in the next few years. The state-owned Commercial Aircraft Corporation of China (COMAC) wants to compete with Boeing and Airbus in the Chinese market. The company already has two jets, ARJ21 and C919. The ARJ21 aircraft, with a capacity of 90 passengers, is estimated to have less advanced technology than its competitors Embraer and Bombardier. The C919 aircraft has a capacity of 168 passengers and features a higher technology. It is calculated that the aircraft produced as delayed will start mass production in 2021. COMAC is currently only certified to fly within China. It can also take off on international flights after receiving FAA approval (Engineering.com, 2019).

3.1.2. Cyberspace in China

In addition to being the world's largest economy, China is currently the second country in the world with the largest defense budget. China views its investments in cyberspace as a "*cyber war fare*" (McReynolds, 2015:3). China is estimated to have an army of hackers consisting of 50.000 to 100.000 people (Foreign Policy, 2010). According to Chang and Billo (2004: 2), the USA, Russia and China are looking for ways to protect themselves against a possible cyberattack at any moment. To this end, "*cyber forces*" are being trained and made available to respond to possible attacks, to disable the enemy's infrastructure and to get ready for any eventuality in terms of information technology.

Western states have long blamed China for cyber spying. Due to the difficulty of tracking attacks on the infrastructures and security of countries in cyberspace, it is not clear whether these attacks are done by China which does not accept responsibility. It is possible to define the forces deployed by China in cyberspace in three groups. The first is specialized military network warfare forces. These are military units specialized in network attacks and defense. The second is network warfare experts from the People's Liberation Army of China. There are non-governmental forces as civilian or semi-civilian organized network attack and defense forces can be included in this last group (Elegant, 2009).

Since the 1990s, China has given importance to struggle in the cyberspace called the "*information war*". The US success in applying H-T to the war during the Gulf War drew global attention and two years later, in 1993, the Chinese military internalized the idea of "*winning local wars using modern technology, especially high technology*" (Jash, 2019). In 2004, this aim was updated as "*winning local wars under informationization conditions*". There lays the following fact on the basis of China's strategy: "Informationization has become the key factor in enhancing the warfighting capability of the armed forces" (Jash, 2019). In line with this understanding, we can say that China has placed the cyberspace as the basis of its national security. The Chinese military strategy consists of four principles: "Cyberspace situation awareness, cyber defense, support for the country's endeavors in cyberspace, and participation in international cyber cooperation" (Jinghua, 2019).

Using the global cyberspace, China monitors riots and public events in other countries and applies various measures to prevent similar events to happen in its own land. The other important goal of China's cyber warfare is to defend and protect critical information infrastructure. Although China is a H-T country, American companies still provide majority of the software and hardware needs of the cyber infrastructure. This causes trouble to China's security since it attaches importance to developing domestic technology and works in this direction. Most US companies claim that China is stealing intellectual property and committing information theft through cyber attacks. However, as said earlier such claims remain baseless because it is not easy to prove in cyberspace (Jinghua, 2019).

Cyberwarfare means more than a military approach and intelligence gathering. In order to calculate developments in this field, it is necessary to consider R&D activities, innovation capacity, information technology industry companies, internet infrastructure, cyber army power and the inclusiveness of cyber strategies. Undoubtedly, the most important deficiency that has left China behind the USA is the self-sufficiency problem in critical technologies, as stated above. In the technology index published in 2017 and covering 176 countries, China ranked 80th. This report is based on 11 indicators showing the activities in information technologies and cyberspace and reveals the cyber power of countries. China's disadvantage in cyberspace is that although there are a large number of people speaking Chinese due to population density, only 1.7 percent of the websites on the internet are in the Chinese language. This rate is 53.9 percent for English (IDI, 2017).

On the other hand, although China is often accused of cyber-attacks, it is one of the countries that receive the most attacks in the world. According to a report published in February 2019 by Beijing Knownsec Information Technology, China has an average of 800 million different cyberattacks a day. The vast majority of these attacks are directed against state organizations. Thus, it is not surprise that China attaches importance to cybersecurity and cyber warfare (Liping, 2019).

3.1.3. Mechatronics: Robotics in China

China's robotics industry is one of the largest in the world. In terms of robot density, China ranks 23rd in the world. Robot density is determined by the number of

robots per 10,000 workers. In 2017, 35.6 percent of industrial robot sales worldwide were in China.

As of 2020, China produces 150,000 robots annually. In the same period, approximately one million active robots are already working in the country. China's accelerated rise in the robotics industry has come under the Chinese government's "Made in China 2025" strategy that forseees China turn towards local products, especially in production and innovation while increasing production, thus reducing dependence on foreign companies (MIC, 2018).

To achieve these goals, China also supports many start-up projects in robotics. These incentives are increasing, especially in the areas of automobile manufacturing, electronics, and logistics. Through this strategy, incentives such as tax reduction and R&D assistance are applied to companies. As a result, the number of robotics industry companies in China, which was 800 as of 2017, suddenly increased to 6500 at the end of the year (Asia Fund Managers, 2019). This rise alone is a clear indicator of China's breakthrough in this area in recent years. In addition, there is serious competition in robotics.

China seems to have a bright future in the robotics industry. The factors underlying the focus on the robotics industry in China are not only related to the 2025 strategy. In recent years, increase in labor costs in China, the number of skilled workers becoming unable to meet the needs and the aging population also reveal reasons for incentives and therefore, investments made in the robotics industry.

Currently, 68 robots are employed for 10,000 workers in China. In Germany, this figure is over 300. Recently, \$ 150 billion have been invested in the robotics industry in Guangdong province alone (Woetzel et al., 2019:77). Taking into account other regions of China following this trend, China seems to have a highly advantageous position in the robotics industry against its western and regional rivals.

China's biggest challenge and rival in the robotics industry is the Western companies. It is known that foreign companies dominate 50 percent of the Chinese market currently (Woetzel et al., 2019:14). China's goals in robotics are quite high. By 2025, China's strategy is to increase the number of active robots in the country to 1.8 million units. While doing this, China wants 70 percent of the robots used in the country to be produced in China. Currently, this rate is only 30 percent. Another goal

of China in this area is to bring at least one or two Chinese companies into the top five companies in the robotics industry worldwide (SCMP.com, 2018).

The China Robotics Industry Development Report (2019) was published at the end of the World Robotic Conference 2019, held in Beijing during 20-25 August 2019. According to this report, the size of the robotics market in China is expected to reach at the level of \$ 8.68 billion. Compared to 2014, this corresponds to 21 percent increase. China is the first country globally in terms of industrial robot spending in this process. China's budget in this regard is 5.73 billion dollars corresponding to 66 percent of the total market. Over the years, robots of China's own production have solidified their place in the market (China Robotics Industry Development Report, 2019).

In the service robot market, China is rising steadily. As of 2019, it has increased 33 percent in this area, with \$ 2.2 billion compared to the previous year. Robots in this sector generally consist of home robots and robots used in the public space. It is thought that China has closed the quality gap between its US and European competitors in the service robot industry. In the field of special-use robots (among them rescue robots, drones, and underwater robots), there is an increase in direct proportion to the domestic demand. It should be noted that this market has risen to 750 million dollars as of 2019.

In China, especially the Yangtze River Delta stands out in industrial development, while the Jing-Jin-Ji region stands out in the field of industrial innovation. Beijing, on the other hand, has achieved remarkable success in the development of artificial intelligence technologies in robots, especially recently (China Robotics Industry Development Report, 2019).

3.1.4. Biotechnology in China

In recent years, China has achieved a two-digit development performance in the field of biotechnology and has managed to become one of the most advanced in this field. Chinese government considers the biotechnology sector as one of the key and central areas of national scientific and economic development.

At the center of the biotechnology sector in China is the China National Center for Biotechnology Development (Jia, 2004:1197). This institution was established in

1983 and worked under the Ministry of Science and Technology. Biotechnology studies in China having started in 1980s, turned into a sector with approximately 200 companies by 1997. In 2000, the number of biotech companies in China reached 600. This increase has continued gradually since those years. The studies reveal China's potential as a future biotech superpower. Today, the number of companies serving in the field of medicine and biotechnology in China has reached to 4441 (Nature, 2019). However, a large number of companies in China does not mean that they have done great things in this field. The biggest problem of biotech companies in China is seen as devoting a small portion of their income to R&D studies. According to the World Health Organization (WHO), the budget allocated by these companies for R&D does not exceed 5 percent. However, the same rate is 50 percent and above in Europe and the US. As in many areas of technology, R&D studies are vital for innovation in biotechnology. China lags behind in this field due to the fact that it allocates such a small budget for R&D studies compared to its competitors.

One of the most important pillars of China's "*Made in China 2025*" strategy is biotechnology. The Chinese government is considering giving more incentives to innovation and R&D. The majority of companies in China now seem to concentrate on obtaining licenses for Western-accepted medicines and technologies in China and marketing in their country of a large population. This is another handicap of the biotech industry in China because concentrating on licensing Western-made medicines prevents the companies to be innovative. However, China aims to reverse this handicap and turn to investments that develop more innovative and domestic technology in the sector with a large economy.

Chinese government spends \$ 100 billion annually for health. China offers very attractive incentives to pull back the workforce working in these fields around the world. It is estimated that the number of workforces that have responded to these offers so far is around 250,000. China's goal in biotechnology is to make up 4 percent of its GDP from this field by 2020. In this context, more than 50 percent of the technology parks related to biotechnology were opened in the country in recent years. While 111 biotech parks are opened, 108 technology parks are related to other sectors. The majority of biotech parks are concentrated in the Guangzhou area hosting 93 of 111 biotech parks (Arranz, 2018).

Investments made in the biotechnology sector in China between 2014 and 2017 amounted to \$ 45 billion dollars. Of these, \$ 12 billion dollars belong to the private sector. China's goal is to increase this share every year (Arranz, 2018).

Table 3.1. Biotech Companies in China

Sector	Ratio
AgroBio	5.9 %
Bioinformatics and Bioelectronics	2.8 %
Contract Research and Manufacturing	9.5 %
Cosmetics	3.6 %
Diagnostics and Analytical Services	10.5 %
Drug Delivery	1.1 %
Environment	1.5 %
Food and Nutraceuticals	21.8 %
Genomics and Proteomics	5 %
Industrial Biotechnology	0.7 %
Other Services and Suppliers	27 %
Therapeutics	6.2 %
Veterinary	4.3 %
Total	100 %

Source: Chinese Biotech, 2020

Accordingly, the Food and Nutraceuticals sector has the largest share with 21.8 percent, while the Diagnostics and Analytical Services sector has a share of 10.5 percent. (Chinese Biotech, 2020). While this is the case in the field of biotechnology, the other area we will examine will be Nuclear Technology.

3.1.5. Nuclear Technology in China

China is one of the largest nuclear power producers in the world. The country is currently ranked third globally in terms of total nuclear power capacity and energy generation. As of 2019, nuclear power meets 4.9 percent of China's total energy needs. This rate indicates a 20 percent increase compared to 2018, as extension of the two new nuclear reactors opened in 2019. This shows that China is currently investing in

nuclear power. China's goal is to increase this rate to 6 percent by the end of 2020 and its total energy capacity to 150 GW by 2030 (World Nuclear News, 2019).

As of March 2019, there are 46 active nuclear reactors in China. Their total power reaches 42.8 GW. The total capacity of 11 nuclear reactors currently under construction is 10.8 GW. Apart from these, China has plans for a total of 36 GW of new reactors (World Nuclear.org, 2020).

There are two major nuclear power companies in China. One of them is the China National Nuclear Corporation, and the other is China General Nuclear Power Group. China not only uses its own local resources in nuclear power but also tends towards technology transfer through international cooperation.

China is among the countries that are almost self-sufficient in nuclear power generation and technology. Thus, its aim is to export nuclear power technology. One of the most important reasons for China's firm commitment to nuclear energy is to reduce its reliance on fossil fuels and to minimize environmental pollution effects. At present, coal is China's primary source of energy with serious environmental impact.

China has transferred nuclear technology from France, Canada, and Russia and has succeeded in developing and localizing it afterward. After the nuclear accident in Fukushima, although nuclear power investments were delayed for a short time, only China announced that it would continue to invest in nuclear power (World Nuclear.Org, 2020).

China's nuclear power is not just limited to energy. China also has nuclear weapons. It is estimated that China, which conducted its first nuclear weapons tests in 1964 and tested the first hydrogen bomb in 1967 and it already has a large number of nuclear warhead weapons. China's nuclear power is a state secret, and therefore clear information is not available. It was thought to have around 260 warheads as of 2015. As of 2020, it is stated that the number of these warheads is around 320 (Sipri, 2020).

China is one of the nuclear weapon countries recognized by the Nuclear Non-Proliferation Treaty (NPT). However, China has adopted the “no first use” principle as a matter of policy. China states that it stores warheads separately from launch systems and will not be able to put them together unless there is a serious threat (Chalmers, 2014).

Despite all these commitments, China continues to exist as one of the strongest countries in the world in terms of nuclear weapons, and this power is accepted both in the region and in the world.

3.2. India and Hi-Tech

India's current population is estimated at 1.39 billion (as of May 15, 2021: 1,391,995,147) corresponding to 17.7 percent of the world total population (Worldometers, 2021). With this population, it is the second-most populous country in the world after China. However, considering the population growth rates, it is expected to be the world's most populous country bypassing China, in the near future. India is one of the most attractive countries in the world in terms of technology investments. Technology is also among the priority areas for the current Indian government since it is the key to economic development. Thus, the country attaches particular importance to scientific research.

As of 2020, India ranks 6th in the world in terms of scientific publications and 10th in patents. In 2017, India was ranked 13th in Nature Index¹⁰. In terms of scientific publications in the field of science and engineering, India stands out as the third (Nature Index, 2020). According to the Global Innovation Index¹¹ (GII) published in 2019, India ranks 52nd. It ranks 50th in terms of R&D investments. The government has started to give importance to technology parks in recent years and tries to compensate its deficiency in this area. In 2017, these efforts paid off, and India left its mark on that year with 1000 new companies in start-ups (Global Innovation Index, 2020).

Regarding R&D expenditures, India aims to reach 2 percent of the GDP in 2022. In recent years, important investments and research have been carried out, especially in agriculture, health, space research, and nuclear technology as the government attaches special importance (IBEF, 2020).

¹⁰ Nature Index is a database that tracks institutions and countries and their scientific output. Nature Index lists the leading institutions and countries each year according to the amount of scientific articles and articles published in leading journals.

¹¹ The Global Innovation Index is an annual ranking of countries by their capacity for, and success in, innovation.

As of 2020, more than 4000 PhD and 35000 postgraduates participate in academic life and produce science at India's 933 universities. On a sectoral basis, India ranks third in the world in terms of scientific and technical human resources, seventh in science and technology research, eighth in science and technology fields, and tenth in terms of patent applications. India's R&D investments have reached \$ 94.06 billion as of 2019 (IBEF, 2020).

During 1960-1980, a serious investment in nuclear power draws attention in India. Meanwhile, the Indian space program is developed with the assistance of the Soviet Union. India has achieved great reforms in the field of science and technology since the early 90s. The Ministry of Science and Technology, which was established in 1986, has a great influence in these reforms. Both state and private sector have attached importance to biotechnological investments in medical and agriculture fields. Thus, after nuclear investment and space research, biotechnology has become another remarkable field for India.

Thanks to the economic reforms initiated in 1991, the Indian economy has paid more attention to international economic integration. Annual growth rates were stable between 1993 and 2002, and the economy grew by an average of 6 percent annually (World Bank, 2020).

Today, India has become noticeable in the fields of information technology (IT), biotechnology, aerospace, nuclear science, manufacturing technology, automobile engineering, chemical engineering, shipbuilding, space science, electronics, computer science, and other medical science. In 2017, India has proved to be pioneering in nuclear research as a member of the European Organization for Nuclear Research. India has long stood out as an outsourcing country for global companies, especially in the field of technology. But nowadays, we see that India, which will take the title of being the most populous country in the world, wants to be a country that produces technology rather than offering human resources to technology.

According to the GII, there are a developing innovation culture and awareness in India rising from 81st to 52nd between 2015 and 2019. India has created a safer country perception in terms of risk in recent years and has risen to third place in the world in terms of attracting technology investments in 2019 (GII, 2020).

India has been an outsourcing country for low-cost software and support services for nearly 30 years. American technology companies having their call centers and technical support units in India is a crucial example. Indian engineers have also reached very important positions in Western companies. The value of this outsourcing industry has increased to 150 billion dollars in recent years. However, it does not seem possible for India to proceed as an outsourcing country. Because, apart from India, countries in the region such as the Philippines and Malaysia are also very eager to play this role. As such, being an outsourcing country has started to lose its appeal day by day for India. However, this situation stands out as an opportunity for the country. The fact that the technological workforce of the country producing solutions for the foreign companies, can now become an innovation and production center attracting the attention of Indian and foreign investors.

India has 687,6 million internet users today as a result of the internet network that surrounded the country after 2014 and first managed to be the second country in the world with the most internet-connected population (Datareportal, 2021). Another example of this commitment to technology is the number of smartphone users, which was only 76 million eight years ago, has reached 696 million as of today (Statista, 2021).

There are currently 26 new companies operating in India, valued at more than \$ 1 billion. India, a paradise for start-ups, has recently become the third country in the world in this regard. A survey of young people in India revealed that one-third of young people are interested in entrepreneurship as a career (Lalwani, 2019).

India has a tremendous young population. More than 65 percent of the 1.3 billion people in India are under the age of 35, and more than 50 percent are under 25 (Worldometers, 2021). In recent years, this young population has been migrating from rural areas to cities. This situation has given cities a great consumption power, economic dynamism, and interest in innovation and technology.

It is possible for India to become a global technology center if technology policies are geared towards supporting and promoting the spirit of entrepreneurship and innovation. For example, Bengaluru city of India has the title of being one of the most dynamic cities in the world in terms of urbanization and technology. In 2018 alone, 153 new start-up companies were established in this city, and this momentum

has made the city a technology capital of India. The city of Gurgaon, another rising value, has transformed from an agricultural city to a skyscraper city. The city attracts the attention of big technology giants and receives serious investments in software and finance (India Times, 2019).

India ranks eighth in the world in terms of the number of students graduating from science and engineering majors, but there seems to be insufficient guidance to train them in the right fields. A new employability report on engineers in India showed that less than 4% have the technical, cognitive and language skills required for technology initiatives and only 3% have new-age skills in areas such as artificial intelligence, machine learning, data science and etc. (Lalwani, 2019).

One of India's biggest problems is talent and brain drain. Hundreds or even thousands of Indian engineers work in the world's largest technology companies. Indian geniuses have even managed to become the CEOs of the world's most important technology companies. For example, Sundar Pichai, CEO of Google, Shantanu Narayen, Adobe CEO, and Satya Nadella, Microsoft CEO, are the three most important examples (Ceo Insights India, 2018).

From 2012 to 2017, only 649 Indian scientists returned to their hometowns to continue their research. This is more than twice the number of scientists returning between 2007 and 2012 but that rate of return is not yet thought to be enough for India to meet its goals (Hindustan Times, 2017).

The biggest problem faced by the private sector is the number of workers skilled in technology issues is below expectations. There are a significant number of unemployed young people in India but very few of them are qualified. Therefore, training programs for more industries need to be implemented to educate and train workers. These programs of *industry-university cooperation*, can bring the young unemployed in the country together with companies demanding skilled workers in the private sector. With government support, foreign and domestic investments will help establish India as the next global technology center. Thus, the US-China trade disputes make India a more attractive alternative. Additionally, increasing the skilled workforce could put India in a favorable position to compete with China for market dominance.

Although global investors are hesitant to invest in Indian companies, Indian entrepreneurs have recently managed to attract more than \$ 33.4 billion through

foreign direct investment. Meanwhile, domestic investment is also increasing. Recent polls show that the overwhelming majority of senior executives of Indian companies, 83 percent, think policymakers are behind the times in technology and innovation. It turns out that government officials need to act together with private sector executives and understand their needs (Lalwani, 2019).

In early 2016, the Indian government launched the *Startup India* initiative. Another important program, Make in India, was designed by the government to foster self-confidence, spread innovation, encourage talent development, and build a good manufacturing infrastructure. Finally, *Digital India* stands out as a government project aimed at digitally empowering and doubling the community. All these programs show that the Indian government sees the problem and is starting to look for solutions. However, of course, it is not that easy for India to catch up with the recent technology and close the gap. This requires great effort and, of course, time. To see what needs to be done, it is necessary to take a look at the current situation of India in H-T areas.

3.2.1. Aerospace in India

India's aerospace industry could be categorized as defense, space, and civil aviation. India's aerospace industry has developed significantly as part of the government's "*Make in India*" campaign. According to this strategy, local production will be focused on in the defense equipment and civil aviation industry.

India's burgeoning civil aviation sector has enormous potential for the aerospace industry. Currently, there are 464 airports operating in India. 125 of these are operated by the Airports Authority of India (AAI), while the rest are operated by private sector. By 2020, the AAI has aimed to operate 250 airports across the country. In the close future, India will become the third-largest country in the world in terms of the civil aviation market. As of 2020, passenger traffic at Indian airports reached 421 million: It was 223.61 million in 2016. Therefore, it is clear that Indian aviation has shown a serious development in a few years (AIAI, 2020).

The Aerospace industry in India is predominantly dominated by the government agency Hindustan Aeronautics Limited (HAL) and National Aerospace Laboratories (NAL). HAL's field of activity focuses more on design, production, and repair-maintenance of aircraft, helicopters, engines and other defense equipment. In

addition, this organization produces launch vehicles, satellites and their components for the Indian Space Research Organization (ISRO), India's most important space organization (AIAI, 2020). The NAL on the other hand, conducts research and development activities for the civil aviation industry. While the NAL mainly develops aerospace technology, it also produces small and medium-sized civil aircrafts. The most important private sector organizations operating in the aerospace industry in India are Aequus Aerospace, Mahindra Aerospace, Tata Advanced Systems, Honeywell International India, Bharat Electronics, Taneja Aerospace, and Aviation (AIAI, 2020).

The Indian government's "*Make in India*" policy aims to encourage direct investment in the defense and air industry. In recent years, this strategy has paid off while foreign and local investors have increased their investment in the aerospace industry. The HAL, the fully state-owned company of India, ranks 34th among the 100 important defense industry companies in the world (AIAI, 2020).

The Indian government established the Department of Space in 1972 and has invested in space over the years. The ISRO operating under the Department of Space, is currently continuing the space programs of India. India is one of the most important countries in the Asia Pacific region in terms of satellites in orbit. It currently has about 210 satellites in orbit. In line with the developing needs, India plans to increase this capacity to 500 satellites within five years (Aero India, 2020). Indian space programs have made significant progress. 36 new missions are planned by the ISRO in the next two years within the Indian space program. These include lunar missions such as the Chandrayaan-3 and manned flight missions such as the Gaganyaan. India will send a large number of satellites into orbit in 2020-2021. Ten of them are earth observation satellites, three are telecommunication satellites, two are navigation satellites, and three are space science satellites. India with many rocket launch plans focuses on outer space in the coming years (TWC India, 2020).

In 2019-2020, the ISRO successfully completed 11 tasks it planned including four earth observation satellites launch, the Chandrayaan-2 mission, four rocket launch and one each of telecommunications and space science satellites. The Gaganyaan mission, one of India's most striking missions in recent years, is planned for 2022. Before that, India will send a humanoid robot named Vyom Mitra to space to do environmental research in space and perform tasks that humans can do in orbit. The

Gaganyaan mission, a manned mission, will transport three Indian astronauts into space (TWC India, 2020). Chandrayaan-3, India's third lunar mission, will take place in the first half of 2021. In the mission, which plans to make a soft landing in the south polar region of the moon, Vikram lander will try to reach the moon safely. In the Chandrayaan-2 mission, the vehicle was unable to perform a soft landing and the ISRO lost contact with this vehicle (TWC India, 2020).

3.2.2. Cyberspace in India

India is an important country in information technologies. However, in terms of cybersecurity, it is ranked 47th according to GII 2018 while China ranks 27th in this report. In the Asia-Pacific region, India ranks 10th, while China ranks 6th in this context. India is behind its rivals in cybersecurity (Global Cybersecurity Index, 2018).

In India, the Department of Electronics and Information Technology published the National Cyber Security Policy strategy in 2013. The aim of this strategy was to protect the public and private sector infrastructure against cyber attacks (MEITY, 2013).

As of 2020, the number of internet users in India is 697 million. Having so many internet users in just one country makes India a very important market in cyberspace. India is expected to increase the number of internet users to 974 million, or almost 1 billion by 2025 makes the country the second-largest country in terms of internet technologies after China. It is only a matter of time before it takes the first place with the increase in population growth and internet access rates. (Statista, 2020)

Internet access in India is mainly provided by mobile phones. Thus, there are almost as many internet users in the country as smartphone users confirm this information. Internet access has already peaked in India with the ease of access to smartphones. The number of internet users, which was only 302 million in 2015, increased to 700 million in 2020 (Statista, 2020). With the increasing use of the internet via smartphones, Indians have started to use social media actively. 82 percent of internet users actively use sites such as YouTube and Facebook. On the other hand, in 2010, Facebook opened an office in India for the first time in an Asian country. The government of India wants to limit social media from time to time, arguing that fake

news and disinformation have increased with the linear increase of social media use (Statista, 2020).

According to the 2017 ICT Development Index revealing the development of Information and Communication Technologies, India ranks 134th and shows 4 rows up compared to the previous year. In this sense, India is in a much worse situation than China, which ranks 80th. The increase in the number of Internet users does not mean that India has suddenly placed at the top in information and communication technologies (IDI, 2017). Undoubtedly, this is due to the low internet penetration rates in India. On the other hand, the technology and internet usage rates of women and rural people, as well as the elderly in India, are quite low. In terms of using the internet effectively and comprehensively, the country is considered to be in very primitive conditions (Statista, 2020).

India appears to be at great risk in terms of cybersecurity. It is estimated that the cyberattacks against the cyberinfrastructure of the country, especially from China are quite intense. Despite its reputation in information technologies, Indian authorities are not considered to be very successful in terms of cybersecurity. India's Defense Cyber Agency (DCA), fighting against cyberattacks in India, recently banned the use of many Chinese applications.

According to a report published by the DCA in July 2020, more than 40,000 cyberattacks were directed by China to the Indian infrastructure in just 4 to 5 days. These attacks were predominantly against information, infrastructure, and banking systems (India Global Business, 2020).

According to India's National Cyber Security Policy document, the most important goal of India's strategy is to create a secure cyberspace ecosystem (MEITY, 2013). However, India is considered to be highly vulnerable in this area. In a study, India was reminded of the need to prepare a multi-stakeholder cybersecurity agreement covering all cybersecurity issues and to lead the way in cybersecurity and to ensure all countries to come together and sign it (Basu and Hickok, 2018).

3.2.3. Mechatronics: Robotics in India

As automation technology develops, the robotics and mechatronics industries gain prominence in India. In the last five years, the number of industrial robots in India

has doubled. However, India is still far behind China, Japan, the USA, France, Italy, and of course, Germany in this area.

According to the 2020 World Robotics Report, published by the International Robotic Federation, India has achieved an increase making it 10th among the top 10 countries in terms of annual industrial robot employment. China ranks first in this ranking (World Robotics Report, 2020).

Table 3.2. Industrial Robots: Countries with most Installations

Rank	Country	Annual Installation (2019)
1	China	140000
2	Japan	49900
3	US	33300
4	Republic of Korea	27900
5	Germany	20500
6	Italy	11100
7	France	6700
8	Taiwan	6400
9	Mexico	4600
10	India	4300

Source: World Robotics Report, 2020

According to the same report, 4300 new robots were employed in India in 2019, reaching a total of 26,000 robots. This means that robot employment has doubled in the last five years. By the end of 2019, the number of robots active worldwide reached 2.7 million as a record. Compared to 2018, this figure has increased by 12 percent showing the rapid increase in the robotics industry. Although there was a slight decline in the number of robots employed in India in 2019 compared to 2018, 2018, on the other hand, closed this gap by 39 percent increase compared to 2017. Between 2013 and 2018, the rate of robotization in India has shown a steady increase of 20 percent annually. In India, 44 percent of all robot installations are made solely by the automotive industry. However, robots are also used in the plastic, metal and electrical-electronics industries (World Robotics Report, 2020).

Asia maintains its strongest market position in robotics. While China maintains its leadership with annual employment of 140000 robots, Japan comes next with approximately 50000 robots employment. Approximately 35000 robots participate in the industry annually in America, while another Asian country, Korea, follows it with about 28000 robots. Later, European countries Germany, Italy, and France follow these countries with relatively lower robot employment (World Robotics Report, 2020).

India cannot show the same successful struggle in the field of robotics as China, as being behind in the fields of IT and the generic drug industry. Although there are new start-up companies in the robotics field in the Indian private sector, these companies are not yet ready for the global challenge for India. Although robotic technology is not included much in the Make in India strategy, perhaps the second version of this strategy may give importance to this area. Robotics and mechatronics stand out as vitally important areas for the industry to compete globally in India. Although we say that the rate of robotization has doubled in India in the last five years, the number of robots per 10,000 human workers is currently only 3 robots, which is very low on a global scale. In China, this figure is 68 for 10000 workers. While the world average is 74, this figure is 631 robots against 10000 workers in Korea (World Robotics, 2018).

Problems in the robotics industry in India are generally due to the lack of hardware, human resources, financial incentives, and the fact that the Indian government does not give as much importance to the robotics field as in other technology fields. It is thought that this is due to fear that robotization will increase unemployment in India, and people will lose their jobs. However, considering the rates of robotization and employment in industrialized countries, this fear seems unfounded. The Indian government has also started to pay attention to the field of robotics in recent years. However, time is running against India, as the gap between it and other countries is growing day by day.

3.2.4. Biotechnology in India

Biotechnology is one of the most advanced areas of India in H-T. Department of Biotechnology under the Ministry of Science and Technology dates back to 1986.

Since its establishment, the department has focused on four main objectives identifying weaknesses of the country. Raising human resources in biotechnology, establishing appropriate infrastructure, focusing on research and development activities and determining a regulatory framework in the field of biotechnology (Department of Biotechnology, 2020).

Under the planned program, the National Institute of Immunology was the first independent institute founded in 1981 and brought under this department. After a while, it was united by the National Facility for Animal Tissue and Cell Culture of Pune, established in 1986 and was later named as the National Centre for Cell Science. At the beginning of the 2000s, other important organizations like the Centre for DNA Fingerprinting & Diagnostics, the National Brain Research Centre, The National Institute for Plant Genome Research, Institute of Bioresources and Sustainable Development, and the Institute of Life Sciences were founded. Afterwards, many other important institutes like the National Agri-Food Biotechnology Institute at Mohali, National Institute of Biomedical Genomics at Kalyani, Institute for Stem Cell Biology and Regenerative Medicine, and Translational Health Science and Technology Institute in West Bengal were established (Department of Biotechnology, 2020).

Special efforts on social aspects such as health care, food and agriculture, energy, and environmental security should also be mentioned. In this area for India, international cooperations have become more strategic, with better access and extent, and industry participation is growing. With the program of Young India, the government is finding new funding mechanisms and ensuring grants and funds also awards for new researchers.

According to the last annual report published by India's Department of Biotechnology (2020), India is among the top 12 countries in biotechnology, with almost a 3% share in the global biotechnology industry. India is also the leader in the global supply of vaccines like DPT, BCG, and measles vaccines (Department of Biotechnology, 2020). There are 2700+ Biotech start-ups in the Biotechnology industry in India, and it is supposed to increase up to 10,000 by the next four years. Also, there are more than 2500 Biotech corporations in the country. India has the highest number of US FDA approved plants (665) outside of the US as well as 44% of

global abbreviated new drug applications and over 1400 manufacturing plants compliant with the World Health Organization (Department of Biotechnology, 2020).

By the end of 2025, the Indian Biotechnology industry is projected to reach \$150 billion. Again by 2025, the contribution of the Indian experts in the international biotechnology market is predicted to grow to 19% from 3% in 2017. In India, the government has allowed 100% FDI for many sectors of biotechnology such as greenfield pharma, brownfield pharma, and manufacturing of medical devices.

The Indian Biotechnology industry that was valued at \$64 billion in 2019 will achieve a \$150 billion target by 2024-25. The sector is divided into five major segments- Bio-pharma, Bio-services, Bio-agri, Bio-industrial, and Bio-informatics. The biopharmaceutical sector accounts for the largest share of the biotech industry with a share of 64% of total revenues, followed by bio-agri with 14% market share (2019), bio-services accounted for 18% of the Biotech industry. India is becoming a leading destination for clinical trials, contract research, and manufacturing activities further fuelling the growth of the bio-services sector while the remaining market is catered by bio-industrial (6%) (Department of Biotechnology, 2020).

According to the UNESCO, the expenditure on research and development (as a percent of GDP) has been 0.8% for India, and the target set by the Economic Advisory Council to the Prime Minister for the year 2022 is 2%. India currently has 5,48,719 sq. ft. of incubation space. 50 bio-incubators have been supported by Biotechnology Industry Research Assistance Council (BIRAC) and established since 2014, with more planned across the country. This not-for-profit agency to strengthen emerging biotechnology enterprises aims to undertake strategic research and innovation.

According to the Indian government, there are five major reasons driving India for growth in the Biotechnology industry. These are 1. Growing population (India to become the world's most populous country by 2030). 2. Rising demand for treatments (Increased insurance penetration and a growing burden of disease). 3. Medical infrastructure facilities (\$ 200 billion expenditure planned on medical infrastructure over the next decade). 4. Strong skilled manpower pool ('National Biopharma Mission', an industry-academia mission to skill the workforce). 5. Cost competitive

manufacturing (Development of life-science clusters builds collaborations between research institutes and the private sector) (Invest India, 2020).

3.2.5. Nuclear Technology in India

India's nuclear technology is highly dependent on domestic resources. The Indian government has focused on increasing its nuclear power capacity within the framework of major infrastructure development programs. Thus, the government has very high-scale goals to increase its nuclear capacity. India is outside of the NPT due to its nuclear weapons development programs and therefore has not been able to trade infrastructure and materials in the international arena for more than 30 years. This has caused the civil nuclear power capacity to lag considerably. When this situation came to an end in 2009, India quickly concentrated on its peaceful programs.

India, which had been uranium deficient due to previous trade restrictions, turned to develop its own thorium resources as a remedy. 22 reactors in India produce 6,255 MWe of energy, and 4,824 MWe of energy is expected from 7 reactors under construction (World Nuclear Association, 2020).

Due to India's dependence on external energy resources and lack of reforms in the energy sector, it has difficulty meeting the growing consumption needs. As India's energy needs are projected to increase by 156 percent between 2017 and 2040, aimed to reduce its 92 percent dependence on fossil fuels by 2017 to 79 percent by 2040 (World Nuclear Association, 2020).

Recently The Department of Atomic Energy (DAE) informed the Parliament that 21 new nuclear power reactors with a total installed capacity of 15,700 MW are expected to be set up in the country by 2031. According to the 2019 annual report published by this department, the total nuclear capacity is likely to be about 22.5 GWe by the year 2031.

India's uranium resources are around 183,600 tons. Thus, India is looking for import options to obtain these resources while continuing uranium mine exploration works. The Atomic Minerals Directorate of India carries out uranium exploration activities. In addition, India's thorium mines, which are around 319,000 tons, are seen as an alternative to uranium. This corresponds to 13 percent of the thorium mines in the world. With this thorium India plans to maintain its nuclear programs. In this

context, India claims to have 700,000 tons of thorium reserves (World Nuclear Association, 2020).

India's nuclear industry is largely outside the safeguard of the IAEA due to its exclusion from the NPT as it has nuclear weapons. Thus, the IAEA cannot perform an effective inspection in this country. Therefore, India is deprived of nuclear trade, even for its peaceful nuclear activities, and is considered embargoed in this area.

India, along with Pakistan and Israel, is considered as threshold countries for the international non-proliferation regime because these countries are thought to have nuclear weapon capacities that can be put into action quickly. The military ambitions and goals of these countries also reinforce these concerns.

China's advanced and modern nuclear capacity and its cooperation with Pakistan in the field of missile technology raise India's concerns. India's security concerns are also related to the country's desire to be a dominant power in the region. In addition, China's expanding nuclear weapons and missile programs are also one of the important reasons to be concerned. Lastly, the ongoing problems of the country with Pakistan and the fact that these two countries have nuclear weapons cause India to attach importance to nuclear power.

India had a war with China in 1962 and frozen its diplomatic relations until 1998. China currently occupies some Indian territories. In addition to all these, China also provides nuclear and missile support to Pakistan, India's regional rival.

On the other hand, Pakistan made some regional security proposals to India in order to reduce the tension. Some recommendations have been made in the form of making South Asia a nuclear-free area and signing international agreements for nuclear disarmament. However, India thinks that regional problems should be resolved not regionally but internationally. As India's main concern is China's nuclear capacity, it rejects Pakistan's disarmament proposals.

The Competition Between China and India

When we analyze the H-T competition between China and India, we can clearly see that China is ahead of its competitor almost in all H-T fields. Table 3.3. showing some important data on five main H-T fields indicates that in Aerospace China is 10th in the world while India is 16th when it is about world export rates. While commitment for cybersecurity is high in both countries, China attaches more importance to

cybersecurity and ranks 27th in the world while India ranks 47th. China has annually 140.000 installed robot (In India this number is only 4300) and ranks first in this area. China is also world's biggest robot market. Robot density (number of installed robots per 10.000 employees) in China is 68, while it is only 3 in India. India invests more to biotechnology industry but during Covid 19 pandemic, China succeeded to develop a vaccine (Sinovac) indicating the level of development in biotechnology too. China has 45 operable nuclear reactors and 10 more reactors are under construction while India has 22 operable nuclear reactors and 7 under construction. China has 290 nuclear warheads while India has only 130 or 140. All of these numbers and datas derived from the previous chapters of this thesis shows that China surpasses India in all the fields of H-T.

Table 3.3 Hi-Tech Competition Between China and India

HI-TECH FIELD	CHINA	INDIA
	Population:1,4 billion (1,444,185,526)	Population: 1,39 billion (1,391,995,147)
AEROSPACE	In the top 10 but at the end of the list with \$ 4,6 b. (%1,4) world export.	16th in the world in Aerospace Exporting (% 0,6).
CYBERSPACE	Commitment for cybersecurity (high) – 100.000 cyber soldiers - Ranked 27th in cybersecurity.	Commitment for cybersecurity (high) – Ranked 47th in cybersecurity.
MECHATRONICS-ROBOTICS	140.000 industrial robots (annual installation) – Rank 1st. World's biggest robot market. 23rd in robot density (68 - Number of Installed Robots per 10.000 Employees).	4300 industrial robots (annual installation) – Rank 10th. 44th in robot density (only 3 - Number of Installed Robots per 10.000 Employees).
BIOTECHNOLOGY	Investments made in the biotechnology sector in China between 2014 and 2017 amounted to \$ 45 billion dollars. (+ Sinovac)	By the end of 2025, the Indian Biotechnology industry is projected to reach \$150 billion. Stronger commitment by the Indian government.
NUCLEAR TECHNOLOGY	45 operable nuclear reactors (+10 under construction) in 2019. 290 nuclear warheads.	22 operable nuclear reactors (7 under construction) in 2019. 130-140 nuclear warheads.

CONCLUSION

Technology has been in our lives since the early ages of humanity, even in its most primitive form, just like politics. Just as people's use of simple tools symbolizes their first relationship with technology, their coexistence as a social entity symbolizes its political aspect. Technology has created a driving force that positively affects the development of humanity over the ages and has made it superior to nature and among human groups.

Science and technology, on the other hand, are like two rivers that have a close relationship with each other but flow in different channels. While science investigates the underlying principles of technology, technology is the application of science to practical life. Politics, on the other hand, is an important tool that determines the relationship between people and technology.

Some laws can be discovered with scientific research and this can be achieved with the participation of a limited number of people. But putting that discovery into a technological device and application requires collaboration and organization. Determining the principle of flying for an airplane is something, but it is another thing to build that airplane. This points to the social aspects of technology and its direct relationship with politics.

Over the ages, politicians have steered science and technology, especially wars, and international struggles have led people to benefit more from technology. With the realization that science and technology give nations superiority, a technology race has existed among political units since ancient times.

As there are those who believe that technology develops and advances the human race, they approach this issue more pessimistically and think that technological development is a flawed concept and that power and hegemony create an anti-democratic illusion by overshadowing the concept of development. Whichever one we believe, it is an undeniable fact that technology is an important parameter for states in terms of both military power and economic power in current politics.

H-T is the most valid and advanced technology of the age. Today, the most important fields that the states attach importance are H-T fields. Technology can be transferred and is, therefore, subject to relations between states and nations. IR has

always been interested in technology in this sense. The concept of techno-politics comes into play at this point and helps us to examine technology and politics.

Techno-politics both examine policymakers' relationship with technology and tries to analyze the impact of technology on policies and its power to transform it. Technology is a global concept, and it also has a globalizing aspect to nations. Today, one of the most important factors in the globalization of nations is the technological device and the virtual global world that we call the cyber world, which comes into our lives with high technology.

It is difficult to draw boundaries to high technology, but it is possible to examine it under five main headings: Aerospace, Cyberspace Mechatronics: Robotics, Biotechnology, Nuclear Technology. These areas of H-T are as directly affecting the existence and current situation of both nations and states.

Technology has an impact on politics and our lives more than ever. Technology has two faces. One is dark, and one is light, but both sides are reflected in politics. States use technology in terms of both the welfare and development of nations and global cooperation, but on the other hand, in the dark side of technology, it has been inevitable for states to use technology for military and strategic purposes and to test their destructive power on each other. In addition, states can give the green light to technology exports with the aim of gaining economic gains, strategic concerns, desire to form alliances, and creating technology-dependent satellite states for themselves.

South Asia is an important field for our understanding of the effects of technology on human life. In this region, which hosts a large part of the world population, China and India are the two most populous countries in the world and constitute one-third of the human race. It is clear that these two countries are trying to make the most of high technology in the struggle for regional hegemony.

We have argued that technology needs social organization and human resources. With the industrial revolution, production capacity and workforce have been a very important advantage in terms of economic development. For this very reason, both countries have aimed to develop by organizing the huge human resource correctly. Realizing the transferability of technology, both countries opened their doors to foreign technology and globalization and strived to localize and nationalize it as much as possible.

China's urbanization, industrialization, and, in a way, economic liberalization despite the Communist Rule moves along with the systematic and disciplined practices of politicians that have led to great economic development and technological innovation. Economic prosperity has been created by using the workforce efficiently, and a systematic mechanism has been created by crowning this workforce with technology transfer. India, on the other hand, was late in its technological moves, instead of following a systematic and strategic path, it was watching the technology transform the society and the economy, and as a result, it fell into a disadvantageous position in terms of time and remained relatively behind.

India has maintained its position as an outsourcing country, especially in terms of information technologies, but it has difficulty in transforming this into being a technology producing country. China, on the other hand, has risen to a stronger position by adding the success of technology transfer and technology localization to its role as the production power of foreign countries.

Both countries aspire to dominate Asia. It is understood that China is more active in economic, technological, political, and military fields. Although India has achieved a higher interaction with the countries of the region in social and cultural terms, it lags behind China in terms of technological and political activity.

Looking at the technological data, it is understood that China has a distinct advantage over its competitor, especially in the fields of Aerospace, Mechatronics: Robotics, and Nuclear technologies, while only in the fields of Biotechnology and Cyberspace India can make its presence felt. India attaches more importance to information technologies and biotechnology and nuclear technology due to the regional competition. However, it can be thought that China is ahead of its competitors in all H-T fields, the potentials of states in terms of cyber warfare and nuclear power are not fully known, and this fact has made it difficult to present a clear picture in these areas.

With the current Covid-19 epidemic emerged in China and spread all over the world, biotechnology has gained importance again as never before. The pandemic that emerged in China has spread widely in India, and all countries of the world have entered into vaccine development efforts in the face of this disaster that shook all countries of the world. Although the developments regarding the emerging pandemic

are still very fresh while this thesis is being written, it is obvious that this process will provide very important data in terms of analyzing the effects of high technology on human life. Especially during the struggle against the epidemic, economic resilience, and the ability to continue living more efficiently in the field of cyberspace, and the robust and developed technological infrastructure of the countries against such disasters became prominent as important issues.

With this study, we have concluded that our hypothesis that we mentioned at the beginning related to techno-politics were verified. One of the conclusions that we arrived at is that techno-politics is one of the most important areas of competition in international politics and will continue to be so in the future. Also, H-T competition between China and India is at the center of a new rivalry in the field of international politics, both in the Asia continent and globally. And finally, high technology is both a global concept and it has a globalizing effect. In this sense, the countries that aim to lead in a local, regional, and global sense have to take part in this high technology competition, and they are trying to do so. This is what we witness when we look at the political decisions and strategic plans made by the politicians of these countries.

In the following years, it is thought that more studies will be carried out on the effects of H-T on human life and the concept of techno-politics in this sense, and special importance will be attached to this field in the IR discipline. This study is expected to be a source and an example for other studies to be conducted.

BIBLIOGRAPHY

- Abramovitz, Melissa (2015:10). *Biological engineering*. Gale Virtual Reference Library.
- ABPI (2016). *The Association of the British Pharmaceutical Industry*. "Worldwide Pharmaceutical Company R&D Expenditure by Country." Retrieved from <https://www.abpi.org.uk/facts-and-figures/science-and-innovation/worldwide-pharmaceutical-company-rd-expenditure-by-country/> Accessed May 5, 2020.
- Adams, J., Pendlebury, D., Rogers, G., & Szomszor, M. (2019). *Global Research Report—South and East Asia*.
- Aero India (2020). *Aerospace Industry in India*. Retrieved from <https://www.defense-aerospace.com/articles-view/feature/5/102287/quick-overview-of-india%E2%80%99s-aerospace-industry.html>
- All India Association of Industries (2020). *Aerospace*. Retrieved from <https://www.aiaindia.com/aerospace.html#:~:text=Aerospace%20industry%20in%20India%20is,components%20for%20India's%20defence%20sector.>
- Altunoğlu, Mustafa (2005). *Küresel-Yerel Eksenli Kimlik Tartışmalarının Türkiye'deki İzduşümleri*. Kemal Görmez (Gen. Yay. Yön.), Küreselleşme ve Yerelleşme, Gazi Kitabevi, Ankara.
- Anthony, David W. (2007). *The Horse, the Wheel, and Language: How Bronze-Age Riders from the Eurasian Steppes Shaped the Modern World*. Princeton: Princeton University Press. p. 65. ISBN 978-0-691-05887-0.
- Aristotle. (384-322 BC/1998). *Politics*. (Trans. by C.D.C Reeve). Cambridge: Hackett Publishing Company
- Arkin, R. C. (2010). *The case for ethical autonomy in unmanned systems*. *Journal of Military Ethics*, 9(4), 332–341.
- Arranz, Adolfo (2018). *Betting big on biotech*. Retrieved from: <https://multimedia.scmp.com/news/china/article/2167415/china-2025-biotech/index.html>
- Arthur, W. Brian (2009). *The Nature of Technology*. New York: Free Press. p. 28. ISBN 978-1-4165-4405-0.
- Asia Fund Managers (2019). *China robotics industry: A steady path to automation*. Retrieved in May 15, 2021 from <https://www.asiafundmanagers.com/int/china-robotics/#:~:text=As%20a%20result%2C%20in%202017,2018%2C%20to%20reach%20%2410.1%20billion>
- Asimov, Isaac (1950:40). *Runaround. I, Robot (The Isaac Asimov Collection ed.)*. New York City: Doubleday.
- Atalayar.com (2021). *President Al-Sisi allies with Xi Jinping to robust Egypt's satellite industry*. Retrieved in May 15, 2021 from <https://atalayar.com/en/content/president-al-sisi-allies-xi-jinping-robust-egypts-satellite-industry>
- Bain, Read (1937). *Technology and State Government*. *American Sociological Review*. 2 (6): 860. doi:10.2307/2084365. JSTOR 2084365.
- Baylis J. (2008). *The globalization of world politics: An introduction to international relations*. Oxford University Press.
- Basu, A. and Hickok, E. (2018). *Cyberspace and External Affairs: A Memorandum for India*. The Centre for Internet and Society. Retrieved from: <https://cis-india.org/internet-governance/files/cyberspace-and-external-affairs>

- Bauman, Z. (2013). *Modernity and the holocaust*. Hoboken, NJ: Wiley.
- BBC News (1999). *China's trillion dollar economy*. Retrieved in May 15, 2021 from <http://news.bbc.co.uk/2/hi/business/582419.stm>
- Bhasin, M. (2008). *India's Role in South Asia: Perceived Hegemony or Reluctant Leadership?*. Indian Foreign Affairs Journal, 3(4), 1-25.
- Bigelow, Jacob. (1829). *Elements of Technology, 2nd ed.* Boston: Hilliard, Gray, Little & Wilkins.
- Biotechnology. (2019). *American Chemical Society*. Retrieved from: www.acs.org.
- Biotechnology. (2019). *European Federation of Biotechnology*. Retrieved from www.efbiotechnology.org
- Block, M. (1863). *Dictionnaire général de la politique*. Paris: O. Lorenz
- Bridel, M. (1950). *The Methods and Present State of Swiss Political Science*. In Contemporary Political Science: A Survey of Methods, Research and Teaching (pp.65-68). Paris: Unesco
- Brey, P. (1997). 'Social Constructivism for Philosophers of Technology: A Shopper's Guide.' *Techné: Journal of the Society for Philosophy and Technology* 2:3-4, 56-78.
- Breslin, Gerry, ed. (2011). *Technicism*. Collins English Dictionary. HarperCollins. ISBN 978-0-00-743786-3.
- Brown, M., & Singh, P. (2018). *China's technology transfer strategy*. Silicon Valley, CA: Defense Innovation Unit Experimental Report.
- Buchanan, R.A., (2019). *History of Technology*. Encyclopedia Britannica. Retrieved from <https://www.britannica.com/technology/history-of-technology>. Access Date: 2019, December 3
- Carroll, L. (2017). *A Comprehensive Definition of Technology from an Ethological Perspective*. *Social Sciences*, 6(4), 126. doi:10.3390/socsci6040126
- Catlin, G.E.G., (1930). *A Study of the Principles of Politics: Being an Essay Towards Political Rationalization, (1st Ed.)* London: Routledge
- Centre For Aviation (2020), *Russia now Europe's #1 airline market, thanks to domestic size*. Retrieved in May 12, 2021 from <https://centreforaviation.com/analysis/reports/russia-now-europes-1-airline-market-thanks-to-domestic-size-522390>
- CEO Insights India (2018). *10 Best Indian CEOs From U.S.– 2018*. Retrieved in May 15, 2021 from <https://www.ceoinsightsindia.com/magazine/indian-ceos-from-us-special/august-2018-issue-special3.html>
- Cevizci, Ahmet. (2007) *Felsefeye Giriş. (Second Edition)*. Bursa: Sentez Yayınları
- Chalmers, Hugh (2014). *A Disturbance in the Force: Debating Continuous At-Sea Deterrence*. Royal United Services Institute. London.
- Chang, W. and Billo, C. (2004). *Cyber Warfare Analysis of the Means and Motivations of Selected Nation States*. Hanover: Institute for Security Technology Studies at Dartmouth College, November 2004.
- China Robotics Industry Development Report. (2019) Retrieved from http://bjwb.bjd.com.cn/html/2019-08/21/content_12166149.htm
- Chinese Biotech (2020). *Biotech Companies in China*. Retrieved from: https://www.chinesebiotech.com/cn/portal/stats_biotech.php
- CNSA (2019). *China National Space Administration*. Retrieved from <http://www.cnsa.gov.cn/english/>
- Cole-Turner R. (2003). *Biotechnology*. Encyclopedia of Science and Religion.

- Cook, James. (1985). *Nuclear Follies*. Forbes Magazine.
- Cortright, J., Mayer, H. (2001). *High Tech Specialization: A Comparison of High Technology Centers*. Brookings Institution, Center on Urban & Metropolitan Policy.
- Cyberspace. *In the Oxford Dictionary*. Retrieved April 26, 2020, from <https://www.lexico.com/en/definition/cyberspace>
- Datareportal (2021). *Digital 2020: India*. Retrieved from <https://datareportal.com/reports/digital-2020-india>
- Demoule, J. & Stiegler, B. (2008). *L'avenir du passé: Modernité de l'archéologie. La Découverte*. p. 23. ISBN 978-2-7071-5495-8.
- Department of Biotechnology (2020). *Government of India Ministry of Science and Technology*. Retrieved from: <http://dbtindia.gov.in/about-us/introduction>
- Dahl, R. A. (1961). *Who Governs: Democracy and Power in an American City*. New Haven and London: Yale University Press
- Dahl, R. A. (2006). *On Political Equality*. New Haven and London: Yale University Press
- Economist Intelligence Unit (2013). *Cyber Power Index: Findings and Methodology*. The Economist. Retrieved from: <http://gssd.mit.edu/search-gssd/site/cyber-power-index-findings-methodology-59935-tue-03-05-2013-1051>
- Edgar, J.D. (2004). *The Colours of Biotechnology: Science, Development and Humankind*. Electronic Journal of Biotechnology
- Edwards. P.N. and Hecht, G. (2010). *History and the Technopolitics of Identity: The Case of Apartheid South Africa*. Journal of Southern African Studies, Volume 36, Number 3, September 2010.
- Elegant, Simon (2009). *Cyberwarfare: The Issue China Won't Touch*. Time Magazine. Retrieved August 18, 2020.
- Energy.Gov. (2021). *What's the Lifespan for a Nuclear Reactor? Much Longer Than You Might Think*. Retrieved in May 14, 2021 from <https://www.energy.gov/ne/articles/whats-lifespan-nuclear-reactor-much-longer-you-might-think#:~:text=Eighty%2Deight%20of%20America's%2093,will%20expire%20in%20the%202030s>.
- English.Gov.Cn. (2021). *The State Council The People's Republic of China*. Retrieved in May 15, 2021 from <http://english.www.gov.cn/>
- Ernst & Young. (2018). *Beyond borders. Biotechnology Report 2017: Staying the Course*. Retrieved from [https://www.ey.com/Publication/vwLUAssets/ey-biotechnology-report-2017-beyond-borders-staying-the-course/\\$FILE/ey-biotechnology-report-2017-beyond-borders-staying-the-course.pdf](https://www.ey.com/Publication/vwLUAssets/ey-biotechnology-report-2017-beyond-borders-staying-the-course/$FILE/ey-biotechnology-report-2017-beyond-borders-staying-the-course.pdf) Accessed May 04, 2020.
- FAI. (2021). *The 100 km Boundary for Astronautics*. Fédération Aéronautique Internationale. Retrieved in 28 May 12, 2021 from <https://www.fai.org/page/icare-boundary>
- Fara, P. (2009). *Science, A Four Thousand Year History*. Oxford, Oxford University Press.
- Feenberg, A. (2012). *Questioning technology*. Routledge.
- Flight Global (2019). *Top 100 aerospace companies by revenue 2018 (\$ millions)*. Retrieved from: <https://www.flightglobal.com/download?ac=67085>
- Gagliardone, I. (2014). *A Country in Order: Technopolitics, Nation Building, and the Development of ICT in Ethiopia*. Information Technologies & International Development, 10(1), 3–19, Spring 2014.
- Garner, J. W. (1910). *Introduction to Political Science: A treatise on the Origin, Nature, Functions, and Organization of the State*. New York: American Book Company

- Gerber, L. G. (1982). *The Baruch Plan and the origins of the Cold War*. *Diplomatic History*, 6(1), 69-96.
- Gettell, R.G. (1910). *Introduction to Political Science*. Boston: Ginn and Company
- Gibson, William (1984). *Neuromancer*. New York: Ace Books. p. 69. ISBN 978-0-441-56956-4.
- Giddens, A. (1990). *The Consequences of Modernity: Self and Society in the Late Modern Age* (Cambridge: Polity Press, and Stanford, Cal.: Stanford University Press).
- Gilpin, R. (2001). *Global Political Economy* (Princeton, NJ: Princeton University Press).
- GII (2020). *Global Innovation Index*. <https://www.globalinnovationindex.org>
- Global Cybersecurity Index. (2018). Retrieved May 5, 2020 from https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2018-PDF-E.pdf
- Gökberk, Macit (1961/2004). *Felsefe Tarihi. (15th Edition)*. İstanbul: Remzi Kitabevi
- Grossman, Lev. (2011). *2045: The Year Man Becomes Immortal*. *Time Magazine*, February 2011, Retrieved December 18, 2019. From <http://content.time.com/time/magazine/article/0,9171,2048299,00.html>
- Harari, Y. N. (2014). *Sapiens: A brief history of humankind*. Toronto: Penguin Random House Canada.
- Harari, Y. N. (2016). *Homo Deus – A Brief History of Tomorrow* (Trans. by Poyzan Nur Taneli). İstanbul: Kolektif Kitap
- Harvey, D. (1989). *The Condition of Postmodernity: An Enquiry into the Conditions of Cultural Change* (Oxford: Blackwell).
- Headrick, D. R. (1981). *Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York: Oxford University Press)
- Headrick, D. R. (2009). *Technology: A world history*. New York: Oxford University Press.
- Hecht, Gabrielle, (2011). *Entangled Geographies: Empire and Technopolitics in the Global Cold War*. 1st ed. The MIT Press
- Herrera, G.L. (2006) *Technology and International Transformation: The Railroad, the Atom Bomb, and the Politics of Technological Change*. (Albany: State University of New York Press)
- Heywood, Andrew. (2004). *Political theory: An introduction (3rd. Edition)*. New York: Palgrave Macmillan
- Hindustan Times. (2017). *In 5 years 649 Indian scientists have returned to pursue research opportunities*. Retrieved from <https://www.hindustantimes.com/science/in-5-years-649-indian-scientists-have-returned-to-pursue-research-opportunities/story-4LLaTjjgqOJoHRiKZqqzAP.html>
- Hobbes, T. (1651/1881). *Leviathan*. Oxford: 1873 Press
- Hoddeson, Lillian; Henriksen, Paul W.; Meade, Roger A.; Westfall, Catherine L. (1993). *Critical Assembly: A Technical History of Los Alamos During the Oppenheimer Years, 1943–1945*. New York: Cambridge University Press.
- Hughes, Agatha C., Michael Thad Allen, and Gabrielle Hecht. 2001. *Technologies of Power: Essays in Honour of Thomas Parke Hughes and Agatha Chipley Hughes*. MIT Press
- Hughes, J.J. (2006). *Human Enhancement and the emergent technopolitics of the 21st century*. In: W. S.Bainbridge and M.C. Roco, (eds.) *Managing Nano-Bio-Info-Cogno Innovations: Converging Technologies in Society*, 285–307. 2006 Springer.
- Hvistendahl, Mara (2010). *China's Hacker Army*. *Foreign Policy Magazine*. Retrieved from: <https://foreignpolicy.com/2010/03/03/chinas-hacker-army/>

- IAEA (2021). *Nuclear power plant ageing and life extension: Safety aspects*. Retrieved in May 14, 2021 from <https://www.iaea.org/sites/default/files/29402043133.pdf>
- IDI. (2017). *ICT Development Index*. Retrieved from: <https://www.itu.int/net4/ITU-D/idi/2017/> in 19.08.2020
- IFR Press Release (2018). *Robot density rises globally*. International Federation of Robotics. Retrieved May 5, 2020 from <https://ifr.org/ifr-press-releases/news/robot-density-rises-globally>
- IIT Research Institute. (1969). *Technology in Retrospect and Critical Events in Science*. Volume 2. Report No: PB234768. Chicago. Retrieved from: National Technical Reports Library website: <https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/PB234768.xhtml#>
- India Global Bussiness. (2020). *India's cyberspace odyssey*. Retrieved from: <https://indiaincgroup.com/indias-cyberspace-odyssey/>
- India Times (2019). *What Would Gurgaon vs Bangalore Startup Match Look Like*. Retrieved in May 15, 2021 from <https://timesofindia.indiatimes.com/india/startups-bangalore-vs-gurgaon/articleshow/68149030.cms>
- Ince, Murat. (2009). *Küreselleşme ve Yerelleşme: Bir Çelişki mi?*. Gazi Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 11(1), 259-275.
- Invest India (2020). *Biotechnology*. Retrieved from: <https://www.investindia.gov.in/sector/biotechnology>
- Jash, A. (2019). *China seeks to "Informationisation" to Fight Modern Warfare*. Retrieved in May 15, 2021 from <https://indianarmy.nic.in/writereaddata/Claws/China%20Seeks%20to%20informatio nisation%20to%20fight%20modern%20warfare.htm>
- Jaspers, Karl. (1953). *The Origin and Goal of History* (Michael Bullock, Trans.). London: Routledge K. Paul.
- Jia, H. (2004) *China moves to reform biotech policies*. Nat Biotechnol 22, 1197. <https://doi.org/10.1038/nbt1004-1197>
- Jinghua, L. (2019). *What Are China's Cyber Capabilities and Intentions?*. Carnegie Endowment for International Peace. Retrieved from: <https://carnegieendowment.org/2019/04/01/what-are-china-s-cyber-capabilities-and-intentions-pub-78734>
- Jones, T. C. (2011). *Crude Ecology: Technology and the Politics of Dissent in Saudi Arabia. Entangled Geographies: Empire and Technopolitics in the Global Cold War*. 209.
- Kaag, J., & Kaufman, W. (2009). *Military frameworks: Technological know-how and the legitimization of warfare*. Cambridge Review of International Affairs, 22(4), 585–606.
- Kellner, D. (2001:14-34). Globalisation, technopolitics and revolution. *Theoria*, 48(98)
- Kennedy, A. B. (2013). *China's search for renewable energy: pragmatic techno-nationalism*. Asian Survey, 53(5), 909-930.
- Knights, D. and Murray, F. (1994). *Managers Divided. Organisation Politics and Information Technology Management*. Chichester, John Wiley and Sons.
- Kocabaş, Ş. (1996). *İslâm ve bilim*. Dîvân: Disiplinlerarası Çalışmalar Dergisi, (1), 67-83.
- Kuehl, D. T. (2009). *From cyberspace to cyberpower: Defining the problem*. Cyberpower and national security, 1.
- Lalwani, Ashok (2019). *This is how India can become the next Silicon Valley*. Retrieved from: <https://www.weforum.org/agenda/2019/10/india-technology-development-silicon-valley/>

- Laswell, D. H. (1951). *The Political Writings of Harold D. Laswell*. Illinois: The Free Press
- Lawrence J. Kamm. (1996). *Understanding Electro-Mechanical Engineering: An Introduction to Mechatronics*. John Wiley & Sons.
- Lebkowsky, J. (1997). *TechnoPolitics*. In 21C, 11-01-1997. Melbourne: The Commission.
- Lennon, T., & Mass, N. (2008). *Model-based design for mechatronic systems*. Electronics world-sutton then cheam-, 1865, 23.
- Lillemose, J. & Kryger, M. (2015). *The (Re)invention of Cyberspace*. Retrieved from <https://kunstkritikk.com/the-reinvention-of-cyberspace/> Access Date: 2020, April 26
- Liping, Gu. (2019). *China hit by world's largest number of cyberattacks in 2018*. Ecns.cn. Retrieved from <http://www.ecns.cn/news/sci-tech/2019-02-22/detail-ifzevinw9626699.shtml> on August, 19, 2020
- Liu, F. C., Simon, D. F., Sun, Y. T., & Cao, C. (2011). *China's innovation policies: Evolution, institutional structure, and trajectory*. *Research Policy*, 40(7), 917-931.
- Locke, J. (1689/1998). *Concerning Civil Government, Second Essay: An Essay Concerning the True Original Extent and End of Civil Government*. Pennsylvania: The Pennsylvania State University
- Logos. In The Merriam-Webster.com Dictionary. Retrieved December 4, 2019, from <https://www.merriam-webster.com/dictionary/Logos>
- Machiavelli, N. (1883). *The Prince*. New York: 1873 Press
- MacKenzie, D. A. and Wajcman, Judy. eds. (1999). *The Social Shaping of Technology: : How The Refrigerator Got Its Hum*. (Milton Keynes: Open University Press).
- MacKinnon, R. (2013). *Consent of the networked: The worldwide struggle for internet freedom*. New York: Perseus.
- MarketLine Industry Profiles. (2019). *Global Biotechnology*. Retrieved May 2020 from <https://store.marketline.com/report/ohmf8274--global-biotechnology-6/>
- Mason, Bob. (2019). *So Who Has the Most Advanced Cyber Warfare Technology*. Retrieved from: <https://www.fxempire.com/education/article/so-who-has-the-most-advanced-cyber-warfare-technology-444874>
- Mayer, M., de Scalzi, N., Martino, L., & Chiarugi, I. (2013). *International politics in the digital age: Power diffusion or power concentration?*. In Proc. 27th SISP Conference
- Mayer, M., Carpes, M., & Knoblich, R. (2014). *The global politics of science and technology: An introduction*. In *The Global Politics of Science and Technology-Vol. 1* (pp. 1-35). Springer, Berlin, Heidelberg.
- M&A Statistics. (2019). *Statistics on Mergers & Acquisitions (M&A)*. Imaa-institute.org. Retrieved 2019-04-24.
- McCarthy, D. R. (2017). *Conclusion: technology and International Relations theory*. *Technology and World Politics: An Introduction*, 111.
- McGrew, A. (2002). *Between two worlds: Europe in a globalizing era*. *Government and opposition*, 343-358.
- McReynolds, Joe (2015). *China's Evolving Perspectives on Network Warfare: Lessons from the Science of Military Strategy*. April 16, 2015, jamestown.org
- MEITY (2013). *National Cyber Security Policy - 2013*. Retrieved from: <https://www.meity.gov.in/content/national-cyber-security-policy-2013-1>
- Merriam-Webster. (n.d.). *Globalisation*. In Merriam-Webster.com dictionary. Retrieved April 21, 2021, from <https://www.merriam-webster.com/dictionary/globalisation>
- MIC (2018), *Made In China 2025 Strategy Report*. Retrieved from <https://isdpeu.com/content/uploads/2018/06/Made-in-China-Backgrounder.pdf>

- Miller, D. (2003). *Political Philosophy: A Very Short Introduction*. Oxford: Oxford University Press
- Mitchell, Timothy. 2002. *Rule of Experts: Egypt, Techno-Politics, Modernity*. 1st ed. University of California Press
- Morgenthau, H. J. (1964). *Modern science and political power*. Columbia Law Review, 64, 1386– 1409.
- Morningstar, Chip and F. Randall Farmer (2003:664-667). *The Lessons of Lucasfilm's Habitat*. The New Media Reader. Ed. Wardrip-Fruin and Nick Montfort: The MIT Press.
- Morris, Ian. (2010). *Why the West Rules-For Now: The Patterns of History, and What They Reveal About the Future*. New York: Farrar, Straus and Giroux
- Mumford, E. and Ward, T. B. (1968). *Computers, Planning and People*. London, BT Batsford Ltd.
- Nature, (2019). *The next biotech superpower*. Nat Biotechnol 37, 1243 (2019). <https://doi.org/10.1038/s41587-019-0316-7>
- Nature Index (2020). *Nature Index* <https://www.natureindex.com/>
- Negroponte, Nicholas (1995). *Being Digital* (New York: Knopf).
- Norwegian University of Science and Technology. (2020). *What is Biotechnology?*. Retrieved from: <https://www.ntnu.edu/ibt/about-us/what-is-biotechnology>
- OECD. (2010). *OECD Science, Technology and Industry Outlook 2010 Highlights*. Retrieved from <http://www.oecd.org/science/inno/46674411.pdf> Accessed May 5, 2020
- OECD. (2017). *The Next Production Revolution: Implications for Governments and Business*. OECD Publishing. Paris, <https://doi.org/10.1787/9789264271036-en>.
- Oshi, M. M. J. (2015). *Charles Dickens' Contribution to Victorian Social Reform Through his Novels*. PhD Thesis. Sudan University of Science and Technology
- Paul, T.V. (2019). *When balance of power meets globalization: China, India and the small states of South Asia*. Politics,
- Plato. (380 BC / 1970). *Plato's The Republic* (Trans. by F. M. Cornford). London: Oxford University Press
- Politics. In The Merriam-Webster.com Dictionary. Retrieved December 23, 2019, from <https://www.merriam-webster.com/dictionary/politics>
- Politics. In The Cambridge Dictionary. Retrieved December, 23, 2019, from <https://dictionary.cambridge.org/dictionary/english/politics>
- Rasmussen, T. (2007). *Techno-politics, Internet Governance and some challenges facing the Internet*. Oxford Internet Institute, Research Report 15, October 2007.
- Rasmussen, A. (2014). *NATO's new frontier*. World Affairs, February 11. <http://www.projectsyndicate.org/commentary/anders-fogh-rasmussen-presents-the-benefits-of-creating-a-european-missile-defense-system>. Accessed 05 May 2020.
- Rhodes, R. (2012). *The making of the atomic bomb*. Simon and Schuster.
- Roskin, M., Cord, R., Medeiros, J. & Jones, W. (2017). *Political Science: An Introduction* (14th Ed.). New York: Pearson
- Rousseau, J.J. (1762/2002). *The Social Contract and The First and Second Discourses* (Trans. by Susan Dunn). New Haven: Yale University Press
- Rüdiger, Wolfgang, ed. (1990). *Anti-nuclear Movements: A World Survey of Opposition to Nuclear Energy*. Detroit, MI: Longman Current Affairs.
- Schatzberg, E. (2006). *Technik Comes to America: Changing Meanings of Technology before 1930*. Technology and Culture 47(3), 486-512. doi:10.1353/tech.2006.0201.

- Schmid, S. D. (2011). *Nuclear colonization? Soviet technopolitics in the second world. Entangled geographies: Empire and technopolitics in the global Cold War.* 125-154.
- Schlosser, E. (2013). *Command and control: Nuclear weapons, the Damascus accident, and the illusion of safety.* New York: Penguin.
- Scholte, J. A. (2000, 2005), *Globalization: A Critical Introduction* (Basingstoke: Macmillan; 2nd edn, 2005).
- Seeley, J.R. (1896). *Introduction to Political Science: Two Series of Lectures.* London: Macmillan and Co.
- Scharping, T. (2003). *Birth control in China 1949–2000: Population policy and demographic development.* London: Routledge.
- SCMP.com (2018). *Made In China 2025: a peek at the robot revolution under way in the hub of the 'world's factory'.* Retrieved in May 15, 2021 from <https://www.scmp.com/economy/china-economy/article/2164103/made-china-2025-peek-robot-revolution-under-way-hub-worlds>
- Sherwin, Chalmers W. & Isenson, Raymond S. (1967:1571–1577). *Project Hindsight.* Science 156, 3782. <https://doi.org/10.1126/science.156.3782.1571>
- Sipri (2020). *Nuclear weapon modernization continues but the outlook for arms control is bleak: New SIPRI Yearbook out now.* Retrieved from: <https://www.sipri.org/media/press-release/2020/nuclear-weapon-modernization-continues-outlook-arms-control-bleak-new-sipri-yearbook-out-now>
- Spacenews.com (2020). *China's Landspace raises \$175 million for Zhuque-2 launch vehicles.* Retrieved in May 15, 2021 from <https://spacenews.com/chinas-landspace-raises-175-million-for-zhuque-2-launch-vehicles/>
- Spacey, J. (2016). *Low Tech vs High Tech.* Retrieved in May 10, 2016. from <https://simplicable.com/new/low-tech-vs-high-tech>
- Statista (2019). *Number of Operable Nuclear Reactors as of June 2019 by Country.* In Statista - The Statistics Portal. Retrieved April 29, 2020 from <https://www.statista.com/statistics/267158/number-of-nuclear-reactors-in-operation-by-country/>
- Statista (2020). *Number of internet users in India 2015-2025.* In Statista – The Statistics Portal. Retrieved September 29, 2020 from <https://www.statista.com/statistics/255146/number-of-internet-users-in-india/>
- Statista (2021). *Number of smartphone users in India in 2015 to 2020 with a forecast until 2025.* Retrieved May 15, 2021 from <https://www.statista.com/statistics/1229799/india-smartphone-penetration-rate/>
- Stiegler, Bernard (1998). *Technics and Time, 1: The Fault of Epimetheus.* Stanford University Press. pp. 17, 82. ISBN 978-0-8047-3041-9.
- Strate, Lance (1999). *The varieties of cyberspace: Problems in definition and delimitation.* Western Journal of Communication. 63 (3): 382–83. doi:10.1080/10570319909374648
- Techne. In The Merriam-Webster.com Dictionary. Retrieved December 4, 2019, from <https://www.merriam-webster.com/dictionary/techne>
- Technology. In The Merriam-Webster.com Dictionary. Retrieved December 4, 2019, from <https://www.merriam-webster.com/dictionary/technology>
- The Economist. (2019). *Can China become a scientific superpower? - The great experiment.* The Economist. 12 January 2019. Retrieved 24 April 2020.

- The Editors of Encyclopaedia Britannica (2012). *Logos*. Encyclopedia Britannica. Retrieved from <https://www.britannica.com/topic/logos>. Access Date: 2019, December 17
- The Open University. (2016). *Theories in Technology Evaluation*. The Open University. Retrieved from: www.open.edu/openlearn/science-maths-technology/engineering-and-technology/technology/theoriestechnology-evaluation/content-section-0
- Thieman WJ. & Palladino M.A. (2008). *Introduction to Biotechnology*. Pearson/Benjamin Cummings.
- Thorpe, M.S., Gary S. (2015). *AP Environmental Science, 6th ed.* Barrons Educational Series.
- Tiley, M. (Director). (2020). *History 101: Rise of China*. [Video File]. Netflix Originals. Retrieved from: <https://www.netflix.com/title/81116168>
- Toret, J. (2013). *Tecnopolítica: la potencia de las multitudes conectadas*. El sistema red 15M, un nuevo paradigma de la política distribuida. IN3 Working Paper Series.
- Tucker, S. (1998). *The Great War. 1914-18 (Vol. 2)*. Indiana University Press.
- TWC India (2020). *ISRO Plans to Launch 36 Missions in 2020-2021*. Retrieved from <https://weather.com/en-IN/india/news/news/2020-03-24-isro-plans-to-launch-36-missions-in-2020-2021>
- Utterback, J. (1974). *Innovation in Industry and the Diffusion of Technology*. *Science*, 183(4125), 620-626. Retrieved from www.jstor.org/stable/1737690
- Volti, Rudi. (2009). *Society and Technological Change, 6th ed.* New York: Worth Publishers
- Wadhwa, V., Jain, S., Saxenian, A., Gereffi, G., & Wang, H. (2011). *The grass is indeed greener in India and China for returnee entrepreneurs: America's new immigrant entrepreneurs—Part VI*. Available at SSRN 1824670.
- Westall, S. & Dahl, F. (2011). *IAEA Head Sees Wide Support for Stricter Nuclear Plant Safety*. Reuters. Retrieved from: [IAEA head sees wide support for stricter atom safety | Reuters](http://www.reuters.com/article/iaea-head-sees-wide-support-for-stricter-atom-safety/iaea-head-sees-wide-support-for-stricter-atom-safety-idUSTRE70100020110324)
- White House (2003). *The National Strategy To Secure Cyberspace*. <https://georgewbush-whitehouse.archives.gov/pcipb/>
- Wiener, N. (1956). *I am a mathematician: the later life of a prodigy: an autobiographical account of the mature years and career of Norbert Wiener and a continuation of the account of his childhood in Ex-prodigy (Vol. 20)*. Garden City, NY: Doubleday.
- Wei, Y., Huang, C., Li, J., & Xie, L. (2016). *An evaluation model for urban carrying capacity: A case study of China's mega-cities*. *Habitat International*, 53, 87-96.
- Weiss S.I. and Amir, R. A. (2019). *Aerospace Industry*. Encyclopedia Britannica. Retrieved from <https://www.britannica.com/technology/aerospace-industry>. Access Date: 2020, April 24
- Winner, L. (1980). *Do Artifacts Have Politics?*. *Daedalus* Vol. 109, No. 1, Modern Technology: Problem or Opportunity? (Winter, 1980), pp. 121-136 Published by: The MIT Press on behalf of American Academy of Arts & Sciences
- Woetzel, J., Seong, J., Leung, N., Ngai, J., Manyika, J., Madgavkar, A., ... & Mironenko, A. (2019). *China and the world: Inside the dynamics of a changing relationship*. McKinsey Global Institute.
- Worden, R. L., Savada, A. M., & Dolan, R. E. (1987). *China: A country study*. Department Of The Army Washington Dc.
- Workman, D. (2019). *Aerospace Exports by Country*. Retrieved from <http://www.worldstopexports.com/aerospace-exports-by-country/>
- World Bank (2020). *GDP growth (annual %) - India* Retrieved from <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=IN>

- World Nuclear Association (2020). *Nuclear Power in India*. Retrieved from: <https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx>
- SIPRI Yearbook. (2019). *SIPRI yearbook 2019: World Nuclear Forces*. Stockholm International Peace Research Institute.
- World Nuclear News. (2019). *China's nuclear power output jumps 18% year on year*. Retrieved from: <https://www.world-nuclear-news.org/Articles/Chinas-nuclear-generating-capacity-continued-to-gr>
- World Nuclear.Org. (2020). *World Nuclear Power Reactors & Uranium Requirements*. Retrieved from: <https://www.world-nuclear.org/information-library/facts-and-figures/world-nuclear-power-reactors-and-uranium-requireme.aspx>
- World Robotics. (2019). *International Federation of Robotics*. Retrieved May 5, 2020 from <https://ifr.org/free-downloads/>
- Worldometers. (2021). *China Population*. Retrieved in 15 May, 2021 from <https://www.worldometers.info/world-population/china-population/>
- Worldometers. (2021). *India Population*. Retrieved in 15 May, 2021 from <https://www.worldometers.info/world-population/india-population/>
- Yaman, A. (2019). *Küreselleşme Süreci ve Küreselleşmenin Yerel Kültüre Etkisi*. Karadeniz-Blacksea-Черное море, (44), 422-436.
- Yang, L. (2017). *China and SAARC: Is there still an opportunity?*. Singapore: Lee Kuan Yew School of Public Policy
- Yip, G. S., & McKern, B. (2016). *China's next strategic advantage: From imitation to innovation*. MIT Press.