

Ministry of Education and Science of Ukraine
Black Sea Universities Network

ODESA NATIONAL UNIVERSITY OF TECHNOLOGY

International Competition of
Student Scientific Works

BLACK SEA SCIENCE 2022 PROCEEDINGS



ODESA, ONUT 2022

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BLACK SEA SCIENCE 2022

Proceedings

Odesa, ONUT 2022

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Black Sea Science 2022: Proceedings of the International Competition of Student Scientific Works / Odesa National University of Technology; B. Iegorov, M. Mardar (editors-in-chief) [*et al.*]. – Odesa: ONUT, 2022. – 749 p.

Proceedings of International Competition of Student Scientific Works «Black Sea Science 2022» contain the works of winners of the competition.

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INTRODUCTION

International Competition of Student Scientific Works “Black Sea Science” has been held annually since 2018 at the initiative of Odesa National University of Technology (formerly Odesa National Academy of Food Technologies) with the support of the Ministry of Education and Science of Ukraine. It has been supported by Black Sea Universities Network (the Association of 110 higher education institutions from 12 countries of the Black Sea Region) since 2019, and by Iseki-FOOD Association (European Integrating Food Science and Engineering Knowledge into the Food Chain Association) since 2020.

The goal of the competition is to expand international relations and attract students to research activities. It is held in the following fields:

- Food science and technologies
- Economics and administration
- Information technologies, automation and robotics
- Power engineering and energy efficiency
- Ecology and environmental protection

The jury includes both Ukrainian and foreign scientists. In the 4 years that the competition has been held, the jury included scientists from universities of 24 countries: Angola, Azerbaijan, Benin, Bulgaria, China, Czech Republic, France, Georgia, Germany, Greece, Israel, Italy, Kazakhstan, Latvia, Lithuania, Moldova, Pakistan, Poland, Romania, Serbia, Slovakia, Switzerland, Turkey, USA.

At the same time, every year the geography has expanded and the number of foreign jury members has increased: from 46 jury members representing 25 universities from 12 countries in 2018, to 73 jury members of the 46 universities from 19 countries in 2022.

More than a thousand student research papers have been submitted to the competition from both Ukrainian and foreign institutions from 25 countries: China, Poland, Mexico, USA, France, Greece, Germany, Canada, Costa Rica, Brazil, India, Pakistan, Israel, Macedonia, Lithuania, Latvia, Slovakia, Romania, Kyrgyzstan, Kazakhstan, Bulgaria, Moldova, Georgia, Turkey, Serbia.

The interest of foreign students in the competition grew every year. In 2018, the students representing 15 institutions from 7 countries have submitted 33 works. In 2021 the number of submitted works increased to 73, authored by the students of 40 institutions from 18 countries.

The competition is held in two stages. In the first stage, student research papers are reviewed by members of the jury who are experts in the relevant fields. In the second stage of the competition, the winners of the first stage have the opportunity to present their work to a wide audience in person or online.

All participants of the competition and their scientific supervisors are awarded appropriate certificates, and the scientific works of the winners are included in the electronic proceedings of the competition. Every year the competition receives a large number of positive responses from Ukrainian and foreign colleagues with the desire to participate in the coming years.

2. ECONOMICS AND **ADMINISTRATION**

**THE ROLE OF INTELLECTUAL PROPERTY RIGHTS AND
INTERNATIONAL TRANSFER OF TECHNOLOGY IN FOSTERING THE
ECONOMIC DEVELOPMENT: THE CASE OF CHINA**

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Abstract: *The significance and role of the intellectual property rights (IPR) evolves each year in dependence of the country economy. By striking the right balance between the interests of innovators and the wider public interest, the IP system aims to foster an environment in which creativity and innovation can flourish. Companies are attentive when it comes to identifying and protecting intellectual property because it holds such high value in today's increasingly knowledge-based economy and stimulates domestic economic growth. Also, producing value intellectual property requires heavy investments in brainpower and time of skilled labour, which means that increasing the inbound of foreign direct investment could determine the rise in the R&D expenditure from the GDP. This translates into heavy investments by organizations and individuals that should not be accessed with no rights by others.*

Keywords: *intellectual property rights, developing countries, transfer of technology, IPR Index, Foreign Direct Investment, patents, trademarks, industrial designs, innovation, economic growth.*

I. INTRODUCTION

Over the years, the role of intellectual property has grown considerably in all areas of activity, and especially in those countries which register continuous economic growth by recording a high tendency in displaying intellectual property protection systems in which the public has a basic degree of confidence [23].

Legal protection of innovation has been one of the determinant factors of economic development in many countries. Habits of mind and patterns of activity which release human creativity and generate new technology have been fostered by innovation protection. Protection of industrial and commercial secrets through the "trade secret," protection of creative expressions through copyright, protection of inventions by patents, and protection of commercial names through trademarks, has played a beneficial role in boosting economic growth in those states [23]. In this context, the intellectual property rights do represent an encouragement to stimulate the increase of economic growth of a nation, which consequently it does strengthen the motivation and possibilities of population in producing and developing new things, as well as encouraging investment in R&D and innovation, which will, eventually, create job opportunities and faster development of the world technologies. Moreover, being recognized as an asset to trade, it leads to the increase of competitiveness through industries worldwide [25, p.6]. When realising new invention, it is important to patent it, with the purpose to give the creator all the credits, to guarantee the industrial property rights, make possible for the inventions to be transferrable between inventors and thereby stimulate international trade and economic, technical and scientific

cooperation and, fulfil the function of trading products manufactured with the aid of inventions to its foreign partners, otherwise it will be considered as a “know-how”.

In these regards, in 1984, the United States designated inadequate protection of patents, trademarks and copyrights as an unfair practice that could invoke retaliation under section 301 of the Trade Act of 1974, which was adopted with the purpose to eliminate unfair foreign trade practices that adversely affect U.S. trade and investment in both goods and services. As result, during the Uruguay Rounds, in the period of 1986-1994 there was negotiated the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which establishes minimum standards for the regulation by national governments of different forms of intellectual property (IP) as applied to nationals of other WTO member nations and introduced intellectual property law into the multilateral trading system for the first time by remaining the most comprehensive multilateral agreement on intellectual property [13, p.1].

Another substantial role and importance in developing, increasing and expanding the economic growth is played by the international transfer of technology (ITT), which represents a multilateral flow of information and technical knowledge. It integrates various scientific fields, institutions, and business entities. Knowledge thus obtained contributes to the creation of a certain, more or less advanced, technological base [23]. The process presented above is not a new thing. It existed from the beginning of the humanity. Each simple gesture, word or even concept was created by someone, was transmitted through generations, and evolved over the years, and it did represent a simple explicit transfer of technological knowledge in a friendly environment. During the course of the years the complex requirements of the human being increased, being determined by their daily life needs. The elementary creation of various agricultural instruments, the formation and transfer of the knowledge how to realise it, represents an involuntary deliver of technology. Back then, there were no IPRs and law that permitted to the creator to take advantage from the invention, but, over the years, the continuous rapid evolution of different sectors and industries introduced the necessity of an elaborated management transfer of technology.

The actuality of the researched topic is determined by the increase of the importance of innovations, the purpose of which is the sustainable economic growth both at national and global level in a prosperous digital era, through various types of investments and applicable laws for the protection of intellectual property rights.

Therefore, this article is divided into two main sections: the first represents a general overview of the intellectual property rights in China after the sign of the TRIPS Agreement, while the second one focuses on the analyses of the China technology transfer, mainly with its “direct” competitor U.S.A.

II. LITERATURE ANALYSIS

The article is conducted based on several centric ideas about the intellectual property rights and technological transfer in the context of continuous prosperous economic development, especially in the developing countries.

Romer (1990), and Grossman and Helpman, (1991) recognized that Intellectual property rights are seen as part of the infrastructure supporting investments in Research and Development (R&D) leading to innovation and subsequent economic growth [22,

6 Ch. 11]. However, Kanwar (2006), analysed the IPR and its role in the economic development deeper, by claiming that strengthening IPRs could lead to greater innovation in developed countries, which in turn, could be helpful for developing countries [12]. Similarly, Taylor (1994) also argued that strengthening IPRs affect innovation and economic growth indirectly through the flow of FDI and transfer of technology from the North to South [26]. The model "South-North" mentioned, was developed by David Ricardo [17], which provides a growth-sustaining escape mechanism by enabling two regions to specialise. On the same prospective, the economics professor Ronald Findlay from the Columbia University developed largely the theory and explaining the growth of a less developed "South" or "periphery" economy that interacts through trade with a more developed "North" or "core" economy. Likewise, Grossman and Helpman (1991), based on the model presented above, analysed the consequences of imperfect IPRs protection on technical progress and economic growth by assuming that innovation takes place only in the North, which are considered to be dominated by developed economies, and imitation takes place only in the South, represented by developing ones. According to these authors, imperfect IPRs protection encourages imitation activity in the South. As result, the increase in number of replicated goods, there is registered a rise in the "stock of knowledge" in the south countries. However, from this model can be drawn the conclusion that a strong protection of the Intellectual Property Rights may reduce the rate imitations, which means that the north countries will maintain its monopoly over a long period of time in terms of innovation and technological progress, while the south countries, the productivity decrease, determine by the rapid innovation evolution, and the stock of knowledge is limited for a specific period of time. Nevertheless, taking into account the expansion of imitation process, appears two contradictory factors. The first one, acts positively on behalf of the north countries, being a stimulator for innovation and technical progress, with the purpose to maintain its dominant position on the market, while the second one, affects negatively the innovators themselves by the disappearance of the rent that they receive at the moment of the introduction of their innovation and its successful spreading, because of the variety of the specific innovation is imitated [6, Ch. 11].

On the contrary, Falvey et al., (2006) argued theoretically that strong IPRs may have a negative effect on developing countries that undertake little or no R&D, by asserting that because of the low level of innovative capabilities in the developing countries, imitation can be a significant source of technological development [5].

Comparably to the Taylor's (1994) idea, Park and Lippoldt (2008) showed that stronger IPRs in developing countries are associated with an increase of technology-intensive FDI [19], while Awokuse and Yin (2008), provided a concrete example concerning the relationship of IPR protection in China to FDI inflows, concluding that IPR reforms in China have had a positive and significant effect on inbound FDI [27].

Diwan and Rodrik demonstrated that stronger patent rights in developing countries give enterprises from developed countries a greater incentive to research and introduce technologies appropriate to developing countries. Similarly, Taylor (1994) showed that weak patent rights in developing countries lead enterprises from developed

countries to introduce less-than-best-practice technologies to developing countries. Interestingly, the relationship goes in both directions.

In relation to several academic research, which present a strong correlation between IPR and technology transfer, Lippoldt (2008) showed that IPR strengthening in countries—particularly with respect to patents—is associated with increased technology transfer via trade and investment [19]. Research has revealed that a country's level of intellectual property protection considerably affects whether foreign firms will transfer technology into it. That matters because the welfare gains from the importation of technology via innovative products, while differing across countries, can be substantial. For instance, foreign sources of technology account for over 90 percent of domestic productivity growth in all but a handful of countries.

III. OBJECT, SUBJECT, AND METHODS OF RESEARCH

The object of this study is to determine the impact and importance of intellectual property rights and technology transfer in the developing countries and how they affect the economic growth. To have a more elaborated and concrete picture of the analysed theme, it was presented in depth the case study of China, and the China-U.S. relationship in terms of technology transfer.

In order to comprehend the impact of the intellectual property rights and the international transfer technology upon the economic development in the developed countries, and what are the key factors that influence directly the development and competitiveness of new inventions within a developed market, there are some objectives that are set within the framework of this study:

- to make an analysis of the intellectual property rights impact upon the economic development of the developing countries, especially China;
- to analyse the relationship between U.S.-China within the Intellectual Property rights and technology transfer framework;
- analysis of the Chinese domestic and foreign patentees.

The subject of this research is the intellectual property rights and technology transfer in China.

The methods of research consist of the qualitative and quantitative research, such as theoretical and statistical analysis, deduction and data synthesis in accordance with the consulted sources for approaching the relevance of IPR within and integrated and continuously growing economy. At the same time, there was analysed the evolution of the intellectual property rights from the TRIPS Agreement, the China IPR and its position in different world rankings. Therefore, to outline the effects of technology transfer in the developing countries was take the China-U.S. trade relationship in accordance to the Ricardo's examined method. For the overall research, we have looked up to such indicators: Human Development Index (HDI), Global Innovation Index (GII), Intellectual Property Rights Index (IPRI). Based on these indicators, the research analyse: the correlation between GII, the number of IPR applications, and the expenditure on the R&D from the GDP and the relationship between FDI inflows and R&D expenditure and their impact on the IPR applications and index. Simultaneously was consulted several reports from the World International Property Organization (WIPO), China National Intellectual Property Administration (CNIPA) 2020 Annual

Report and used data from the World Bank Data, Chinese National Bureau of Statistic, WIPO Statistics and IPRI Database.

IV. RESULTS

4.1 The evolution of intellectual property from the establishment of the TRIPS Agreement.

Nowadays the relevance of intellectual property is crucial when developing a new product, technology or method of development. Being into an era where already everything exists, the tendency and risks of copying it is substantially high. In this context, the applicable law is useful in helping the countries, companies or inventors to overcome conflicts regarding the IPR.

From the implementation of the TRIPS Agreement in 1994, the global protection for creative innovation and expression markedly increased, as the gradual harmonization of national IPRs policies. A similar and comparable period to that before signing the TRIPS Agreement came at the end of the 19th century during the negotiations of the Paris Convention (1886). The Paris Convention was adopted in a period of intensive and extensive industrialization, where the high demand for patents represented a public support for appropriating the returns to inventions in the manufacturing era. Today's even greater advance in protection, determined by the relevance of IPRs in supporting the new high-technology, information-based economy of the new century. In the 21st, we are not talking about the invention of a simple pen, which back then was considered a turning point, but new software programs, advanced technology, pharmaceutical formulas, etc., which are more exposed, if not protected according to the intellectual property law.

Over the years the world countries showed a high potential of innovation in introducing new innovative products on the market. The term of innovation fits perfectly into the context, due to the fact that itself represents the intellectual property, which accordingly to the World Intellectual Property Organization (WIPO) is defined as “creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce”- to sum up, invent “something innovative”.

Following, the Global Innovation Index (GII) 2021 only a few economies have consistently delivered peak innovation performance. Only Switzerland and Sweden have remained in the top three of the innovation ranking for more than a decade. Switzerland, Sweden, the United States of America and the United Kingdom have ranked in the top five for the past three years, as shown in figure 1, and registering a GII score between 65.5 and 59.8 points. These countries registering also top positions according to the HDI. However, it also can be seen that beginning with 2019, China become part of this top, as being the only developing country that manage to enter in a 5 years' time period, by registering an increase in its position, and becoming the twelfth innovative country. At the same time, China remains the only developing country in the top 30 most innovative economies [3, p.3-20].



Figure 1. Movement in the GII top 15 positions, 2017–2021

Source: Elaborated by the author in accordance with the GII Database, WIPO 2021[3, p.22]

Even though the developed countries register a high GII over the years, they do not account for the highest number of IPRs applications. According to the statistical data provided by WIPO, the high-income countries in line with the World Bank Data (or developed countries according to HDI), is the second largest group in terms of applications for IPRs (see table 1).

Table 1. Total Applications by type of IPR at the world, high-income countries, upper-middle income countries level and China for years 2011, 2020.

Source: elaborate by the author in accordance to the World Bank Data and WIPO Statistics. [31] <https://data.worldbank.org>

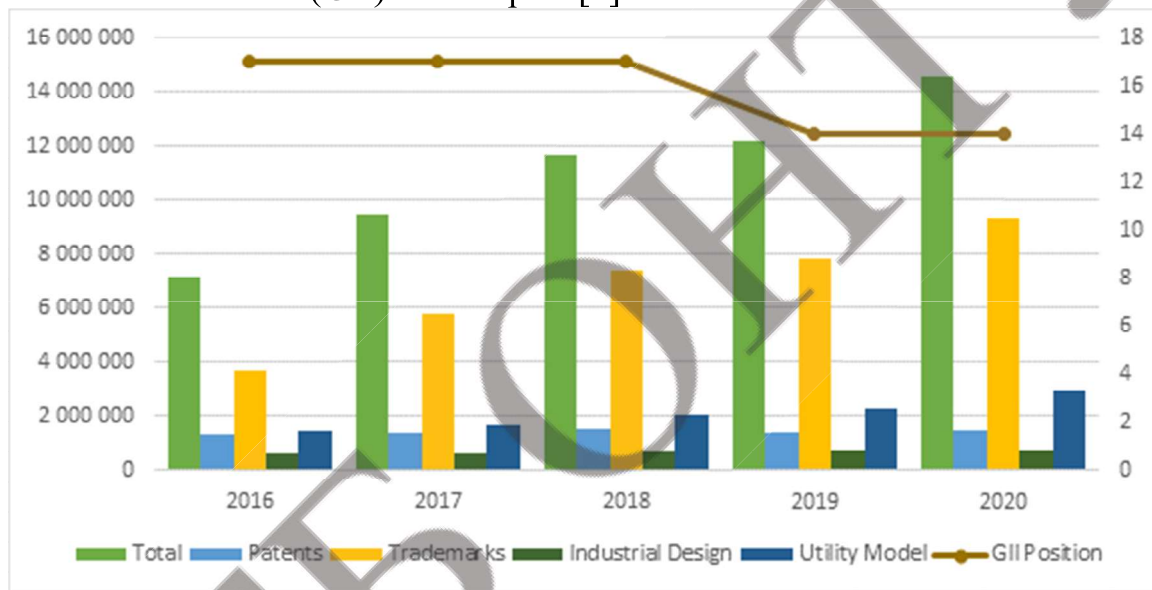
Type of IPR	2011				2020			
	World	High-Income countries	Upper-middle income countries	China	World	High-Income countries	Upper-middle income countries	China
Industrial design	1,089,600	441,300	609,600	521,468	1,387,800	465,100	861,400	770,362
Patent	2,158,200	1,410,800	655,800	526,412	3,276,700	1,552,800	1,617,100	1,497,159
Trademark	6,319,000	2,878,400	2,618,400	1,414,576	17,198,300	4,238,100	11,198,200	9,345,757
Utility Model	671,220	49,410	609,530	585,467	3,000,110	39,590	2,949,590	2,926,633

The highest number of applicants come from the group of upper-middle income countries, especially from China, being also the highest applicant for year 2020, and the one that determined the significantly evolution in a ten years' time period (e.g.,

China increased its patent applications by 184,4%, or utility models applications by 380,14%), (45.7% from the World Patent and Utility Models applications, 54.3% from the World Trademarks applications and 55.5% from the World Industrial Designs applications). As result, we can deduct that even though developed economies represent the group that dominate the knowledge-intensive flows, developing countries' share is growing rapidly, being represented by China, which knowledge-intensive flows are the world's second largest. [10] To correlate with the GII, beginning with year 2019, China registers a high raid growth in the number of application (see graph 1), (e.g., trademarks applications increased by 19,31% from 2019 to 2020, while from 2018 to 2019 increased only by 6.3%).

Graph 1. Correlation between GII and the number of IPR applications of China, 2016-2020

Source: elaborate by the author in accordance to the WIPO Database and the Global Innovation Index (GII) 2021 report [3].



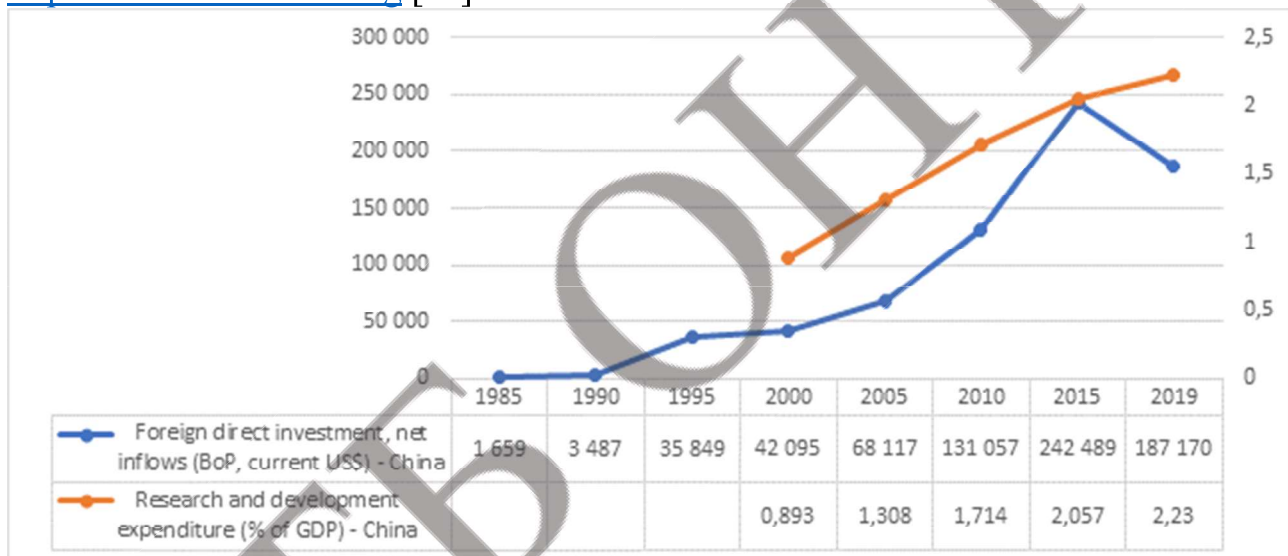
In order to gain the access to WTO, China enhanced the protection of IPRs by designing a number of strategies in 1996 APEC Individual Action Plan, including improve the enforcement of administration, enhance the public awareness of IPRs protection and strengthen judicial tools. [29] Finally, China has obtained the entry into the WTO in 2001, complying with the minimum standards of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs). The TRIPs require a number of countries to strengthen their patent and other intellectual property rights (IPR) systems. Even though policy makers have committed to significant reforms, the implementation of this agreement remains contentious.

The main benefit claimed for strong IPR protection is that by allowing innovators to appropriate a share of the benefits of their creative activities, R&D is encouraged, which leads to innovation and higher long-run growth. R&D expenditure is a measure of the input into innovative activity. Patent applications are a measure of the output, and patents are recognized as the most important form in which industrial innovation is protected [21]. As more and more Chinese firms develop their R&D capacity and obtain their own intellectual property, the general public's perception of intellectual property is likely to change and a greater domestically-driven push for

stronger intellectual property protection is expected increase. In this case, the ability to produce different and more high-tech products which obtained by R&D and innovation, are provided by Foreign Direct Investments (FDI), which have become more important. FDI, provides substantial financial capital, technological know-how and managerial expertise to the recipient economies (see Graph 2). According to the National Bureau of Statistics from China, the total public and private science and technology expenditures in 2019 rose 12.5% over the previous year to 2.21 trillion Chinese yuan (\$322 billion). Spending on basic research accounted for 6% of the total; applied research, 11.3%; and development, 82.7%. The spending amounted to 2.23% of GDP, an increase of 0.09 percentage points from the previous year. And following the OECD's purchasing power parity comparison, in terms of absolute expenditures, China represents the world's second biggest spender on R&D [14].

Graph 2. Foreign direct investment, net inflows (BoP, current US\$) and R&D expenditure (% of GDP) - China

Source: elaborated by the author based on the World Bank Data. <https://data.worldbank.org> [31]



In 2005 China only accounted for 0.8% of triadic patents (defined as a set of patents registered in various countries (i.e., patent offices) to protect the same invention) (i.e. triadic patent families are a set of patents filed at three of these major patent offices: the European Patent Office (EPO), the Japan Patent Office (JPO) and the United States Patent and Trademark Office (USPTO)), China set the goal to increase R&D spending to 2.5% of GDP and join the top five countries receiving triadic patents by 2015 [14]. However, beginning with year 2014, China aimed to strive the fourth position within the triadic patents, and maintaining it through a 5 years period until 2019, according to according to the 2021 Mapping Technology Structure report issued by the Institutes of Science and Development of the Chinese Academy of Sciences. In order to increase its position, China should focus on creating high-quality patents, representing one of the key challenges in striving the science and technology development, and simultaneously increase its number of triadic patents in chemistry and materials science, scientific fields in which China is traditionally strong.

To get ready for global competition, Chinese companies are also consciously building up their intellectual property portfolios. For example, in the automotive sector,

access to technology, brand names and other intellectual property assets appears to have been a main motivation for Chinese efforts to acquire foreign producers. This increased stakes in intellectual property are already contributing to a shift in the balance of domestic business perspectives on intellectual property.

The multi-dimensional nature of China’s intellectual property environment has important policy implications. First, while the legal side of intellectual property protection has been increasingly formalized and centralized, regional variation – in particular local weakness in enforcement – remains to be addressed. Second, achieving an effective IPR regime will require reform extending beyond legal structures to include other complementary policies such as those needed to assure appropriate access to capital and talent. There are also risks of distortion or discrimination in the Government’s strategic approach to innovation. Finally, redoubled education and awareness-building may be required to challenge social misperceptions with respect to the abuse of intellectual property. According to the Intellectual Property Rights Index, in 2021, China reported a score of 6.088 on a scale from 1 to 7 (see table 2). The index is analysed based on three variables:

$$IPRI = (LP + PPR + IPR) / 3$$

IPRI- Intellectual Property Rights Index;

LP- Legal and Political environment;

PPR- Physical Property Rights;

IPR- Intellectual Property Rights.

Table 2. Intellectual Property Rights Index of China in 2011, 2015, 2021

Source: elaborated by the author based on data provided by the IPRI.

<https://www.internationalpropertyrightsindex.org>

	2011	2015	2021
IPRI SCORES	5.500	5.389	6.088
LP SCORES	4.500	4.316	4.856
PPR SCORES	6.800	6.539	7.131
PPR SCORES	5.200	5.313	6.275

This evolution of China’s IPR is due of two major turning point events. Firstly, the transition from a centrally planned economy to a market economy provided the strong impetus for the development and improvement of China’s IPR system. Second, the openness of China’s market for FDI and the increased success of Chinese products in the overseas market generated pressure for China’s IPR system to accelerate its development to be in line with international standards [15].

China’s drive to modernization through improving intellectual property protection has been pushed forward by constant efforts to improve formal intellectual property laws and institutions for acquiring, maintaining, and enforcing intellectual property rights. Chinese policymakers and government officials have worked diligently for over forty-five years in a consistent, unwavering drive to create and improve the country’s public intellectual property institutions (the time period is taken into-consideration from 1973, when Premier Minister Zhou visited WIPO for the first time, also being considered the first time that the Chinese government allowed an officer to visit an international intellectual property institution [15]). It’s for sure that both the management and enforcement of IPR in China will make a progress over time.

4.2 Technology transfer and Protection of Intellectual Property Rights in China

Technology transfer (TT) represents the process of transferring (disseminating) technology from the person or organization that owns or holds it to another person or organization, in an attempt to transform inventions and scientific outcomes into new products and services that benefit society. [2] It is thought as a channel of spreading in the norms of law, the technical progress and the evolution of innovative products, seen as factors which stimulate the economic growth for the high-income and countries, considered to be more technological advanced. From this type of countries, the developing ones acquire such advanced technology, with the intent to increase the economy and register in a long-term technological progress.

China and U.S. represent an adequate example to describe the model presented in the literature, “South-North”. Chinese companies—in many cases with the backing of the Chinese government—use a variety of methods (see table 3) to acquire valuable technology, intellectual property (IP), and knowhow from U.S. firms. Generally, China invests in the critical future technologies that will be foundational for future innovations both for commercial and military applications: artificial intelligence, robotics, autonomous vehicles, augmented and virtual reality, financial technology and gene editing. [16]

Table 3. Methods of facilitating Technology Transfer by the Chinese companies from the United States

Source: U.S.- China Economic and Security Review Commission, May 2019. [1, p.3]

	Description
Foreign Direct Investment (FDI)	The Chinese government directs Chinese firms to invest in and acquire U.S. companies and assets in order to obtain cutting-edge technologies and IP, fostering technology transfer in strategic industries.
Venture Capital (VC) Investment	Chinese VC investments in the United States have increased in recent years, in particular targeting U.S. technology start-ups. Although the trends and implications of Chinese VC investment in the United States are new and still underexamined, they may allow Chinese firms to access valuable U.S. technology and IP, including technologies with potential dual-use applications.
Joint Ventures (JVs)	In many industries, foreign firms must enter into JVs to invest or operate in China. JVs are often the source of Chinese companies’ most technologically advanced and innovative procedures and products, acquired through technology transfer from their foreign JV partner.
Licensing Agreements	Licensing approval processes in China are often unclear and arduous, requiring companies to disclose sensitive information typically not required in other markets. Chinese government agencies often do not have to agree to destroy company information submitted in the licensing process, so companies’ IP can be shared or exposed even after the license is adjudicated.
Cyber Espionage	Through covert cyber intrusions, Chinese actors gain unauthorized access to a wide range of commercially valuable U.S. business information—including IP, trade secrets, technical data, negotiating positions, and sensitive and proprietary internal communications—which are then provided to and utilized by select Chinese firms.
Talent Acquisitions	The Chinese government maintains government programs aimed at recruiting overseas Chinese and foreign experts and entrepreneurs in

	strategic sectors to teach and work in China. Moreover, Beijing utilizes intergovernmental and academic partnerships and collaborations in the United States, establishes Chinese research facilities in the United States, and sends experts abroad to gain access to cutting-edge research and equipment without disclosing the organizations or individual's connections to the Chinese government.
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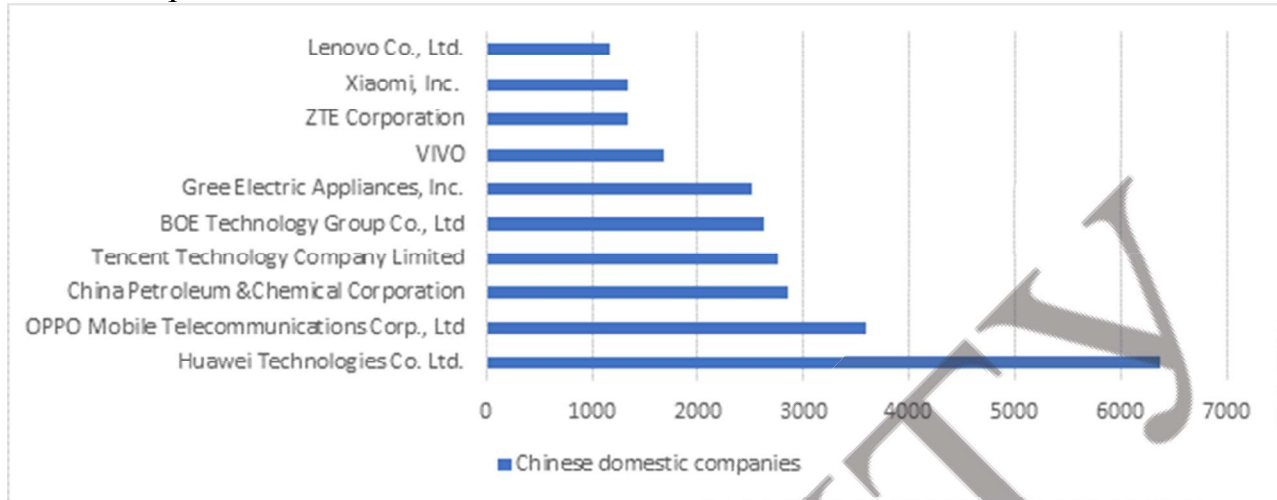
Licensing is the best-known approach in transferring patented technologies. Because of the dominant positions of multinationals in controlling core technologies, domestic Chinese companies are price takers in patent licensing negotiations. According to the American Chamber of Commerce in China's 2019 business survey, 35 percent of survey respondents cited licensing requirements as a top challenge of operating in China [7]. Similarly, the U.S.-China Business Council has found that more than half of U.S. companies experience licensing challenges even during renewal processes in China, and report facing challenges obtaining licenses that their domestic competitors do not [28]. Chinese data protection and security laws also allow the Chinese Communist Party (CCP) to acquire U.S. IP and technology through localization requirements for foreign technology firms. For instance, China's new Cybersecurity Law, which entered into force in June 2017, requires data to be stored locally in China, forcing foreign companies to either invest in new China based data servers subject to government spot checks, or hire a local server provider such as Huawei, Tencent, or Alibaba [8]. The Chinese government has utilized coordinated, government-backed cyber espionage campaigns to steal information from a variety of U.S.-based commercial firms, including those in the oil and energy, steel, and aviation industries [18]. According to James Lewis, a senior vice president at the Center for U.S.-China Economic and Security Review Commission 9 Strategic and International Studies, over the past two decades Chinese cyber espionage has likely cost the U.S. economy between \$20 billion and \$30 billion annually [9]. The Chinese government maintains official programs aimed at recruiting overseas Chinese and foreign experts and entrepreneurs in strategic sectors to come teach and work in China. These programs seek to acquire U.S. technology by blurring the line between informal technology transfer and IP theft, using methods such as utilizing open-source intelligence, recruiting leading U.S. experts in high-tech fields, and promoting academic exchanges [11].

Corresponding to the China National Intellectual Property Administration (CNIPA) 2020 Annual Report the number of invention patent applications filed in China in 2020 year increased by 6.9%. Among them, there were 1.345 million domestic invention patent applications filed (see graph 3), accounting for 89.8% of the total, a year-on-year increase of 8.1%; there were 152,000 foreign invention patent applications filed (see graph 4) in China, accounting for 10.2% of the total, a year-on-year decrease of 3.0%.

The Chinese IP law enforcement authorities have been taking aggressive actions against IP infringements. All of these efforts have resulted in enhancing IP protection in China, helping the IPR right holders to build a stronger IP-based moat for their businesses and creating a competition environment friendly to the IP right holders.

Graph 3. The top 10 Chinese invention patentees in 2020 and the number of invention patent grants

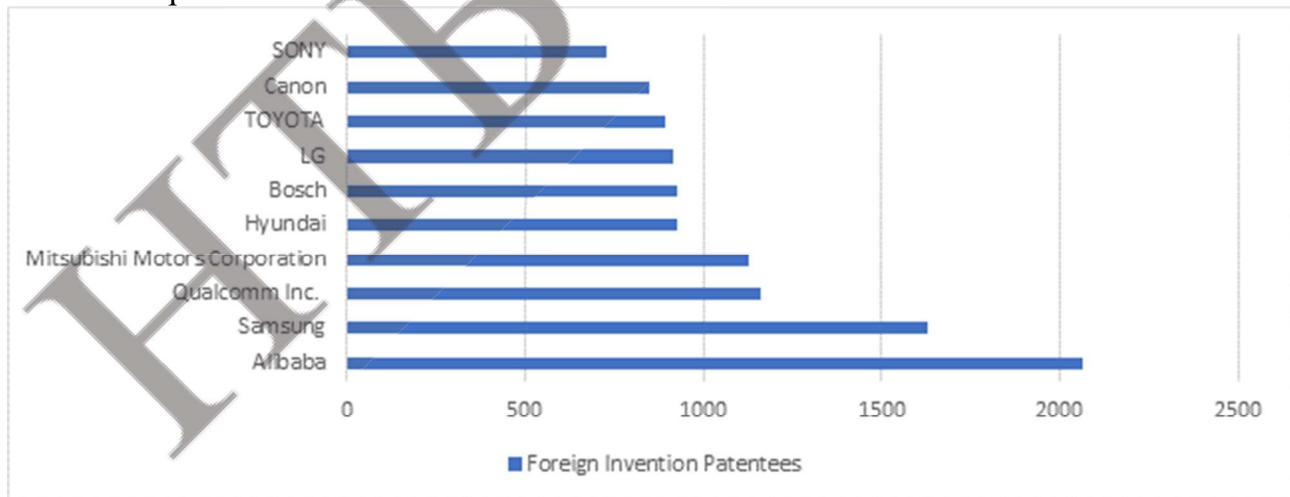
Source: China National Intellectual Property Administration (CNIPA) 2020 Annual Report



In 2020, a total of 3,470 civil IP litigations were docketed and 3,260 lawsuits were concluded by the Supreme People's Court, respectively 38.58% and 64.98% higher than the cases in 2019. In 2020, the local courts across China docketed 443,326 civil IP litigations of first instance and concluded 442,722 lawsuits, respectively 11.1% and 12.22 higher than the previous year. Through strengthening the IP laws, China increased its IP litigations (e.g., patent litigation increased from 2019 by 28.09% registering 28,528 Patents litigations). [4]

Graph 4. Top 10 Foreign Invention Patentees in 2020 and the number of invention patent grants.

Source: China National Intellectual Property Administration (CNIPA) 2020 Annual Report



Despite all the litigation that registers China, the country still registers foreign patentees, as can be seen from the graph 4. The main foreign applicants are Japan and USA, with a total application of IPRs of 53.368 and respectively 43.589 applications in 2020. China tends to emphasize the importance of promoting the domestic inventions by maintaining strong IPR protection within the borders, by registering less foreign patentees than domestic ones. From the top 10 foreign invention patentee in

2020, only one American company (Qualcomm Inc.) has managed to gain a position, the others being taken by South Korean, Japanese and German companies.

The recent developments of IPR protection are bound to drive innovation and create a pro-business environment and help the IPR holders to rely on IPR to protect their economic castles and ensure competitive advantages and continued growth in the market. Looking at the general market overview, technology transfer had a direct impact in 2021 on contributing to global public health issues, by enabling global access to COVID-19 vaccines. [32] During 2021, vaccine developers concluded over 200 technology transfer agreements. One example was AstraZeneca concluding the licensing and technology transfer agreements on AstraZeneca with the Serum Institute of India and with Daiichi Sankyo of Japan to supply vaccines for COVID-19, which were developed in collaboration with the University of Oxford. [30] Within this process Intellectual Property was part of the solution and an important tool for facilitation of affordable global access to COVID 19 treatments – as it was the case in two licensing agreements between Medicines Patent Pool (MPP) and pharmaceutical companies Merck and Pfizer.

V. CONCLUSION

Being creative and innovative in the 21st century is the biggest challenge, but putting your product on the market can be considered a competition. In this context, intellectual property is the safest way to present and sell ideas and products on the national and international market, giving the opportunity to hold a copyright without the possibility of being plagiarized. Through intellectual property rights and the law that promotes them, the economic development of countries is ensured.

According to Ricardo's model, developed countries are a primary and innovative source for developing ones. However, according to the analysis, developing countries get the most applications for all kinds of intellectual property rights over the years, and China represents the main applicant. Following to the research, China is a fairly competitive developing economy in the international market with regard to the IPR and technology transfer. It registered an impressive growth in the GII, determined by the high number of IPRs application within one year period, by achieving an increase of 19,03% of the total application in 2020. Even though it does not represent the highest increasing, there should be taken into consideration the other factors that influenced the GII position changing, such FDI inflows and R&D expenditure in the year 2020, representing real mechanism in fostering the innovation development and improvement.

The relation of China and U.S. in terms of IPR and technology transfer are very specific, in the case it is take into consideration the conflict that started in 2016, resulted in the expression of mutual dissatisfaction of the parties involved, where the Trump administration alleges that China practices unfair trade with the U.S, pointing to the growing trade deficit in China's favour, the theft of intellectual property, and the forced transfer of technology to China. However, they still represent for each other one the major trading partners in terms of technology transfer of IPRs. In the case of China, U.S. representing the second larger applicant as a foreign country after Japan.

In the context of technology transfer, China is still promoting the domestic innovation, by registering a higher number of applicants than foreign ones. The main

characteristic of the Chinese IPRs, is that they strive to focus on critical future innovation, those that are innovative and essential for the future population, despite that for the presents seems to look ambiguous.

To sum up, the research presented the impact and importance of intellectual property rights and technology transfer in the developing countries and how they affect the economic growth, based on the China case study.

VI. REFERENCES

1. Sean O'Connor (2019). How Chinese Companies Facilitate Technology Transfer from the United States. *U.S.-China Economic and Security Overview*. <https://www.uscc.gov/sites/default/files/Research/How%20Chinese%20Companies%20Facilitate%20Tech%20Transfer%20from%20the%20US.pdf>
2. Bozeman, Barry (2000). "Technology transfer and public policy: a review of research and theory". *Research Policy*, 29 (4). <https://www.sciencedirect.com/science/article/abs/pii/S0048733399000931>
3. WIPO. (2021) Global Innovation Index 2021- Tacking innovation through the COVID-19 Crisis. (14th edition). https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021.pdf
4. Chuanhong Long and Aimin Huo. (2021). China Is Strengthening Its IPR Protection. *UpToDate*. Retrieved February 23, 2021, from: <https://www.mondaq.com/china/trademark/1102556/china-is-strengthening-its-ipr-protection>
5. Falvey, R. Foster, N., and Greenaway, D. (2006). Intellectual Property Rights and Economic Growth. *Review of Development Economics*, 10(4): 700-719
6. Grossman, G. and Helpman, E. (1991). *Innovation and Growth in the Global Economy*. Cambridge, MA: MIT Press.
7. U.S.-China Business Council. (2016) Hearing on China's Implementation of its World Trade Organization Commitments. <https://www.uschina.org/sites/default/files/USCBC%202016%20TPSC%20Testimony%20Final.pdf>
8. Jack Wagner. (June 1, 2017). *China's Cybersecurity Law: What You Need to Know*. *Diplomat* <https://thediplomat.com/2017/06/chinacybersecurity-law-what-you-need-to-know/>
9. James Andrew Lewis. (2018). How Much Have the Chinese Actually Taken? *UpToDate*. Retrieved February 23, 2021, from: <https://www.csis.org/analysis/how-much-have-chinese-actually-taken>
10. James Manyika et al. (2014). *Global Flows in a Digital Age*. McKinsey Global Institute. <https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/global-flows-in-a-digital-age>
11. Jonathan Ray et al. (2016). *China's Industrial and Military Robotics Development*. Center for Intelligence Research and Analysis. https://www.uscc.gov/sites/default/files/Research/DGI_China%27s%20Industrial%20and%20Military%20Robotics%20Development.pdf
12. Kanwar, S. (2006), "Innovation and Intellectual Property Rights. *Center for Development Economics- Working Paper No. 142*.
13. Keith E. Maskus (2000) *Intellectual Property Rights in the Global Economy* (1st edition). Institute for International Economics.
14. Dennise Normile (28 August, 2020). China again boosts R&D spending by more than 10%. *UpToDate*. Retrieved 24 January, 2021. <https://www.science.org/content/article/china-again-boosts-rd-spending-more-10#:~:text=Total%20public%20and%20private%20science,%25%3B%20and%20development%2C%2082.7%25>.
15. Lu Chen. (2015) The Evolution of Intellectual Property Protection in China. *iBusiness*, 7. https://www.scirp.org/pdf/IB_2015031714025299.pdf

16. Michael Brown and Pavneet Singh (2018). *China's Technology Transfer Strategy*. Defense Innovation Unit Experimental. <http://nationalsecurity.gmu.edu/wp-content/uploads/2020/02/DIUX-China-Tech-Transfer-Study-Selected-Readings.pdf>
17. Molana H. and Vines D. (1989) North-South growth and the terms of trade: a model on Kaldorian Lines. *The Economic Journal* 99. <https://www.jstor.org/stable/2234035>
18. Office of the U.S. Trade Representative (2018) *Findings of the Investigation into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation under Section 301 of the Trade Act of 1974*. <https://ustr.gov/sites/default/files/Section%20301%20FINAL.PDF>
19. Park and Lippoldt. (2008) Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries. *OECD Trade Policy Working Paper No. 62*. [doi:10.1787/244764462745](https://doi.org/10.1787/244764462745)
20. Ricardo H. Cavazos Cepeda, Douglas C. Lippoldt, Jonathan Senft. (2010) Policy complements to the strengthening of IPRs in developing countries. *OECD Trade Policy Working Paper No. 104*. <https://doi.org/10.1787/18166873>
21. Rod Falvey and Neil Foster. (2006). The Role of Intellectual Property Right in Technology Transfer and Economic Growth: Theory and Evidence. UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION. https://www.unido.org/sites/default/files/2009-04/Role_of_intellectual_property_rights_in_technology_transfer_and_economic_growth_0.pdf
22. Romer, P.M. (1990), "Endogenous Growth and Technical Change," *Journal of Political Economy*, 99: 807 – 827. <https://www.journals.uchicago.edu/doi/10.1086/26172>
23. Sherwood, Robert M. (1990). *Intellectual Property and Economic Development* (1st edition). Routledge. <https://doi.org/10.4324/9780429045530>
24. Stephen Ezell, Nigel Cory. (2019). The Way Forward for Intellectual Property Internationally. *UpToDate*. Retrieved February 21, 2021, from: https://itif.org/publications/2019/04/25/way-forward-intellectual-property-internationally#_ednref20
25. Steven D. Anderman (1998). *EC Competition Law and Intellectual Property Rights. The Regulation of Innovation*. Oxford University Press.
26. Taylor, S. M. (1994). Trips, Trade, and Growth. *International Economic Review*, 35(2): 361-381.
27. Titus O. Awokuse and Hong Yin. (2008). *Do Stronger Intellectual Property Rights Protection Induce More Bilateral Trade? Evidence From China's Imports*. [Conference Paper]. American Agricultural Economics Association 2008 Annual Meeting, Orlando, FL.
28. U.S.-China Business Council (2016). *Hearing on China's Implementation of its World Trade Organization Commitments, written testimony to the Office of the U.S. Trade Representative*. <https://www.uschina.org/sites/default/files/USCBC%202016%20TPSC%20Testimony%20Final.pdf>
29. Wang, L. (2004) Intellectual Property Protection in China. *International Information & Library Review*, 36, 253-261. <http://dx.doi.org/10.1016/j.iilr.2003.10.007>
30. WIPO Research. Access to COVID-19 treatments and the Medicines Patent Pool: Here's Why it Matters and How IP Makes it Possible (2021). *UpToDate*. Retrieved January 22, 2022, from https://www.wipo.int/research/en/news/2021/news_0023.html
31. World Bank Data. <https://www.worldbank.org/en/home>
32. World Trade Organization, World Health Organization and World Intellectual Property Organization (2021). *Promoting Access to Medical Technologies and Innovation* (2nd edition). https://www.wipo.int/export/sites/www/policy/en/global_health/pdf/wipo_pub_628_2020_covid19_insert.pdf

Author: Valentina Kirilova Advisor: Olena Nikoliuk Odessa National Academy of Food Technologies (Ukraine).....	283
THE ROLE OF INTELLECTUAL PROPERTY RIGHTS AND INTERNATIONAL TRANSFER OF TECHNOLOGY IN FOSTERING THE ECONOMIC DEVELOPMENT: THE CASE OF CHINA	
Author: Cristina Tomşa Advisor: Rodica Crudu Academy of Economic Studies of Moldova (ASEM).....	296
DIGITAL MODEL OF BLOCKCHAIN ECONOMY AND ITS IMPACT ON VARIOUS AREAS	
Author: Yana Klymenko Advisor: Liudmyla Batsenko Sumy National Agrarian University (Ukraine).....	311
AQUACULTURE – A FIELD OF THE FUTURE: NATIONAL PROPERTY, WORLD TRENDS OF DEVELOPMENT	
Authors: Alexandra Kramarenko, Heorhii Smilichenko Advisors: Inna Irtyshecheva ¹ , Iryna Nadtochii ² ¹ Admiral Makarov National University of Shipbuilding (Ukraine) ² Kherson Educational-Scientific Institute of Admiral Makarov National University of Shipbuilding (Ukraine).....	323
3. INFORMATION TECHNOLOGIES, AUTOMATION AND ROBOTICS.... 334	
CYBER-PHYSICAL SYSTEM FOR SMART PARKING BASED ON COMPUTER VISION TECHNOLOGY	
Authors: Volodymyr Avsiyevych, Volodymyr Kovalenko Advisors: Olga Pavlova, Pavlo Radiuk Khmelnytskyi National University (Ukraine).....	335
MODELLING AND INVESTIGATION OF THE INFLUENCE OF BICYCLE FRAME DESIGN PARAMETERS ON ITS ERGONOMIC PROPERTIES	
Author: Kateryna Mankovska Advisor: Tetyana Moskalova National Technical University "Dnipro Polytechnic" (Ukraine).....	346
DECISION SUPPORT SYSTEM FOR SUPPLYING LOGISTICS WHEN SUPPLYING RESIDENTS OF SMALL CITIES WITH DRINKING WATER IN EXTREME CASES	
Author: Olexij Zakabula Advisor: Oleksandr Melnykov Donbas State Engineering Academy (Ukraine).....	358