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## **Foreign Direct Investment: Dynamics and Structural Changes**

#### **OLEKSANDR ROGACH<sup>1</sup>**

**Abstract:** The paper analyzes the current dynamic of MNEs investment activity, and main determinants and factors of foreign direct investment (FDI) cycle. It shows slowdown of new outward FDI flows after the global financial crisis and analyzes the main factors that caused this situation. The article considers four main determinants of the MNE current investment activity, such as structural changes in foreign direct investment; a significant drop in the average rate of return on FDI; unification of fiscal requirements and changes in MNE profit taxation; growth of geopolitical risks and political uncertainty.

**Key words**: Multinational Enterprises • Foreign Direct Investment • Transnational Corporations • International Investment • International • Tax Arbitration.

#### **Literature Review**

Beginning with the pioneer papers of Hymer (1976), reasons for FDI and the issue of direct control or specific assets of international firms have been considered in various aspects. Vernon (1979) analyzed FDI process through the study of new product introduction into the market and its life cycle. Within the frame of industrial organization approach the study of internal (intrafirm) operations and transaction costs also contributed to better understanding of the nature of international corporations and foreign direct investment. Buckley & Casson (1976), Caves (1996) developed internalization theory of FDI. Macroeconomic view on the foreign direct investment flows in the interpretation by Kojima (1978), or in the context of the theory of capital-market imperfections by Aliber (1970), also expanded the idea of e possible causes of FDI and motives of firms to transfer production abroad. Dunning (1988) studied foreign direct investment and international production within framework of his OLI paradigm. Bartlett & Ghoshal (1989) offered to treat the international firm as a network of various structural units.

Dawson (2017) examined the changes in the FDI sectoral priorities and new directions for investment flows. Stoddard & Noy (2015) studied the impact of the global financial crisis on the dynamic of FDI and the strategy of MNEs foreign activity. Yeyati, Panizza & Stein (2007) hypothesized about the cyclic nature of FDI flows between industrialized and developing countries. Chenaf-Nicet & Rougier (2016) analyzed the link between macroeconomic instability in countries and foreign direct investment flows.

#### **Research Results**

Over the last two decades, the FDI flows have become truly global. In terms of scale and geographical range of investment, they are one of distinct features of modern globalization. In the early 2000s, extremely high foreign direct investment growth caused a real investment boom, which peaked in 2007, when new annual FDI hit a record high of nearly \$2 trillion. But the global financial crisis and the economic recession of some countries have interrupted the process of the longest and most powerful investment wave (Rogach, 2019). Although the global FDI flows stabilized and ceased to decline over the two years after the crisis, the pre-crisis dynamic has not been restored.

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The last ten years (2009-2018) have witnessed new trends in the dynamic, proportions and geographical flows of FDI. Multinational enterprises have somewhat changed the landmarks of localization of their production and slowed down the fragmentation of their network systems. These actualize the need for current FDI trend analysis and forecasting their further dynamic.

The peculiarity of the FDI flow dynamic after the global financial crisis of 2008-2009 was the low growth rate of new annual direct investment. The average volume of new FDI did not even exceed the precrisis peak of 2007. FDI growth rates have barely exceeded 1% in the last decade, while they were 8% before the global financial crisis, reaching as much as 20% in the late 1990s. Such dynamic of new FDI does not give reason to speak about the beginning of a new global investment wave. In 2017-2018, even the annual new FDI was significantly reduced compared to the previous year (in 2018, up 13% to \$1.3 trillion) (UNCTAD, 2019). This situation is very different from the pre-crisis picture of two decades, when over the long term the average foreign investment growth rates far exceeded the dynamic of world GDP and world trade.

The decline in FDI during the crisis cycles of 1990-1992, 2000-2001, and 2008-2009 had a rather logical explanation. It always reflected some correlation with the fall of world trade and world GDP and confirmed the link between FDI dynamic and fundamental drivers of global economic growth (Kyrkilis and Pantelidis, 2003; Saini and Singhania, 2018; Liew, 2016). There has been a rather unusual trend in recent years (notably 2017): global GDP and world trade indicators are showing positive dynamic, while annual FDI is declining. Such diverse trends in annual FDI inflows, world trade and global GDP require an explanation for relationship between these macroeconomic variables as well as new determinants of growth in investment flows.

Significant changes in the current dynamic of annual FDI flows did not confirm expert expectations of their growth, based on current forecasts of major global macroeconomic and firm-level factors, MNE'S managers' surveys and estimations of national investment agencies (UNCTAD 2017). They also did not confirm the calculations of the FDI Inflow econometric model made by UNCTAD, which showed moderate optimistic scenarios for the growth of these flows in the near medium term.

Indeed, in the past decades, improving macroeconomic prospects has always had a direct positive impact on the multinational enterprises' investment performance. But this did not happen in the second half of the current decade. In 2016-2018, the world GDP growth rates and the gross fixed capital formation (on average, both in the group of industrialized and developing countries) steadily increased. But new annual direct investment was shrinking in volume. Why did this happen?

UNCTAD experts believe that this trend may indicate not only current market changes, but a longer (as previously expected) negative multinational enterprise investment cycle (UNCTAD, 2018). It is likely that this cycle is not directly related to fundamental macroeconomic indicators, although indirectly such a link should also be expected. UNCTAD analysts explain such a negative cycle by several factors:

- structural shifts in foreign direct investment;
- a significant fall in the average rate of return on FDI;
- unification of fiscal requirements and changes in MNE's taxation;
- increasing geopolitical risks and political uncertainty.

Let us consider all these factors and their impact on the investment activity of multinational enterprises.

There are several forms of structural shifts in FDI exports: geographical structural shifts (specific gravity of different groups of countries), sectoral proportions (share of manufacturing, primary sector and services), proportions between new FDI and mergers and acquisitions, and proportions in corporate sources of FDI financing.

These structural shifts reflect various macro- and microeconomic factors of capital flows. For example, changes in the FDI geographical proportions are a consequence of location advantage evolution, such as countries' competitiveness and price on major factors of production. Sectoral proportions are undergoing major changes as a result of the Fourth Industrial Revolution, and technological transformation of global value chains. The proportions between new projects and mergers and acquisitions, as well as the

structure of FDI financing corporate sources, are a consequence of the complex interplay between MNE's corporate strategy and other structural changes. It is important to analyze the changes in these proportions in the last ten years in more detail.

Over the last twenty years, there has been a change in the geographical structure of the FDI movement. There are several stages of such changes.

*Stage 1* After the global economic downturn of 2001-2002 the share of industrialized countries in new annual FDI increased until almost 2007 (Duong, 2015). This trend was interrupted by the global financial crisis.

*Stage 2* For almost seven consecutive years (2007-2013) the gap between industrialized and developing countries in new capital inflows was narrowing, reflecting more active operations by multinational firms in emerging markets and China.

*Stage 3* In 2013-2014 for the first time in decades, developing countries received more new direct investment than industrialized countries. Greenfield investment in new projects grew especially extensively. But as it turned out later, this trend was short-term.

*Stage 4* In 2015-2017 industrialized countries again became a major area of MNE investment. In 2015 55% of world FDI was directed to these countries. Although in the next two years, the preference for this group of countries decreased significantly, they continued to outperform developing countries (\$712 billion against \$671 billion in 2017) (UNCTAD, 2018, p.2-3).

Thus, the international FDI movement in recent years has been characterized by the restoration of the structural proportions that existed in previous decades regarding the groups of FDI recipient countries.

In addition to the traditional analysis of the FDI distribution between industrialized and developing countries, another aspect is highlighted by the classification of these countries into selective or regional groups – G-20, APEC (Asia-Pacific Economic Cooperation), and BRICS (Brazil, Russia, India, China, South African Republic). UNCTAD calculations show that the G-20 (19 countries) accounted for about 58% of all new annual FDI; APEC (21 economics) – 57%, BRICS – 19% of 2017 new investment flows. G-20 countries account for 58% of all accumulated foreign investment, with 95% of MNE parent companies are located here (UNCTAD, 2018, p.5). For the APEC Group, 80% of new annual FDI come from the US, China, Hong Kong, and Singapore. BRICS countries are still the host to 9% of accumulated foreign investment, although they account for 41% of the world population and 23% of world GDP (UNCTAD, 2016, p.12).

Regarding the world's largest MNE headquarters and logistics centres, this role is played by Hong Kong, Singapore, Belgium, the Netherlands, and Ireland. They have become global hubs for providing financial, technological, transportation, office and service to international businesses (Hers, Witteman, and Rougoor, 2018).

The sectoral structure of accumulated FDI indicates that 2/3 of their volume is in the service sector. During the second half of the twentieth century, there were significant differences between industrialized and developing countries in terms of manufacturing and services in the overall FDI structure. But today such discrepancies are almost gone – 64-65% are in the service sector and 27% are in the manufacturing industry (Dawson, 2017). The total cost of multinational firm investment in the service sector in the early XXI century reached \$4 trillion, while in manufacturing – 2 times less. Fifteen years later, this proportion has even increased in favour of the service sector – \$16 trillion and \$7 trillion respectively (Fig. 3). The bulk of FDI in the service sector is concentrated in the wholesale and financial service industries (more than 60%).

In recent years MNEs new annual investment in manufacturing has been slightly less than in the service sector. The share of these two sectors was almost the same in the value of M&A transactions, while FDI in new projects prevailed in manufacturing services (Sander, 2019).

It should be noted that the imperfect methodology of data collection may be the reason for FDI revaluation in the service sector. Such data reflect reporting of MNE affiliates rather than their parent companies' sector affiliation. For example, the FDI of an automotive international company should logically be classified as investment in manufacturing. Suppose an affiliate of this firm invests in the wholesale of motor vehicles or in management and other business services of a regional headquarters function, such as in Hong Kong. Such investment is formally integrated into the service sector by the reporting country's

statistical authorities, although they relate to the automotive industry. According to UNCTAD experts, this imperfection of methodology could overvalue FDI in the service sector by a third (UNCTAD, 2017).



**Figure 1.** The amount of FDI accumulated stock in individual sectors of the economy (trillion dollars) Source: UNCTAD, World Investment Report, 2015-2017.

FDI is divided into investment in new projects (Greenfield FDI) and investment in acquisitions of existing firms in a host country (cross-border M&A). Different proportions of these FDI components have historically been observed in different groups of countries. For example, in industrialized countries, mergers and acquisitions have traditionally prevailed, while in developing countries (especially in the second half of the twentieth century) investment in new projects was the main form of FDI (Stepanok, 2015).

A notable trend during the 2008-2009 world financial crisis and the first post-crisis years was a significant predominance of Greenfield FDI over M&A deals. In 2008 it reached its maximum levels – \$1,300 billion versus \$600 billion. Although these investment components were much smaller in the precrisis years, the drop in FDI in new projects was smaller compared to the reduction in the value of M&A transactions. Until 2014 the gap in value of these direct investment components remained at a significant level (Stoddard & Noy, 2015). But in the following years, this trend has lost its strength and the ratio between the mentioned investment groups changed significantly. In 2015-2017 foreign direct investment in the acquisition of existing assets exceeded or was almost equal to the volume of FDI in new projects. The multinational enterprises' gross earnings growth, together with the growth of stock prices, has pushed the value of cross-border mergers and acquisitions.

Among the most famous mega M&A deals were the \$39 billion acquisition of SAB Miller PLC (United Kingdom) by Anheuser-Busch Inbev (Belgium) and the \$39 billion acquisition of Allergan PLC (USA) by Teva Pharmaceutical Industries Ltd (Israel), ARM Holdings (UK) takeover Soft Bank Group (Japan) for \$32 billion, as well as the merger of US multinational companies Dow Chemical and DuPont resulting in one of the world's largest chemical conglomerates with the capital value of \$130 billion (Nurin, 2016; Dowdupont 2018).

The financial crisis has led to changes in the structure of MNEs capital export sources (export of equity capital for acquisition of new shares, reinvested earnings, intra-corporate loans and other transfers). In recent years there has been an increase in the share of retained earnings in the structure of new investment. In industrialized countries before the global financial crisis, the share of reinvested earnings was 30-35% of new capital export (Lundan, 2006). After the crisis, it was no lower than 43% and, in some years, exceeded 50% and even 65% (Curcuru & Thomas, 2014). As for multinational enterprises in developing countries, this trend is also evident, although the structural changes in FDI financing are somewhat smaller here. Prior to the global financial crisis, only 26-30% of capital exports were financed from retained earnings, and in 2010-2015 - 43-49%.

These differences between the MNEs of industrialized and developing countries also relate to investment in the acquisition of new shares. International firms in developing countries invest in new stocks

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less than their competitors in the US, EU and Japan. This reflects their smaller ability to acquire foreign companies and open foreign branches (Nguyen, 2016). Instead, much of their FDI is sourced from reinvested earnings. The exceptions are Chinese MNEs which are actively involved in the process of cross-border mergers and acquisitions. In industrialized countries capital investment in new equity accounts for 2/3 of all FDI and is its largest component.

Another factor in the negative multinational enterprises investment cycle in recent years has been the fall in the rate of return on foreign direct investment. It influenced the dynamic of new investment and the volume of affiliate income reinvestment. The first decade of the twentieth century was characterized by sufficiently high rates of return for multinational firms – more than 8% on invested capital. This created the basis for the dynamic growth of FDI. Significant profits have not only been transferred to MNEs home countries but also accumulated in their offshore centers for further international investment (Guvenen, Rassier, and Ruhl, 2017).

Following the global financial crisis of 2008-2009, the rate of return on foreign investment declined (OECD, 2016). Although MNE's total annual earnings in recent years have sometimes even exceeded the pre-crisis level (for example in 2010-2011, 2017), asset returns have been much lower. In 2012-2017 they decreased from 8.1 to 6.7% in all countries (Fig. 5). This trend is one of the attributes of a multinational firm's negative investment cycle.



**Figure 2.** Return on foreign direct investment (percentage) Source: UNCTAD, 2019a.

Some theoretical studies consider MNEs as agents of arbitrage in the capital markets (Dziuba, 2017; Rogach, 2018). This applies not only to finding cheap financial resources but also to placing them in jurisdictions with favourable fiscal regimes. According to UNCTAD experts, tax arbitrage has been one of the reasons of negative investment cycle and partly explain why the FDI flowsdecline in recent years. Indeed, tax considerations in the past decades have played a major role in increasing FDI export volumes and, to some extent, determining the direction of multinational enterprises capital flows (Baker, Foley, & Wurgler, 2008).

Huge amounts of capital resources were channeled into offshore financial hubs (offshore financial centres and special corporate centres for accumulating investment resources). Such special corporate institutions (centres) were registered as residents of a country with which they had no real economic relationship but served as holdings of global firm's assets or centres of profit accumulation (Schwarz, 2009). The main benefits of offshore financial centres for MNEs were their ability to use low tax rates, bilateral investment or double tax treaties, and access to capital resources in international markets. As a rule, holding companies are the main recipients of multinational enterprise's resources. Although in some cases the

location of such holding companies was dictated by the needs of multinational enterprise regional networks; and the main reasons for their localization were tax considerations.

Most of the MNE holdings acted as centres of profit accumulation and were therefore located in jurisdictions with low tax rates or favorable fiscal regimes. This suggests that tax motivation plays a key role in the FDI international movement. For example, such special corporate centres for accumulation of investment resources are located in Luxembourg, the Netherlands, the Caribbean offshore financial centers (the British Virgin Islands, Cayman Islands). For example, about 20% of all foreign affiliates of the top 100 MNEs in UNCTAD's Transnationality Index are in low tax rates or offshore financial centres (Kunisch, Menz & Birkinshaw, 2019; UNCTAD, 2016).

Depending on the MNE financial needs and mechanisms for applying preferential taxation, there was extremely high volatility of such FDI flows. The statistics of all jurisdictions with low taxation and preferential fiscal regimes shows quarterly inflows and outflows of huge financial flows. Accumulation of such resources during the first three quarters and the sharp outflow of capital during the fourth quarter is a typical pattern. For example, multinational enterprises transferred \$129 billion to their profit centres located in Luxembourg in the first quarter of 2015, while, at the same time, there was an outflow of resources over three quarters, multinational enterprises suddenly began to pay intra-corporate loans of \$207 billion from these centres, which resulted in a net disinvestment of \$115 billion from Luxembourg (UNCTAD, 2016, p.19).

A similar pattern was observed in 2015 in the Netherlands – after accumulation of profits during the three quarters at the end of the year, MNEs withdrew almost \$200 billion from this country. UNCTAD experts have shown a close correlation of rapid changes in the financial resource flow between the multinational firm's financial centres located in Luxembourg and the Netherlands. This also reflects the MNEs' tax optimization strategy.

The increasing role of holding companies as MNEs' profit centres has been clearly observed over the last two decades. While in 2005-2008 holding companies (mainly in areas with special fiscal regimes and/or offshore jurisdictions) aggregated at least 40% of the profits from multinational firms' global operations, in the years following the global financial crisis (2015), they were declared almost 60% of global MNEs revenue (UNCTAD, 2016).

New requirements for financial reporting, transparency of financial companies and holdings of multinationals introduced in the Netherlands, Luxembourg, Ireland and some other countries in recent years, as well as revision of legislation on transfer pricing and taxation between licensing activities (amendments to EU directives for transactions between parent companies and affiliates) have narrowed the scope of tax arbitrage and reduced the flow of capital to corporate profit centres.

In this context, it is also important to look at the European Commission Tax Fraud Package and the introduction of the new FATCA provisions in the United States. The latter now classifies foreign financial institutions (FFIs) as affiliates of non-financial US MNEs that participate in group financing or holdings, and increases the tax liabilities of holding profit centres. The Organization for Economic Co-operation and Development (OECD) initiative to counteract the tax erosion and profit-sharing of offshore jurisdictions (Base Erosion and Profit Shifting - BEPS) has also reduced the financial and tax motivation of FDI (Morriss & Moberg, 2019).

Such regulatory action by governments has significantly reduced the flow of MNEs capital to offshore Caribbean jurisdictions in comparison with previous years. Changes have also occurred in the geographical sources of such transfers. Previously the main clients of the Caribbean Offshore Financial Centers were US corporations, but in 2010-2014 about 2/3 of the investment inflow into the British Virgin Islands and the Cayman Islands came from Hong Kong, China, Russia and Brazil.

Thus, structural shifts in FDI, significant declines in average FDI earnings, unification of fiscal requirements and changes in MNEs taxation, rising geopolitical risks and political uncertainty have been important determinants of FDI movements in the last five years. They played a significant role in shaping the overall dynamics of FDI and investment trends for multinational enterprises.

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## **Determinants of Optimisation of E-commerce Structure of Ukraine**

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**Abstract:** The current stage of functioning of the global economic environment is characterized by regular expansion of trade and industrial relations, and financial and innovative cooperation between its subjects. However, modern development of science, technology, and global information systems provides the basis for introduction of new methods, ways and tools of economic interaction in various fields. In this connection, e-commerce is of particular importance as an effective way of developing business with the use of the latest information technologies that allow to streamline business processes. Its application increases the speed of obtaining information in international operations, shortens the cycle of production and sales, reduces the costs associated with the exchange of information, and contributes to improving competitiveness of international business entities.

#### **Research Results**

E-commerce operations are growing rapidly in the world, thus forming the following trends in their development. Firstly, mobile e-commerce and settlement of transactions using smartphones, tablets and other mobile devices are predicted for the future of this form of commercial interaction, as the share of Internet users using mobile devices is growing. Secondly, personalization or individualization are becoming a key factor in the success of e-commerce enterprises in today's environment. E-commerce customers have recently become increasingly interested in unique products designed by the site themselves or by other consumers, though with the rapid growth of this type of order, problems with satisfaction of all users may occur. Thirdly, an increasing number of retailers are trying to enable their customers to order products and goods via the Internet; they also offer favourable terms of delivery on the day of ordering, free exchange and return of goods, which are, undoubtedly, their competitive advantages. Fourth, the use of the cutting edge technology to promote products online. The introduction of 3D technologies for in-kind product modelling on the web in order to give them fuller characteristics to attract new customers, the introduction of video viewing technologies with the ability to go from video view to online stores to purchase a particular product with only a click. Fifth, the e-commerce through social networks is being actively developed (Berko, Vysotska & Pasichnyk, 2009).

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E-commerce companies use social networks as a marketing platform to advertise their online stores, increase the number of customers, study their preferences, develop personalized offers based on the data obtained, invite consumers to create wish lists or to get acquainted with recommended friends of products, services and more. Sixth, constant updating and development of new information technologies and computers that facilitate and simplify the access to the network of users and establish their close interaction. Seventh, the largest share of online sales in the world is in media, sports goods, electronics and furniture sectors. Clothes, personal care products, food and beverages are being purchased less frequently online. In the long run, online sales are projected to increase by all categories (Romanishin & Sinelnikov, n.d.).

Eighth, the growth rate of e-commerce in developing countries is higher than in developed countries. This trend is related to faster development of the economy as a whole and retail in particular. The share of Internet commerce in total retail sales tends to increase (Fig. 1):



**Figure 1.** Share of Internet trade in world retail trade volumes, % Source: compiled by the authors based on (CompTIA, 2019; Statista, n.d.; ATKearney, 2019).

These general trends are the basis for development of e-commerce in the world community, including Ukraine. For Ukraine, development of this market is an essential component of integration into the global economic space creating preconditions for increasing the country's competitiveness in the global market for goods and services (Patramanska, 2014). The e-commerce market in Ukraine is just being established, but it is characterized by a rapid growth in online transactions in the area of trade in goods and services. Он-лайн торгівля  $\epsilon$  одним з найбільш динамічних ринків і сегментом економіки, який продовжує зростати, незважаючи на кризові явища, коливання валютних курсів та інші проблеми, з якими Україна зіткнулася в останні роки Online trading is one of the most dynamic markets and an economy segment that continues to grow despite crisis, currency fluctuations and other problems that Ukraine has faced in recent years. (Halochkin & Halochkina, n.d.).

In general, the development of international e-commerce in Ukraine is characterized by certain features related, first of all, to its growth potential, convenience of transaction tools, the degree of market saturation with the range of goods and services, and political and economic factors, etc. (Fig. 2):

High growth potential			
The degree of saturation of	market of goods and serv	ices	
Low Internet penetration			
Imperfect e-commerce mar	ket infrastructure		
Low usage of bank cards, p	ayment systems and e-mo	mey in payment transactions	
Low level of solvency of th	e population		

**Figure 2.** Specific Components of International Electronic Commerce Development in Ukraine Source: compiled by the authors based on (Dubovyk, 2013; Fedorychak, n.d.).

An important component of development of international e-commerce in Ukraine is its high potential for growth. Its e-commerce market is showing growth, despite the low income levels and devaluation of the national currency. At the moment, Tickets.ua, Modnakasta, LeBoutique, Slando, Prom.ua, Aukro, Sokol, FotoMag, Allo and others should be named among the largest e-commerce operators in Ukraine. At the same time, the Ukrainian e-commerce market continues to grow. The forecast for the next few years is quite positive – up to \$ 10 billion in 2019. The level of development of the on-line commerce market will also be influenced by the fact that large operators intend to develop their online sales channel, especially in the consumer electronics segment. (Vkurse, 2017).

It should be noted that Ukraine is ahead of other European countries in terms of growth in Internet sales (Zakon.nau.ua, n.d.). The average annual growth rate is 25-30%. The most difficult period for development of e-commerce was 2014, due to social and political events in Ukraine. However, this figure is higher than the growth rate of the leading EU countries in terms of B2C e-commerce turnover (Fig. 3):



E-commerce Market Growth Rate in EU and Ukraine in 2014-2018,%

**Figure 3.** E-commerce Market Growth Rate in EU and Ukraine in 2014-2018,% Source: compiled by the authors based on (Research and markets, 2019; E-Commerce Europe, 2014; Eurocommerce, 2018).

In addition, the e-commerce growth rate in Ukraine is much higher than the retail segment's, which indicates its dynamic development (Fig. 4).

Another component of international e-commerce development in Ukraine is the degree of market saturation of goods and services. The Ukrainian market for goods and services is developing, and e-commerce is a convenient payment instrument for it. About 67% of Ukrainian Internet users visit e-commerce sites. Among them, priority is given to OLX.ua (40.4% of users), Rozetka.com (32.5%), Prom.ua (26.5%), Aliexpress.com (15.5%), and Ria.com (12.4%) (Uadn, 2015).

Online shopping incentives include lower pricing, positive reviews about a store or friends' tips; and quick or free shipping. In terms of the structure of online purchases, computer and home appliances, mobile phones, office equipment and multimedia account for the largest share.



**Figure 4.** Retail and Internet Trade Volumes in Ukraine and Dynamics of their Growth in 2008-2018, billion USD,%

Source: developed by the authors based on (Research and markets, 2019; E-Commerce Europe, 2014).

The largest turnover among online stores in the field of electronics and home appliances is characterized by the stores Rozetka (\$297 million), Allo (\$79.5 million), Fotos (\$ 49.5 million), Foxtrot (\$49.5 million), and Comfy (\$27.7 million). The largest share in annual turnover among the stores specializing in the sale of clothing and footwear are BonPrix (\$33.7 billion), LeBoutique (\$29.5 billion), Modnakasta (\$24.4 million), and Lamoda (\$8.1 million) (E-Commerce Europe, 2014).

In terms of variety of products and prices, online stores are in serious competition with standard shops and even retail chains. This is primarily due to the fact that the cost of opening an online store is much lower than that of a regular store.

The main trends in the development of e-commerce include: mass transition of customers from offline to online; development of email marketing; an increase in the share of mobile transactions (26% of Internet users make purchases via tablets or smartphones); ordering services online (Booking.com, AirBnB); and electronic procurement (ProZorro). In 2016, the number of users who bought goods on foreign sites increased. According to Master Card, the largest number of purchases was made at the Chinese marketplace Aliexpress (47%), on Amazon, E-bay, and Prom.

The five most popular product categories include clothing, shoes, accessories, home and garden, beauty and health, appliances and electronics, gifts, books, and hobbies. It is worth noting that Internet sales volumes have a steady upward trend (Fig. 5):



**Figure 5.** Internet Sales Volumes in Ukraine in 2012-2019 (forecast), billion UAH Source: compiled by the authors based on (C2CB2C, 2016; Kreditprombank, n.d.; UBR, n.d.).

It should be noted that domestic e-shops are facing a number of problems, among which is underdevelopment of the electronic payment system; lack of practical recommendations related to ensuring a proper combination in using Ukrainian and foreign payment systems; lack of the necessary large-scale support from the government in developing modern infrastructure of e-commerce systems; inability to provide a sufficiently high level of data exchange between e-commerce participants and others.

The average cost of ordering in an online store has decreased in proportion to depreciation of the national currency – by 60%, consumers of luxury goods began to buy cheaper replicas. Therefore, one of the vectors for development of e-commerce is rapid reorientation to new types of goods and services, flexible pricing depending on the exchange rate (Khovrak, 2013; OECD, 2017). Among the most popular online stores are the following (Table 1):

Online Stores	General Characteristics
Rozetka.ua	The store is equipped with the most powerful tools for selecting products by technical characteristics; and presents a wide selection of high-tech products from the group of personal electronics. The site has user friendly content
	contains articles, reviews and tests of presented products.
Allo.ua	The second largest online store in Ukraine was created in 2008 in Dnipropetrovsk (Dnipro) on the basis of a powerful offline business. It has a modern range of digital and computer hardware for home and office, leisure goods, and supplies. The company strives to strengthen and expand the range of interaction with customers and partners in all areas of activity.
Fotos.ua	A hardware and electronics store. Prices are much lower than in ordinary shops, the lowest prices for a number of items in the Ukrainian network.
Mobilluck.com.ua	It was opened in 2004 to provide a new quality service for sale of consumer electronics. During operation, the range of the store has expanded significantly and now includes: GSm and CDmA standard phones, laptops, the whole range of computer technology, digital photo and video equipment, all types of household appliances, accessories for mobile phones, car devices, and devices for phusical exercises.
Fotomag.com.ua	Fotomag online store opened in 2004. It was originally created for sale of photo and video devices to amateur and professional cameramen. However, over time, the company has significantly expanded its product range, and today Fotomag can offer a variety of appliances, electronics, goods for home, cars, tourism and more.

**Table 1.** Characteristics of Individual Online Stores, Operating in the Ukrainian Market

Source: compiled by the authors based on (E-commerce, n.d.).

The profitability levels of these e-commerce market participants testify to the attractiveness of the specified sphere of activity for the enterprises, especially in comparison with the expenses for the organization of retail trade (Fig. 6):



**Figure 6.** Ecommerce Market Leaders In Ukraine by Income Level, USD Million Source: compiled by the authors based on (C2CB2C, 2016; Kreditprombank, n.d.; UBR, n.d.).

Particularly noteworthy is the latest vector, which has become widespread since 2015 – demand for Ukrainian goods has been a trend in the market for three years in a row. The turnover in this segment has increased almost 10 times over the years. The increase in the number of online stores offering domestic products is certainly a positive feature for the development of the Ukrainian economy and contributes to the support of domestic production. In the context of the above, the positive dynamics of domestic goods orders is is worth noting (Fig. 7).

In 2017, the e-commerce market continued its rapid growth. At the same time, the share of e-commerce was 10-15% of retail trade in most developed countries In 2017, the e-commerce market continued its rapid growth, as in most developed countries the share of e-commerce was 10-15% of retail trade it was 2.1% in 2015-and 3% in 2016 in Ukraine). It is worth noting that 2018 showed a dynamic increase in demand for goods and services of online stores.

As for the specialization of domestic online stores, the experts believe that there are other market niches for other types of goods apart from the leading positions of electronics and home appliances, with the room for constructive competition and development. (Ekonomichna pravda, 2015).



**Figure 7.** Dynamics of Orders for Domestic Production in 2015-2019 (forecast) Source: compiled by the authors based on (Ukrainian Retail Association, 2018; Ukrainian Retail Association, 2019).

The following component of development of international e-commerce in Ukraine should be considered low, compared to the European, level of Internet penetration, and, therefore, the low number of people who use it for sale and purchase of goods or services (Fig. 8):

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**Figure 8.** Population of Ukraine and Internet Penetration Rate in 2010-2015, thousand people,% Source: compiled by the authors based on (Ukrainian Retail Association, 2018; Ukrainian Retail Association, 2019).

Thus, the share of Internet penetration in the period 2010-2015 has almost quadrupled. The main number of Internet users in Ukraine is geographically located in Kyiv and Kyiv region. (23.7%) (Ekonomicheskaya pravda, n.d.). The age structure of e-shop consumers is presented in Fig. 9:





According to the results of 2018, the largest share of e-shops is registered in Kyiv (32.3%), Kharkiv region (10.8%), and Odessa region (10.8%). It should be noted that online stores are mainly located in major cities, and delivery across Ukraine has a significant impact on the value of goods, which makes online trading less attractive.

In addition, Ukraine is characterized by rapid growth of mobile Internet. While in 2016, 44% of users used mobile devices to go online, in 2018 this figure reached 65%. Conversely, the Internet penetration rate is 82% and 85% in the EU countries, such as Germany and the UK, respectively (Fig. 10):



**Figure 10.** Internet Penetration in Selected Countries in 2016-2018, % Source: compiled by the authors based on (Research and markets, 2019; My Total Retail, 2018; OECD, 2018).

Japan, Germany, the United Kingdom, the United States, Canada, France, South Korea, and Australia have the highest Internet penetration rates (more than 80%), which is why these countries are characterized by the highest percentage of e-commerce customers (Kim, Dekker & Heij, 2017). In Asian countries demonstrate a rapid pace of online business development due to the fact that a large number of consumers have only recently gained access to the network and, accordingly, actively started their first e-commerce operations, although the Internet penetration is only about 17%. The average number of purchases made in the year was 15.6 times in the USA, 18 in the UK, 18.1 in Germany, and 10.4 in Italy. It should be noted that the high level of e-commerce user acceptance, typical of most EU countries, means a relative reduction in growth potential.

At the same time, a specific feature of international e-commerce development in Ukraine is the low level of use of bank cards, payment systems and electronic money in payment for transactions (Zasenko, 2016). Please note that in Ukraine, more than 80% of online purchases are paid for in cash, bank card payments are only 4%, coming short of payments using bank terminals. Whereas, the following situation is observed around the world (Fig. 11):



**Figure 11.** Methods for Calculating Transactions in the Global e-commerce Market in 2016-2020 (forecast) Source: compiled by the authors based on (Research and markets, 2018; My Total Retail, 2018; OECD, 2018).

№9, 2019

The situation in the domestic market is caused by the high level of distrust in e-commerce operators due to a large number of frauds and online crimes. The predominance of cash payments among domestic buyers is explained by a number of reasons, among which it is worth noting: unformed reputation of online sellers (77%), inability to identify the product for its quality (73%), uncertainty about the reliability of online sellers (72%), uncertainty if the paid goods will be delivered in good condition (48%), as well as a low level of service (45%). However, payment through bank cards and p2p services (card-to-card transfers) continues to evolve. In this regard, experts also note an increase in fraud cases aimed at unauthorized access to payment cards. In most developed European countries, consumers use plastic cards to pay for purchased goods and services.

Another major factor impacting e-commerce development in Ukraine is imperfect e-commerce market infrastructure. Its elements require improvement because they affect the internal functioning of the Ukrainian market and interaction with foreign partners and consumers. We are referring here to postal services, payment systems, storage systems, and interaction tools: electronic documents, digital signatures, and electronic identification tools.

Logistics and transportation of goods and services across the border also need improvement. One can see reasons for this in the tight NBU (National Bank of Ukraine) regulatory policy on electronic money issuance and the unattractive regulatory environment for attracting international payment systems. It should be noted that the development of the electronic money system is primarily constrained by legal restrictions (Dostov, 2006).

The issue and use of electronic money is governed by the Law of Ukraine "On Payment Systems and Funds Transfer in Ukraine" and the Regulations "On Electronic Money in Ukraine." The key provisions of these documents stipulate that only banks can issue electronic money; the amount of money that can be stored simultaneously on an electronic device that cannot be replenished, should not exceed 2 thousand UAH and on a device that can be replenished, should not exceed 14000 UAH; business entities are only allowed to use electronic money to pay for goods up to UAH 62,000 per calendar year. This situation creates, firstly, inconvenience for consumers, and secondly, limits the ability of enterprises to expand their market share.

Reducing the barriers to entry into the electronic money market will create favourable conditions for Ukraine to legalize the activity of foreign electronic money systems which are currently used by Ukrainian consumers. In the first half of 2016, Ukrainians spent 1.8 billion electronic hryvnias, which is 1.6 times more than in the first half of 2015 (UAH 1.1 billion). The volume of the issued e-money – UAH 39 million – almost doubled in the first half of 2016 compared to the previous period. And the number of registered electronic wallets reached 43.6 million (Chernomor, 2015). The main obstacle to market development is the focus of legislation on the domestic regime of circulation from its very outset. Although recent NBU regulations have brought national systems closer to cross-border circulation, such systems must be registered with the National Bank in order to use non-residents' electronic money.

The ability of Ukrainian small businesses to engage in international trade has increased with the launch of large-scale foreign electronic money systems such as PayPal. This can also enhance the competitiveness of Ukrainian enterprises' outsourcing services in the global market.

At the same time, the percentage of e-money usage is quite high in developed countries. In Germany, the situation with payments in e-commerce is atypical, since bank accounts (60%) are mainly used for payments. In the UK, 75% of online purchases are paid using debit and credit cards, about 20% use PayPal, others choose gift certificates, bank transfers, etc. Experts define EU e-payment policy as moderately normative, partly liberal. The main objectives of this policy are to ensure that new entrants are able to join the market and to create an effective competitive environment for them.

According to the NBU, as of October 1, 2014. the total number of payment cards issued by Ukrainian banks with valid expiration date was 69.8 million units. The payment cards were mainly used for cash withdrawal operations, which is related to the underdeveloped payment infrastructure and the possibility for payroll card holders to withdraw cash at ATMs without any fee.

In some cases, the cost of goods for the end consumer in an online store may be up to 20% higher than paying for the goods by cash, which also does not stimulate consumers to pay with a payment card. In addition, possible legalization of electronic money issue bypassing the payment legislation of Ukraine allows

electronic money operators to obtain non-market competitive advantages, which is contrary to the principles of fair competition and does not contribute to creation of a transparent market for electronic money. Therefore, elimination of legal conflicts with Ukrainian laws is a prerequisite for development of the electronic money market.

It should be noted that not all Ukrainian payment systems have legalized their activities. Therefore, it is necessary to simplify the work of payment systems using the Internet, electronic money and other settlement tools based on new technologies, by amending the Ukrainian legislation accordingly. Ukraine should develop national standards and rules for e-commerce regulation that should provide it with equal partnership terms in the context of the Free Trade Area while creating a single virtual payment system that will facilitate the use of electronic money and target domestic online stores, trading venues and marketplaces to cooperate with European partners.

The reasons hampering the development of e-commerce in Ukraine should be seen in the low solvency of the population, which does not contribute to the increase of network users; insufficient level of development of telecommunication infrastructure that does not allow to provide consumers with modern types of services; significant difference in the level of informatization of big cities and regions of the country, etc. (Pavlova, 2014).

Current trends in e-commerce development in Ukraine are as follows:

• the widespread use of mobile devices for business operations in the Internet (with a growth rate of mobile sales of 4-5% per year);

• growing purchases through social networks. Most often, Ukrainians buy clothes, accessories and gifts, shoes, cosmetics, perfumes and baby goods;

• personalisation and individualisation of services. Consumers of e-commerce businesses are interested in unique products designed by the sites themselves or by other consumers;

• the widespread use of electronic money and other new payment methods, as well as launching their own e-currency by e-commerce enterprises;

• active development of the B2B e-commerce corporate sector;

• an increase in the number of online stores, the emergence of hybrid stores (that is, those that have both traditional and electronic retail space);

• diversification of the range of goods and services: e.g., ordering fresh food, hygiene products, etc.;

• multi-channel sales, allowing customers to choose the means of communication and payment;

• reducing barriers to cross-border operations.

One of the peculiarities of e-commerce in Ukraine is that this business is extremely attractive to investors because of the low level of required capital investments. But the problems in this area include the underdeveloped telephone infrastructure in Ukraine, lack of expertise of entrepreneurs in the sphere of the market, absece of a new generation of management and maintenance staff capable of operating in the electronic services' market.

The main obstacles to electronic shopping in Ukraine are low trust in online stores, little need for online shopping, and customers' desire to see products firsthand before buying them. However, the latest surveys show that a significant number of buyers still trust the quality and the guarantees provided, and only a small proportion of those surveyed say they have never made online purchases (Business Automation Association (Spilka Avtomatyzatoriv Biznesu), n.d.).

In recent years, Ukraine has developed quite favourable conditions for e-commerce development, but there are a number of factors impeding its growth, namely the limited number of credit card holders, lack of developed electronic payment systems, inability to ensure a high level of security of data exchange between participants of e-commerce, problems of protection of intellectual property rights, underdevelopment of legal base regulating e-commerce, lack of professionals able to work in the e-commerce system, etc.

Identifying current global trends in e-business development and analysing opportunities and prospects for Ukraine's participation in global e-commerce are possible by: identifying global trends in the field of Internet technologies, using the experience of leading EU countries as leaders in e-commerce; exploring the opportunities of the European information technology market and its development in the coming years; consideration of the current state of the Ukrainian Internet segment and prospects for development of ecommerce in this country; and identifying necessary conditions for faster integration of Ukraine into the international e-commerce system.

Over the last two years, the Ukrainian Internet segment has been growing in all directions. The rapid increase in Internet users will be the driving force of the Internet sector in Ukraine. The Internet economy of this country is represented by the branches of computer engineering and communications, advertising and media industry, Internet services, and e-commerce. The main advantages of e-commerce are: prompt data accessing, especially in international operations; reduction of non-production costs (sales, advertising costs, costs related to customer service and information support); shortened production and sales cycle, since there is no need to re-confirm the information and reduce the likelihood of errors when entering information; significantly reduced costs associated with the exchange of information through the use of cheaper telecommunications; greater openness of companies to consumers.

Such form of organization of information and trade interaction between companies through the Internet, as B2B e-commerce, is quite promising in Ukraine. In conditions of deepening international division of labour, active development of joint commerce, when enterprises not only buy products from each other, but also work together on production of new goods and services, this direction of e-commerce is of particular importance because it involves formation of long-term partnerships between enterprises provided through communications networks (Fedorichak, n.d.).

Corporate portals are already being created in Ukraine, within which corporate information is systematized and accessed by certified users. Creation of electronic markets, acquisition chain management systems, customer relationship management systems are also promising for Ukraine. An important step towards implementing any business-to-business systems is to use open international standards. Technical conditions for application of these technologies already exist – a national electronic catalogue of goods has been created in Ukraine.

Undoubtedly, global trends are also affecting development of international e-commerce in Ukraine. First, computer sales have recently boomed due to the decline in prices for computer systems and software. Second, the number of Internet users has grown. The world leading companies predict that by 2020, more than 1 billion people will begin to go online and more than 100 million sites will be created. The Ukrainian segment of the Internet currently represents more than 12 thousand sites, and monthly growth of visitors by 15% is also expected. Third, the number of online purchases is steadily increasing. In order to actively involve Ukraine in international e-business, it is necessary to: 1) introduce basic equipment, computers and telecommunications, including in rural areas, which will ensure expansion of computer literacy of the population and the proper level of infrastructure development; 2) promotion of rapid development of network infrastructure: development of online stores, network business structures, network operators and creation of several large domestic Internet portals; 3) teaching professional and general Internet skills at all levels of the education system, including civil officers; 4) development of the internal consumer market, increase of purchasing power by achieving stable economic growth (Highler & Pyatnitsky, 2013).

Therefore, the development of e-commerce in Ukraine is extremely important, as it is an effective tool that will allow many Ukrainian companies, first of all, enterprises providing commercial services and selling commodity products, to enter the world market. E-commerce gives impetus to further development of both Internet technologies and all financial infrastructure in this country. For entrepreneurs of Ukraine, electronic market of EU is quite attractive and potentially interesting for electronic business transactions. So it is of particular importance to use the European experience in implementing the latest systems and payment technologies in the sphere of international trade relations of Ukraine.

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## **Cryptocurrency Development: Modern Trends**

## MARYNA HRYSENKO<sup>4</sup> LIUDMILA SHVORAK<sup>5</sup> DENIS RUSAK<sup>6</sup>

**Abstract.** This paper analyses trends and mechanisms of cryptocurrency in the monetary sphere. In particular, it describes the approaches to definition of this notion laid by different international institutions, peculiarities of blockchain mechanism as the basis for crypto currency mining. It also determines main functions of cryptocurrency market players, nature of the different types of cryptocurrency and their market capitalization. Furthermore, the article describes essential methods of calculation used in cryptocurrency modelling and forecasting, as well as approaches of leading countries to regulate their cryptocurrency markets.

Keywords: Cryptocurrency • Blockchain • Bitcoin • Capitalization • Regulation.

#### Introduction

Active development of information technology and spread of globalization processes have contributed to emergence of new varieties of digital money, which today has become a new challenge to the customary money circulation and has transformed into a purely conditional (virtual) reality and a key element of the virtual economy. In digital money it is important to distinguish cryptocurrency – a digital currency protected by cryptographic technology. The urgency of scientific research on its use in the monetary sphere is conditioned by institutional problems faced by the society in the process of information economics and ecommerce development. Mainly those are the problems of trust, volatility, determination of the legal status of cryptography, risks of information attacks, bans from individual states, etc.

#### **Research Results**

The payment system of cryptocurrency is based on the following principles: decentralization, anonymity of participants, independence from government influence, lack of a single control centre and data scattered among contracting parties. There are several approaches to the definition of crypto currency (detailed in Table 1). The most common idea is that cryptocurrency is a digital (virtual, electronic) currency, consisting of coins, its counterfeit, encrypted information that cannot be copied. For cryptocurrency there is no issue centre, and its issues are based on cryptographic methods and 'Proof-of-Work' scheme. The actions are decentralized in the distributed computer network. It is not secured and is based on pure trust of users. Its main advantage is anonymity meaning that one can store it in electronic purses and transfer it between purses.

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Institution	Definition of Cryptocurrency		
	In the Report on Virtual Currency Schemes of 2012, the ECB defined such		
	currencies as a form of unregulated digital money, usually issued and		
	controlled by its developers, and used and accepted among the members of		
	a specific virtual community. It further clarified that three types of virtual		
	currencies can be distinguished depending on the interaction with traditional		
	currencies and the real economy:		
	- virtual currencies that can only be used in a closed virtual system,		
	usually in online games;		
European Control Bonk	- virtual currencies that are unilaterally linked to the real economy: a		
European Central Bank	conversion rate exists to purchase the currency (with traditional		
	money), and the purchased currency can subsequently be used to		
	buy virtual goods and services (and, also, exceptionally, to buy real		
	goods and services);		
	- virtual currencies that are bilaterally linked to the real economy:		
	there are conversion rates both for purchasing virtual currency and		
	for selling such currency; the purchased currency can be used to buy		
	both virtual and real goods and services.		
	The IMF has categorised cryptocurrencies as a subset of virtual currencies,		
	which it defines as digital representations of value issued by private		
	developers and denominated in their own unit of account. According to the		
International Monetary	IMF, the concept of virtual currencies covers a wider array of currencies,		
Fund	ranging from simple IOUs ('Informal certificates of debt' or 'I owe you's')		
	by issuers (such as Internet or mobile coupons and airline miles), virtual		
	currencies backed by assets such as gold, and cryptocurrencies such as		
	Bitcoin.		
	The Committee on Payments and Market Infrastructures ("CPMI"), a body		
	of the BIS, has qualified cryptocurrencies as digital currencies or digital		
	currency schemes. These schemes are said to exhibit the following key		
	there are access the value of which is determined by workly and		
Doub for International	- they are assets, the value of which is determined by supply and		
Bank for International	demand, similar in concept to commodities such as gold, yet with		
Settlements	they make use of distributed ladgers to allow remote peer to peer		
	- they make use of distributed ledgers to allow remote peer-to-peer		
	and without the need for intermediaries:		
	- they are not operated by any specific individual or institution		
	and a do not operated by any specific individual of institution.		

## **Table 1.** Definition of Cryptocurrency Notion by Different Institutions

European Banking Authority	The EBA has suggested to refer to cryptocurrencies as virtual currencies, which it defines as digital representations of value that are neither issued by a central bank or public authority nor necessarily attached to a fiat currency but are used by natural or legal persons as a means of exchange and can be transferred, stored or traded electronically.
European Securities and Markets Authority	The ESMA has referred to cryptocurrencies as virtual currencies, in a pan- European warning issued in cooperation with the European Insurance and Occupational Pensions Authority (EIOPA) and the EBA. Fully in line with the EBA's definition, virtual currencies are defined as digital representations of value that are neither issued nor guaranteed by a central bank or public authority and do not have the legal status of currency or money.
World Bank	The World Bank has classified cryptocurrencies as a subset of digital currencies, which it defines as digital representations of value that are denominated in their own unit of account, distinct from e-money, which is simply a digital payment mechanism, representing and denominated in fiat money. Contrary to most other policy makers, the World Bank has also defined cryptocurrencies themselves as digital currencies that rely on cryptographic techniques to achieve consensus.
Financial Action Task Force	<ul> <li>Like many other policy makers, the FATF has approached cryptocurrencies as a subset of virtual currencies, which it defines as digital representations of value that can be digitally traded and function as (1) a medium of exchange; and/or (2) a unit of account; and/or (3) a store of value, but do not have legal tender status (i.e., when tendered to a creditor, are a valid and legal offer of payment) in any jurisdiction. It further suggests that virtual currencies can be divided into two basic types:</li> <li>convertible virtual currencies that have an equivalent value in real currency and can be exchanged back-and-forth for real currency; these virtual currencies can be of a centralised or a decentralised nature (i.e. they can either have a central administrating authority that controls the system or no central oversight at all);</li> <li>non-convertible virtual currencies that are specific to a particular virtual domain or world (e.g. a Massively Multiplayer Online Role-Playing Game like World of Warcraft), and under the rules governing its use, cannot be exchanged for fiat currency.</li> </ul>
Verkhovna Rada of Ukraine	The definition of cryptocurrency was determined in the the Law On Circulation of Cryptocurrency in Ukraine. Cryptocurrency according to this institution is a: - program code (a set of characters, numbers and letters) that is object

	<ul> <li>property rights which may act as a mine, information about which is entered and stored in the system of blocks in the quality accounting units of the current block system in the form of data (software code);</li> <li>decentralized digital value measurement that can be digitally expressed and functions as a means of exchange, cost savings or accounting units based on mathematical calculations are the result of them and have cryptographic accounting protection. Cryptocurrency for legal purposes is considered a financial asset.</li> </ul>
Investopedia	A cryptocurrency is a digital or virtual currency that uses cryptography for security. A crypto currency is difficult to counterfeit because of this security feature. Many crypto currencies are decentralized systems based on blockchain technology, a distributed ledger enforced by a disparate network of computers. A defining feature of a crypto currency, and arguably its biggest allure, is its organic nature; it is not issued by any central authority, rendering it theoretically immune to government interference or manipulation.
Mariam-Webster	Crypto currency is any form of currency that only exists digitally, that usually has no central issuing or regulating authority but instead uses a decentralized system to record transactions and manage the issuance of new units, and that relies on cryptography to prevent counterfeiting and fraudulent transactions.

Source: Complied by authors based on (ECB, 2012; IMF, 2016; CPMI, 2016; ESMA, EBA & EIOPA, n.d.; Natarjan, Krause & Gradstein, 2017).

Crypto currency is emitted directly to the electronic network and is not connected with any 'ordinary' currency or with any national currency system. Thus, the term 'cryptology' refers to the term 'electronic money', and not the term 'money' as a basic category. As it was noted, crypto currency is based on the blockchain and 'proof-of-work' scheme. Blockchain is a particular type or subset of so-called distributed ledger technology (DLT) (Van del Looverbosch, 2018). DLT is a way of recording and sharing data across multiple data stores (also known as ledgers) where each has exactly the same data records and is collectively maintained and controlled by a distributed network of computer servers called nodes. Blockchain is a mechanism that employs an encryption method known as cryptography and uses (a set of) specific mathematical algorithms to create and verify a continuously growing data structure –where data can only be added but the existing data cannot be removed – that takes the form of a chain of 'transaction blocks' which functions as a distributed ledger (Natarjan, Krause & Gradstein, 2017). Blockchain as a technology may be of two forms – open, permissionless blockchain and permissioned blockchain. The key difference is the necessity to receive a permission of the administrator to join or leave the network.

Blockchain can be considered a distributed database. Additions to this database are initiated by one of the members (i.e. the network nodes) who creates a new 'block' of data which can contain all sorts of information. This new block is then broadcast to every party in the network in an encrypted form (utilising cryptography) so that the transaction details are not made public (Natarjan, Krause & Gradstein, 2017). Those in the network (i.e. the other network nodes) collectively determine the block's validity in accordance with a pre-defined algorithmic validation method, commonly referred to as a 'consensus mechanism'. Once

validated, the new 'block' is added to the blockchain, which essentially results in an update of the transaction ledger that is distributed across the network (CPMI, 2015). Basically, any node within a blockchain network can propose the addition of new information to it. In order to validate whether this addition of information (for example, a transaction record) is legitimate the nodes have to reach some form of agreement. Here the 'consensus mechanism' can be applied to. In short, a consensus mechanism is a predefined specific (cryptographic) validation method that ensures a correct sequencing of transactions on the blockchain(Natarjan, Krause & Gradstein, 2017). In case of cryptocurrencies, such sequencing is required to address the issue of 'double-spending' (i.e. the issue that one and the same payment instrument or asset can be transferred more than once if transfers are not registered and controlled centrally) (Natarjan, Krause & Gradstein, 2017).

A consensus mechanism in case of cryptocurrencies may be structured into 'Proof-of-Work' (PoW) mechanism and 'Proof-of-Stake' (PoS) mechanism. In a PoW system, network participants have to solve so-called 'cryptographic puzzles' to be allowed to add new 'blocks' to the blockchain. This puzzle-solving process is commonly referred to as 'mining' (Natarjan, Krause & Gradstein, 2017). In a PoS system, a transaction validator (i.e. a network node) must prove its ownership of a certain asset (or in case of cryptocurrencies, a certain amount of coins) in order to participate in the validation of transactions. This act of validating transactions is called 'forging' (EY, 2018) instead of 'mining'.

Usually a term 'cryptocurrency' is used in a broad sense. However, in practice one should distinguish this term from tokens and cryptosecurities. Tokens are issued in the framework of an Initial Token Offering (ITO) to raise funds for a given project or enterprise (Rohr & Wright 2017). They constitute a novel class of crypto-assets which embody some sort of claim against an entity that arises from the use of blockchain technology (Snyers & Pauwels, 2018). In case of cryptosecurities one should note that blockchain technology could also be used to register, issue and transfer regular shares and other corporate securities, so that the capitalisation table of a company is always accurate and up-to-date.

A cryptocurrency market involves a number of actors that play a certain role on it. The key of them are the following: cryptocurrency users, miners, exchangers, trading platforms, wallet providers, coin inventors, and coin offerors. Main functions of them are described in Table 2.

Cryptocurrency market player	Functions	
	A cryptocurrency user is a natural person or legal entity	
	who obtains coins to use them:	
Cryptocurrency users	- to purchase real or virtual goods or services;	
	- to make P2P payments;	
	- to hold them for investment purposes.	
	Miners participate in validating transactions on the	
	blockchain by solving a "cryptographic puzzle A miner	
Countron on minors	supports the network by harnessing computing power to	
Cryptocurrency miners	validate transactions and is rewarded with newly mined	
	coins (i.e. through an automatic decentralized new	
	issuance).	
	Cryptocurrency exchanges are persons or entities who	
Cryptocurrency exchangers	offer exchange services to cryptocurrency users, usually	
	against payment of a certain fee. They allow	
	cryptocurrency users to sell their coins for fiat currency	
	or buy new coins with fiat currency.	
Cryptocurrency trading platforms	Trading platforms are market places that bring together	
	different cryptocurrency users that are either looking to	
	buy or sell coins, providing them with a platform where	
	they can directly trade with each other.	

Table 2. Functions of Cryptocurrency Market Actors

	Wallet providers are those entities that provide
Cryptocurrency wallet providers	cryptocurrency users digital wallets or e-wallets which
	are used for holding, storing and transferring coins.
	Coin inventors are individuals or organizations who
Cryptocurrency coin inventors	have developed technical foundations of a
	cryptocurrency and set the initial rules for its use.
	Coin offerors are individuals or organizations that offer
	coins to cryptocurrency users upon the coin's initial
Cryptocurrency coin offerors	release, either against payment (i.e. through a crowd
	sale) or at no charge programme, normally to fund the
	coin's further development or boost its initial
	popularity.

Source: Complied by authors based on (ECB, 2015; FATF, 2014).

Today, there are more than 2,000 cryptocurrencies, more than 600 of them active. The most popular ones are Bitcoin, Ethereum and Ripple which exist both as money and as payment systems. According to data from the Coin Market Cap website, the total market capitalization in June 2019 amounted to \$287 billion, while bitcoins account for 57% of the total market value and ethereums for 10% of the total market value (CoinMarketCap, 2019). The detailed information on 10 most popular cryptocurrencies by their capitalizatiom is laid in Table 3.

Name	Market Capitalization	Price	Circulating Supply
Bitcoin	\$162 869 617 748	\$9 166,77	17 767 387
Ethereum	\$28 671 530 072	\$269,09	106 551 703
XRP	\$18 479 214 809	\$0,434785	42 501 950 124
Litecoin	\$8 611 213 840	\$138,24	62 290 575
Bitcoin Cash	\$7 443 558 159	\$417,10	17 846 038
EOS	\$6 366 214 958	\$6,92	919 736 127
Binance Coin	\$4 980 161 701	\$35,28	141 175 490
Bitcoin SV	\$4 025 231 643	\$225,58	17 843 923
Tether	\$3 530 208 921	\$1,00	3 529 784 845
Stellar	\$2 446 556 602	\$0,126053	19 408 944 001

**Table 3.** Top 10 Cryptocurrencies by Market Capitalization as of June 2019

Source: Complied by authors based on (Paech, 2015).

Bitcoin is a virtual, decentralized and anonymous currency that is not backed by government or any other legal entity, and that cannot be exchanged into gold or any other commodity (Grinberg, 2011). The text 'Bitcoin: a Peer-to-Peer Electronic Cash System' by Satoshi Nakamoto published on the internet in 2008 stands at the heart of creation of Bitcoin. Based on this text and the ideas conveyed in it, development of Bitcoin accelerated. Contributory to the mystic nature of Bitcoin is that until now it remains unclear whether Satoshi Nakamoto is a real person, a pseudonym, or perhaps even a group of hackers.

The rules of Bitcoin work were designed in advance, and they do not change, the limit of the total volume of emission is 21 million coins. Satoshi Nakamoto has created not only a program, but also a special application – a purse on computer containing Bitcoin cryptocurrency. It is a decentralized, fully transparent system where each participant controls implementation of the rules by all others; it does not intersect with the banking system; the currency limit is forecast to be exhausted over the next 130 years. It is a program code that is not regulated by any country or banking supervisory authority in the world and does not have a single issue center. At the same time, the issue of Bitcoins is limited algorithmically: theoretically, every owner of a powerful computer can 'get' Bitcoins by using computing power, but there is a limit of their total number in circulation. It is believed that the last Bitcoin will be won in 2140, when the reward for the open

block will be 0.00000001 Bitcoin. To date, more than 17.7 million bitcoins have been released (84% of their possible number).

The extraction of cryptocurrency is carried out through the work of millions of computers around the world using a program to calculate mathematical algorithms. Since 2009, Bitcoins began to be produced in home computers. However, over time, this production became more complicated, therefore creation of bitcoin-farms began. One of the world's largest is Bitmain Bitting business estate farms located in the industrial park San Shang Liang (Ordos Town, inland Mongolia - Autonomous Region of China).

The next most popular cryptocurrecny is Ethereum, launched in July 2015. Ethereum is an open source, public, blockchain-based distributed computing platform and operating system featuring smart contract functionality. It supports a modified version of Nakamoto consensus via transaction-based state transitions. Ethereum platform itself is not a cryptocurrency. However, like other open, permissioneless blockchains, Ethereum requires a form of on-chain value to incentivise transaction validation within the network (i.e. a form of payment for the network nodes that execute the operations) (Hileman & Rauchs, 2017). Ether does not only allow smart contracts to be built on the Ethereum platform, but it also functions as a medium of exchange (specifically in the context of ITOs, as many tokens are bought with ether). Ethereum was proposed in late 2013 by Vitalik Buterin, a cryptocurrency researcher and programmer. Development was funded by an online crowdsale that took place between July and August 2014. The system then went live on 30 July 2015, with 72 million coins 'premined'. This accounts for about 67 percent of the total cryptocurrency circulating supply in 2019.

The third by maket capitalization cryptocurrecny is Ripple – a real-time gross settlement system, currency exchange and remittance network created by Ripple Labs Inc., a US-based technology company. Released in 2012, Ripple is built upon a distributed open source protocol and supports tokens representing fiat currency, cryptocurrency, commodities, or other units of value such as frequent flier miles or mobile minutes. Ripple purports to enable secure, instantly and nearly free global financial transactions of any size with no chargebacks. Ripple has been adopted by banks and payment networks as settlement infrastructure technology. Ripple relies on a common shared ledger, which is a distributed database storing information about all Ripple accounts. The network is 'managed by a network of independent validating servers that constantly compare their transaction records'. Servers could belong to anyone, including banks or market makers. Ripple validates accounts and balances instantly for payment transmission and delivers payment notification with very little latency. Payments are irreversible, and there are no chargebacks.

Despite the relative level of transaction security and third-party independence, the legal status of cryptocurrency in different countries is significantly variable. One of the remaining key questions is whether central banks of leading countries recognize such currency. The positions of foreign central banks and other financial regulators in relation to crypto and markets are different. Since April 2017, with the adoption of the relevant law in Japan, cryptocurrency became officially not a monetary means of payment. It is considered a viable asset, which can be used as a means of payment, although the official currency remains the yen. It is anticipated that the Financial Services Agency will monitor virtual currency, and transactions will be documented to protect against abuse. Market operators must have at least \$100,000 of the reserve currency and pay a one-time fee of \$300,000 in licensing. If the license is refused, the money-contribution is not returned. The consortium of Japanese banks received permission from the Central Bank of Japan to agree on creation of its own digital currency J Coin, which is expected to be used no later than 2020 (the year of the summer Olympics in Japan) to pay for tourist goods and transfer money with smartphones. It is forecasted that by 2020 the cryptocurrency market in Japan will increase ten times. Counterfeit exchange transactions on fiat money are not subject to VAT.

For the purpose of federal taxation, cryrtocurrencies in the USA are considered as property. Sale and exchange activities are subject to banking secrecy laws. Operations for the issue of cryptographic goods may in some cases be classified as placement of securities. In the United States, Wing Cash national digital currency platform is expanding to improve its ability to manage its money supply with broadly and nondiscriminatory access to effective e-commerce products. The Federal Reserve System is interested in its development for the US dollar expansion in the digital sector. With the legal authorization of digital banknotes, Digital Fed records will not replace physical bills and coins, but will be an additional Federal Reserve System service.

The document issued by the Central Securities Depository (CSA) administrator specifies concrete requirements for companies involved in the ICO process, as well as exchanges where relevant assets are located. It is noted that the set of digital tokens examined by Canadian regulators falls under the definition of securities which causes the need to comply with legal requirements. New financial products can be tested in limited mode. There are also requirements for creation of investment cryptographic funds in Canada.

In China cryptocurrency is considered a non-monetary digital asset. Public placement of cryptographic goods is prohibited (the People's Bank of China on September 4, 2017 recognized ICO as illegal and ordered to immediately stop all operations with placement of tokens in the country). Individuals are allowed to store cryptocurrency and operate transactions. Such a reaction of the financial regulator of China turned out to be quite the opposite to those of the United States and the EU.

Countries of the EU also have different approaches for the cryptocurrency regulation process. Thus, the legislation of Germany permits cryptocurrency to be a financial instrument that acts in a form of 'private money' that can be taxed. For retailers who accept bitcoins as payment for goods, transactions for the sale of the product itself, as well as operations for the sale of bitcoins which are accepted when making a purchase are taxed. In Switzerland bitcoin is not forbidden. At the same time, there are no clear standards for using such currency. In the Netherlands cryptocurrency is considered as a means of payment, and in case of sale as an independent object – as a commodity. When completing tax returns, owners of cryptocurrency are required to take into account their value in the section 'capital'. In Norway cryptocurrency is not considered a monetary asset and is treated as a financial asset that is subject to property taxation. In Poland mining, sale and purchase of cryptocurrency are considered one of the types of commercial activity and are subject to registration in the authorized body. In Estonia such currency is considered as an alternative means of payment and operations with cryptocurrecny are not prohibited.

At the request of the Bank of England, researchers from the University College, London have developed their own digital currency, which is similar to the bitcoin. The system, called RSCoin, is based on distributed registry technology and allows you to quickly and easily move digital values. However, the main difference between RSCoin and bitcoins is the possibility of their centralization: the system can be fully controlled by central banks. Like bitcoins, RSCoin uses cryptography to create counterfeit digital money, while transaction verification also takes place in blockchain, where all digital currency transfers are recorded. However, if the bitcoin network is universally supported by multiple computers and does not have a single control centre, the RSCoin registry is under the Central Bank control. The developed system also provides for the possibility of unlimited digital signage issue. According to developers, this will allow regulators to take the necessary corrective measures, such as the currency incentive programmes introduced by the US Federal Reserve and other central banks after the 2008 financial crisis. Central banks will also be able to choose partner companies to process new transactions and their records into the central registry.

The growth of capitalization of major cryptographic markets attracts the attention of investors who seek to multiply their own financial resources. To that end issue of cryptocurrencies forecasting appear to be essential to scientists as well as to investors. Reasoning from this fact several key approaches for evaluation of cryptocurrency exchange rates and different methods for calculating cryptocurrency indices may be distinguished. Key approaches for evaluation of the exchange rates of cryptocurrencies are the following – system approach, inductive approach and time series modelling, fundamental analysis, and neural systems. General information on the main advantages and pitfalls of respective methods are laid in Table 4.

There also several indices elaborated by different institutions that are aimed to measure cryptocurrency. One of the first indices to measure cryptocurrency was the academic project of two universities in Berlin and Singapore (Humboldt University Berlin, Singapore Management University). The other one is CRIX - The CRyptocurrency Index. Its feature is an excellent methodological basis for calculations with fully open access. DLT10 is the index from the solid London-based company DLT Finance, which is designed for more utilitarian purposes – to serve as the foundation for a new generation of financial products, index investment funds. Another player – TradeBlock – offers to big clients, investment

banks, exchanges and brokers the indices for the two highly liquid currencies – Bitcoin and Ethereum. New York Stock Exchange (NYSE) began to use the bitcoin index – the NYSE Bitcoin Index (NYXBT).

Method	Advantages	Pitfalls
	- Description of the system;	- Does not provide a quantitative
	- Exposes interconnections with other	analysis of the system;
	systems;	- More analysis when changing
	- Describes the processes within the	components of the system is needed;
System Approach	system;	- It is difficult to apply when describing
	- Provides recommendations for	new structures
	improvement of processes;	
	- Identifies the main factors affecting the	
	system.	
	- Crypto trades are considered from the	- Gives only an estimation of
	point of view of investments;	investments in Boolevan form;
	- Provides a quantitative assessment of	- The country's specific macroeconomic
Fundamental	whether it is worth investing in one or	indicators are not based on the global
A polygic	another asset;	phenomena and systems.
Allalysis	- Based on various factors, the main of	
	which are macroeconomic indicators that	
	are well suited to assess the country's	
	investment potential.	
	- Suitable for a global description of the	- Does not provide a quantitative
Inductive	dynamics of indicators;	analysis of the system;
Approach and	- It is useful in the initial stages of the	- Models have fairly low accuracy in
<b>Time Series</b>	study, when it is necessary to	forecasting;
Modelling	confirm/decline the assumptions.	- Requires work in combination with
		other methodologies.
	- Gives a good model after conducting	- The factors affecting the indicator are
Neural Systems	many inquiries of interrogations;	not taken into account.
	- A fairly simple model in readmission	

Table 4. Main Advantages and Pitfalls of Methods to Evaluate Cryptocurrency Exchange Rates

Source: developed by the authors.

#### Conclusions

The concept of cryptocurency includes many components. It is based on the following principles: decentralization, anonymity of participants, independence from government influence, lack of a single control centre and the scattered data among contracting parties. There are different approaches to define the notion of cryptocurrency. Main institutions that provide such definitions are ECB, IMF, BIS, EBA, ESMA, World Bank, FATF and governments of leading countries. All of them seek to provide relevant regulation with the aim to reach necessary regulation of cryptocurrency sphere.

The notion of cryptocurrency cannot exist without the blockchain concept. Blockchain is a mechanism that employs an encryption method known as cryptography and uses specific mathematical algorithms to create and verify a continuously growing data structure –where data can only be added and the existing data cannot be removed – that takes the form of a chain of 'transaction blocks' which functions as a distributing ledger. Blockchain can be thought of as a distributed database. Blockchain as a technology may be of two forms – open, permissionless blockchain and permissioned. A consensus mechanism of blockchain in the case of cryptocurrencies may be structured into 'Proof-of-Work' mechanism and 'Proof-of-Stake'.

A term 'cryptocurrency' is usually used in a broad sense and should be distinguished from tokens and cryptosecurities. A cryptocurrency market involves a number of actors that play a certain role. They are the following: cryptocurrency users, miners, exchangers, trading platforms, wallet providers, coin inventors, and coin offerors.

Today, there are more than 2,000 cryptocurrencies. The most popular ones are Bitcoin, Ethereum and Ripple. The total market cryptocurrency capitalization in June 2019 amounted to \$287 billion. Bitcoin is still a niche payment instrument whose development can be continued in one of two scenarios: in the first case, it has the opportunity to become an analogue of the main currency which will be widely used for purchase/sale and accumulation without the need for exchange for the national currency in a certain the region; the second is the use of a world-recognized e-currency through which one can pay in any country.

Despite the relative level of transaction security and third-party independence, the legal status of cryptocurrency in different countries is significantly variable. One of the key questions that remain is whether central banks of leading countries recognize such currency. Practices of cryptocurrency regulation in different countries vary. Some consider it as an alternative means of payment, while others prohibit if fully.

The growth of capitalization of major cryptographic markets attracts the attention of investors seeking to multiply their own financial resources. Key approaches for evaluation of the exchange rates of cryptocurrencies are the following – system approach, inductive approach and time series modeling, fundamental analysis, and neural systems. There also several indices elaborated by different institutions that are aimed to measure cryptocurrency. Among them are CRIX, DLT10, TradeBlock, NYSE indexes, etc.

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# The Population Welfare Factors for the Member Countries of International Integration Associations

# **GRYGORIY SHAMBOROVSKYI**<sup>7</sup>

**Abstract:** The article analyzes the influence of macro and microeconomic indicators on the achievement of population welfare (GDP per person, index of happiness, index of prosperity) in the member countries of international integration associations. Regression coefficients are determined based on multi-factor cross-section modelling which influence the level and quality of life in different regions of the world. The classification of countries per incomes, revealed links of population's welfare and trends is proposed.

**Keywords**: Population Welfare • GDP per Capita • Happiness Index • Prosperity Index • Cross-section Regression • Level of Life • Quality of Life

## Introduction

More than 300 international integration agreements have been concluded in the world and more than 30 international integration associations have been created. The most economically, institutionally integrated and legally formed ones can be considered: USMCA (the United States – Mexico – Canada Agreement, previously, the North American Free Trade Agreement, NAFTA); Association of Southeast Asian Nations, ASEAN; MERCOSUR (Mercado Común del Sur, Southern Common Market); the European Union, EU; and the Eurasian Economic Union, EAEU. Megaregional integration processes explain the territorial and cultural proximity and the presence of close neighbouring contacts in business environment, common geopolitical interests and threats in the world's regions.

Nowadays, to assess the population welfare of the member countries of the integration associations, it is necessary to use complex criteria, certain statistical indicators and indicators of quantitative and qualitative character, including international economic integration which form the general system of socio-economic development of the states and allow to estimate costs and benefits of relevant processes, trends and strategies.

#### **Defining the Problem**

The hypotheses are member states of the EU, the USMCA, the ASEAN, the MERCOSUR and the EAEU are different in terms of the level and quality of life of the population, in each of the associations are conditionally rich and poor participants, the indicators of the welfare of the population depend on the socioeconomic development of the member states, factors (policy) of achievement of welfare are different as well. The purpose of the article is to determine the dominant factors of population welfare of the membercountries of integration associations and to construct a multi-factor cross-sectional regression model.

### **Literature Review**

The study of welfare, its measures of the quality and standard of living of the population has a long history. The scholars like A. Smith, 1776; A. Pigou, 1920; K. Arrow, 1950; A. Atkinson, 1970; J. Tobin, 1972; B. Nordhaus, 1972; C. Leipert, 1989 and others devoted their works to the topic. In the Ukrainen the

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study of development factors of the national economy and its individual sectors has been addressed by scholars: V. Mandybura, 1999; E. Libanova, 2014; M. Khvesyk, 2014; A. Mokiy 2011; V. Pryimak, 2011; M. Fleychuk, 2013 and others. However, scientists still do not have a set of indicators that should be used to assess the population welfare. There is no methodology for calculating the values of these partial indicators, a sufficiently effective algorithm for determining the link between international economic integration and the welfare of the population is not developed.

#### **Methodology and Data**

The research methods are economic and mathematical models. The proposed econometric model describes the correlation-regression relationship between macro and microeconomic indicators and indicators of the population welfare in different regions of the world. The methods of regression analysis are the most widely used statistical tools for discovering the relationships among variables. A cross-sectional regression model plays a vital role when comes a need to analyze an economic scenario in different regions at the same point in time.

The first and the most important stage is the choice of the socio-economic development indicators including the international economic integration which affects the member states' welfare when constructing a cross-sectional regression model. We have selected the following indicators based on the analyzed studies and available statistical data:

1. Population, in millions;

2. Gross domestic product (GDP) volume, billions USD;

3. The balance of payments, billionsUSD;

4. Foreign direct investment, billions USD;

5.Inflation rate,%;

6. Unemployment rate,%;

7.Life expectancy, in years;

8. Human development index, score;

9. Economically active population, %;

- Average wage, EUR/USD per month; 10.
- Consumption level, %; 11.
- Environmental performance index, score; 12.
- 13. Gini index:

14. Poverty rate (less 5 USD per day), %, which may affect the country's population welfare of the international integration associations – GDP per capita, the index of happiness, the prosperity index. The statistics data collected from Internet resources (Knoema; WBG).

The proposed model of the welfare achievement based on the selected factors (macro- and microeconomic indicators) can be formalized as follows (equation 1-3):

 $gdp_{pc} = a_{0ti} + a_{1ti}population + a_{2ti}gdp + a_{3ti}pay_bal + a_{4ti}fdi + a_{nti} (1)$ 

 $hpi = a_{0ti} + a_{1ti}population + a_{2ti}gdp + a_{3ti}pay_bal + a_{4ti}fdi + a_{nti}$ (2)

 $lpi = a_{0ti} + a_{1ti}population + a_{2ti}gdp + a_{3ti}pay_bal + a_{4ti}fdi + a_{nti}$ (3)

where,  $a_{0ti}, \ldots, a_{nti}$  are equation parameters that should be determined.

The cross-sectional regression model (least square method), balanced-panel data method (2016-2018) and advanced analytics software package Statistica were used for the analysis (Miller, 2006; Khalafyan,2007). It has taken the logarithm of the data for the purpose of standardization. The models with the highest statistical significance (considering the correlation coefficient R, the adjusted determination coefficient, F – Fischer discriminant, Durbin-Watson statistic, the level of statistical error, etc.) were №9, 2019 37

selected in the analysis. Y1 - GDP per capita, Y2 - happiness index, Y3 - prosperity index were taken as dependent variables. 14 variables were analyzed as independent variables (only statistically significant were present in the model).

As we know, the least squares method is one of the methods of regression analysis and is designed to estimate unknown values based on measurements that contain random errors. It is also used for the approximate representation of a given function by other (simpler) functions and is often helpful in processing of observations.

To increase the accuracy of the results, measurements of the desired physical value are carried out many times and for the result the arithmetic mean of all individual measurements is taken. The properties of the arithmetic mean have a stochastic nature. Given the properties of the arithmetic mean, we note that the sum of the squares of the deviations of individual measurements from the arithmetic mean will be less than the sum of the squares of deviations of individual measurements from another value.

The essence of the solution of uncertain systems of equations describing a physical construction is that they are imposed by the conditions of minimization (equation 4)

$$\sum_{t=1}^{n} p_i v_i^2 = [pv^2] \to min \tag{4}$$

for uneven measurements, where p - measurement weights; v - measurements correction.

In our article three regressive multifactorial models were constructed as a part of the research process — for countries with high, middle, and low income. The grouping of countries is based on the indices and indicators used by the World Bank in their own studies.

#### Results

For high-income countries, GDP per capita is above 40 000 USD. Regression  $Y1_{HIC}$  – equation 5.

$$Y1_{HIC} = 12.7 - 0.33x_7 + 0.36x_{10} + 0.61x_{11} - 0.48x_{13}$$
(5)

where:  $Y1_{HIC}$  – GDP per capita in high-income countries;

 $x_7$  – life expectancy;

 $x_{10}$  – average wage;

 $x_{11}$  – final consumption;

 $x_{13}$  – Gini index. The results of the regression are given in the Table 1.

	Regression Summary for Dependent Variable: Y1 (Spreadsheet1) $R= 0.89151737 R^2 = 0.79480322$ Adjusted $R^2 = 0.75160390 F(4,19)=18,399 pDW=1,55$							
N=24	b*	Std.Err. of b*	b	Std.Err. of b	t(19)	p-value		
Intercept			12,70787	3,919345	3,24235	0,004287		
x7	-0,326285	0,126914	-5,24865	2,041545	-2,57092	0,018709		
x10	0,365463	0,134469	0,32323	0,118931	2,71783	0,013653		
x11	0,613366	0,126318	0,31013	0,063869	4,85574	0,000110		
x13	-0,485253	0,122728	-0,81430	0,205949	-3,95388	0,000851		

Table 1. Results of the High-income Countries Regression for the Dependent Variable – GDP per capita

where R – coefficient of correlation;

 $R^2$  – adjusted coefficient of determination;

F – Fischer criterion;

DW – Darbin-Watson statistic;

N – number of observations;

Intercept – independent variable;

b\* – coefficient of regression (in relative indicators);

Std.Err.of b\*– standard error of b\*;

b – coefficient of regression (in absolute indicators);

Std.Err.of b – standard error of b;

t – T-criteria of Student;

p-value – the level of statistical error.

The final consumption (regression coefficient 0.61) and average wage (0.36) have the largest directly proportional effect. Scilicet with an increase of the final consumption by 1%, GDP per capita growth is expected to be 0.61 %, while the growth of the average wage by 1% can be a precondition for GDP per capita growth of 0.36 %.

The Gini index (regression coefficient -0.48) and life expectancy (-0.33) carry out the inverse proportional effect. Thus, the growth of society inequality by 1% is a precondition for reducing GDP per capita by 0.48%, while an increase in the life expectancy for one year may lead to a 0.33% drop in GDPper capita.

Regression  $Y2_{HIC}$ :equation 6, results are displayed in Table 2.

$$Y2_{HIC} = 1.7 - 9.7x_1 - 0.23x_3 - 0.11x_4 - 0.17x_6 + 0.28x_8 + 6.48x_9 + 0.12x_{12} - 0.57x_{13} - 0.27x_{14}$$
(6)

where  $Y2_{HIC}$  – happiness index in high-income countries;

 $x_1$  – the population;

 $x_3$  – balance of payments (accounting);

- $x_4$  foreign direct investment;
- $x_6$  unemployment rate;
- $x_8$  human development index;

 $x_9$  – economically active population;

 $x_{12}$  – environmental performance index;

 $x_{13}$  – Gini index;

 $x_{14}$  – poverty rate

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Variable	Variables currently in the equation; DV: Y2 (Spreadsheet1_(Recovered)) R=0,98; R <sup>2</sup> =0,93; F(9,16)=38,83; DW=1,75								
	b*	Partial Cor.	Semipart Cor.	Tolerance	R-square	t(16)	p-value		
<i>x</i> <sub>1</sub>	-9,72014	-0,866080	-0,362485	0,001391	0,998609	-6,92996	0,000003		
<i>x</i> <sub>3</sub>	-0,22792	-0,529488	-0,130592	0,328306	0,671694	-2,49665	0,023834		
$x_4$	-0,10853	-0,408783	-0,093717	0,745588	0,254412	-1,79167	0,092117		
<i>x</i> <sub>6</sub>	0,16915	0,514508	0,125541	0,550839	0,449161	2,40008	0,028915		
<i>x</i> <sub>8</sub>	0,28474	0,652573	0,180193	0,400467	0,599533	3,44491	0,003329		
<i>x</i> 9	9,48226	0,864463	0,359800	0,001440	0,998560	6,87862	0,000004		
<i>x</i> <sub>12</sub>	0,12008	0,438788	0,102167	0,723858	0,276142	1,95323	0,068509		
<i>x</i> <sub>13</sub>	-0,56817	-0,766851	-0,249985	0,193587	0,806413	-4,77919	0,000205		
<i>x</i> <sub>14</sub>	-0,27274	0,497433	-0,119973	0,193490	0,806510	-2,29363	0,035689		

**Table 2.** Results of the High Income Countries Regression for the Dependent Variable – the Happiness Index

where Partial Cor. – partial correlation; Semipart Cor. – Semipartial correlation; Tolerance – tolerance of regression.

The economically active population (6.48); human development index (0.28); and environmental performance index (0.12) have the most directly proportional impact. The unemployment rate (-0.17); population (-9,7); Gini index (-0.57); balance of payments (-0.23); foreign direct investment (-0.11); and the poverty rate (-0,27) carry out the inverse proportional effect.

Regression  $Y3_{HIC}$ : equation 7, results are displayed in Table 3.

$$Y3_{HIC} = 26.67 + 2.04x_2 + 0.45x_3 - 0.48x_6 + 0.22x_7 + 0.39x_8 + 2.6x_9$$
(7)

where  $Y3_{HIC}$  – prosperity index in high-income countries;

 $x_2$  – GDP volume;

 $x_3$  – balance of payments;

 $x_6$  – unemployment rate;

 $x_7$  – life expectancy;

 $x_8$  – human development index;

 $x_9$  – economically active population.

**Table 3.** Results of the High Income Countries Regression for the Dependent Variable – the Prosperity Index

	Regression Summary for Dependent Variable: Y3 (Spreadsheet1_(Recovered)) $R = 0.87370776 R^2 = 0.7633652$ Adjusted $R^2 = 0.69575531 F(6.21) = 11.291 DW = 1.40$						
N=28	b*	Std.Err. of b*	b	Std.Err. of b	t(21)	p-value	
Intercept			-26,6698	13,43940	-1,98445	0,060426	
<i>x</i> <sub>2</sub>	2,04098	1,197358	3,0097	0,59654	5,04526	0,000054	
<i>x</i> <sub>3</sub>	0,45009	0,149899	0,0008	0,00027	3,00265	0,006781	
<i>x</i> <sub>6</sub>	0,48134	0,121653	0,6099	0,15414	3,95665	0,000721	
<i>x</i> <sub>7</sub>	0,22120	0,139378	10,8603	6,84302	1,58707	0,127441	
<i>x</i> <sub>8</sub>	0,39064	0,154505	32,0176	4,99362	6,41171	0,000002	
<i>x</i> 9	-2,64724	1,172172	-2,7068	0,56185	-4,81776	0,000092	

GDP volume (2.04); economically active population (2.6); human development index (0.39); balance of payments (0.45); life expectancy (0.22) have the largest directly proportional effect. The inverse proportional effect is realized by the unemployment rate (-0.48).

In middle-income countries, GDP per capita is  $15\ 000 - 30\ 000\ USD$ . Regression  $Y1_{MIC}$ : equation 8, results are displayed in Table 4.

$$Y1_{MIC} = -9.78 + 0.39x_4 + 0.97x_7 + 0.3x_8 - 0.67x_{14}$$
(8)

Where  $Y1_{MIC}$  – GDP per capita in middle-income countries;

 $x_4$  – economically active population;

 $x_7$  – life expectancy;

 $x_8$  – human development index;

 $x_{14}$  – poverty level.

	Regression Su $R^2=0,9606815$	Regression Summary for Dependent Variable: Y1 (Spreadsheet1_(Recovered)) $R^2=0,96068151$ Adjusted $R^2=0,94944766$ F(4,14)=85,517 DW=2					
N=19	b*	Std.Err. of b*	b	Std.Err. of b	t(14)	p-value	
Intercept			-9,78155	0,844069	-11,5886	0,000000	
<i>x</i> <sub>4</sub>	0,392966	0,058446	0,00499	0,000742	6,7236	0,000010	
<i>x</i> <sub>7</sub>	0,969805	0,073117	5,86190	0,441946	13,2638	0,000000	
<i>x</i> <sub>8</sub>	0,303530	0,066518	2,36638	0,518585	4,5632	0,000442	
<i>x</i> <sub>14</sub>	-0,665647	0,079957	-0,14055	0,016883	-8,3250	0,000001	

**Table 4.** Results of the Middle Income Countries Regression for the Dependent Variable – GDP per person

The life expectancy (0.97); economically active population (0.39); and human development index (0.3) have the most directly proportional effect. The inverse proportional effect is carried out by the poverty rate (0.67).

Regression  $Y2_{MIC}$ :equation 9, results are displayed in Table 5.

 $Y2_{MIC} = 11.94 + 3.51x_2 - 0.52x_3 - 0.81x_6 - 2.75x_7 + 1.27x_{10} - 0.55x_{11} + 0.21x_{12} - 0.78x_{13} - 2.37x_{14} + 0.21x_{15} - 0.20x_{15} + 0.20x_{15$ (9),

where  $Y2_{MIC}$  is happiness index in middle-income countries;

 $x_2$  – GDP volume;

 $x_3$  – balance of payments;

 $x_6$  – unemployment rate;

 $x_7$  – life expectancy;

 $x_{10}$  – average wage;

 $x_{11}$  – final consumption;

 $x_{12}$  – environmental performance index;

 $x_{13}$  – Gini index;

 $x_{14}$  – poverty rate.

Table 5. Results of the Middle Income Countries Regression for the Dependent Variable – the Happiness Index

	Regression Summary for Dependent Variable: Y2 (Spreadsheet1_(Recovered)) $R = 0.97665441 R^2 = 0.95385384$							
	Adjusted R <sup>2</sup> =0,90770768 F(9,9)=20,67 DW=2,7							
N=19	b*	Std.Err. of b*	b	Std.Err. of b	t(9)	p-value		
Intercept			11,94077	1,381270	8,64478	0,000012		
<i>x</i> <sub>2</sub>	3,50928	0,722073	0,25341	0,052141	4,86001	0,000896		
<i>x</i> <sub>3</sub>	-0,51768	0,139869	-0,00235	0,000636	-3,70120	0,004911		
<i>x</i> <sub>6</sub>	-0,80983	0,241315	-0,12606	0,037563	-3,35590	0,008444		
<i>x</i> <sub>7</sub>	-2,75167	0,363336	-6,02316	0,795309	-7,57336	0,000034		
<i>x</i> <sub>10</sub>	1,27241	0,223927	0,36310	0,063900	5,68226	0,000301		
<i>x</i> <sub>11</sub>	-0,54896	0,129827	-0,01439	0,003404	-4,22842	0,002212		
<i>x</i> <sub>12</sub>	-0,20924	0,085452	-0,14575	0,059524	-2,44866	0,036838		
<i>x</i> <sub>13</sub>	-0,78711	0,104419	-0,12588	0,063465	-1,98347	0,078619		
<i>x</i> <sub>14</sub>	-2,37125	0,423316	-0,18132	0,032369	-5,60160	0,000334		

GDP volume (3.51); average wage (1.27); and environmental performance index (0.21) have the biggest directly proportional effect. The inverse proportional effect is made by life expectancy (-2.75); poverty rate (-2,37); unemployment rate (-0,81); balance of payments (-0.52); final consumption (-0.55); and Gini index (-0.21).

Regression  $Y3_{MIC}$ : equation 10, results are given in Table 6.

$$Y3_{MIC} = 12.92 - 0.61x_6 + 0.75x_7 + 0.75x_8 + 5.49x_9 + 0.66x_{10} - 0.41x_{11}$$
(10),

where  $Y3_{MIC}$  is prosperity index in middle-income countries;

- $x_6$  unemployment rate;
- $x_7$  life expectancy, thousand years;
- $x_8$  human development index;
- $x_9$  economically active population;

 $x_{10}$  – average wage;

 $x_{11}$  – final consumption.

 Table 6. Results of Middle-income Countries Regression for a Dependent Variable — the Prosperity Index

 Regression Summary for Dependent Variable;

	Y3 (Spreadsheet1_(Recovered)) $R = 0.93998964 R^2 = 0.88358052 Adjusted R^2 = 0.84249129 F(6.17) = 21.504 DW = 1.7$								
N=24	b*	Std.Err. of b*	b	Std.Err. of b	t(17)	p-value			
Intercept			12,92331	3,324925	3,88680	0,001185			
<i>x</i> <sub>6</sub>	-0,413062	0,109679	-0,22117	0,058728	-3,76610	0,001540			
<i>x</i> <sub>7</sub>	0,745989	0,212335	6,02969	1,716265	3,51326	0,002666			
<i>x</i> <sub>8</sub>	0,754524	0,139903	3,28735	1,297261	2,53407	0,021400			
<i>x</i> 9	5,492204	0,095756	0,12408	0,024139	5,14017	0,000082			
<i>x</i> <sub>10</sub>	0,657411	0,167645	0,70675	0,180226	3,92145	0,001099			
<i>x</i> <sub>11</sub>	-0,410801	0,148302	-0,03752	0,013545	-2,77003	0,013105			

The life expectancy, in years (0.75); average wage (0.66); economically active population, in millions (0.49); Human Development Index (0.75) have the most directly proportional effect. The unemployment rate, % (0.41); final consumption,% (0.41) made the inverse proportional effect.

For low-income countries, GDP per capita is below 15 000 USD.

Regression  $Y1_{LIC}$ : equation 11, results are given in Table 7.

$$Y1_{LIC} = 9.78 + 0.1x_4 + 0.11x_5 - 0.83x_7 + 0.88x_8 + 0.4x_9 + 0.56x_{10} + 0.24x_{11} - 0.64x_{13} - 0.29x_{14}$$
(11),

Where  $Y1_{LIC}$  is GDP per capita in low-income countries;

- $x_4$  is foreign direct investment;
- $x_5$  is inflation rate;
- $x_7$  is life expectancy;
- $x_8$  human development index;
- $x_9$  economically active population, in millions;
- $x_{10}$  –average wage;
- $x_{11}$  final consumption;
- $x_{13}$  Gini index;

 $x_{14}$  – poverty rate.

	Regression Summary for Dependent Variable: Y1 (Spreadsheet1_(Recovered)) $R=0,98964817$ $R^2=0,97940350$ Adjusted $R^2=0,97134399$ F(9,23)=121,52 DW=1,94 $R=0,98964817$						
N=33	b*	Std.Err. of b*	b	Std.Err. of b	t(23)	p-value	
Intercept			9,78991	1,473486	6,64405	0,000001	
<i>x</i> <sub>4</sub>	0,109808	0,067440	0,00206	0,001268	1,62824	0,117096	
<i>x</i> <sub>5</sub>	0,112926	0,034615	0,00659	0,002019	3,26235	0,003427	
<i>x</i> <sub>7</sub>	-0,827009	0,047915	-5,07637	0,767278	-6,61608	0,000001	
<i>x</i> <sub>8</sub>	0,881834	0,075365	6,64968	0,568309	11,70082	0,000000	
<i>x</i> <sub>9</sub>	0,403762	0,065910	0,19490	0,031816	6,12593	0,000003	
<i>x</i> <sub>10</sub>	0,564680	0,065373	1,03928	0,120317	8,63786	0,000000	
<i>x</i> <sub>11</sub>	0,246602	0,064453	0,00800	0,002091	3,82606	0,000866	
<i>x</i> <sub>13</sub>	-0,+41947	0,037445	-1,08076	0,138618	-7,79665	0,000000	
<i>x</i> <sub>14</sub>	-0,295207	0,065752	-0,11441	0,025484	-4,48970	0,000166	

**Table 7.** Results of the Low-income Countries Regression for the Dependent Variable – GDP per capita

The biggest directly proportional effect is made by the human development index (0.88); foreign direct investment, in billions of dollars USA (0.1); average wage (0,56); economically active population (0.4); final consumption (0.24); Inflation rate, % (0.11). The inverse proportional effect is carried out by the life expectancy, in years (-0.83); Gini Index (-0.64); and poverty rate (-0.29).

Regression  $Y2_{LIC}$ : equation 12, results are given Table 8.

 $Y2_{LIC} = 0.39 + 4.46x_1 + 1.91x_2 - 0.55x_3 + 0.38x_4 - 0.44x_6 + 9.84x_9 + 0.28x_{10}$ (12),

where  $Y2_{LIC}$  is happiness index in low-income countries;

 $x_1$ — population;

- $x_2$  GDPvolume;
- $x_3$  balance of payments;
- $x_4$ —foreign direct investment;
- $x_6$  unemployment rate;
- $x_9$  economically active population, in millions;

 $x_{10}$  — average wage.

 $R= 0,82369201 R^2 = 0,67846852$ Regression Summary for Dependent Variable: Y2 (Spreadsheet1\_(Recovered)) Adjusted  $R^2$ =0,61227087 F(7,34)=10,249 DW=1,6 Std.Err. of b\* b\* Std.Err. of b t(34) p-value N=42 b Interc 4,43996 0,000090 0,388666 0,087538 ept 2,12611 4,46627 2,100676 0,457270 0,215074 0,040837  $x_1$ 1,91487 0,165925 0,033242 4,99144 0,383631 0,000018  $x_2$ -0,55487 0,155385 0,000951 0,000580 -1,64025 0,110174  $x_3$ 0,33715 0,001325 0,000641 2,06792 0,046324 0,163037  $x_4$ -0,43957 0,157391 0,059621 0,021348 2,79286 0,008516  $x_6$ 5,84511 2,199416 0,588435 0,221418 2,65758 0,011905  $\chi_9$ 0,28024 0,184353 0,087186 0,057353 1,52015 0,137718  $x_{10}$ 

Table 8. Results of the Low-income Countries Regression for the Dependent Variable - the Happiness Index

The economically active population (5.84), total population (4.46), GDP volume (1.91), foreign direct investment (0.38); and average wage (0.28) have the largest directly proportional effect on happiness index. The inverse proportional effect is made by the unemployment rate (-0.44) and the balance of payments (-0.25).

Table 9 gives results of Regression  $Y3_{LIC}$ : equation 13.

$$Y_{3LLC} = 6.3 - 3.61x_1 + 6.83x_2 + 0.76x_3 + 0.85x_4 - 0.24x_5 + 0.49x_7 + 4.12x_9 + 0.86x_{11}$$
(13)

where  $Y3_{LIC}$  is prosperity index in low-income countries;

 $x_1$  – population;

 $x_2$  – GDP volume;

- $x_3$  balance of payments;
- $x_4$  foreign direct investment;

 $x_5$  – inflation rate;

 $x_7$  – life expectancy;

 $x_9$  – economically active population;

 $x_{11}$  – final consumption.

	Regression Summary for Dependent Variable: Y3 (Spreadsheet1_(Recovered)) $R=0,86111779 R^2=0,74152384$ Adjusted $R^2=0,67482032 F(8,31)=11,117 DW=2$						
N=40	b*	Std.Err. of b*	b	Std.Err. of b	t(31)	p-value	
Intercept			6,34521	1,639581	3,87002	0,000524	
<i>x</i> <sub>1</sub>	-3,60584	1,660814	-0,83352	0,383912	-2,17113	0,037696	
<i>x</i> <sub>2</sub>	6,83163	0,283545	0,16275	0,055490	2,93297	0,006263	
<i>x</i> <sub>3</sub>	0,76225	0,150289	0,00220	0,001260	1,74499	0,090894	
<i>x</i> <sub>4</sub>	0,85461	0,243496	0,00755	0,002151	3,50974	0,001396	
<i>x</i> <sub>5</sub>	-0,23763	0,107856	-0,00019	0,000085	-2,20319	0,035141	
<i>x</i> <sub>7</sub>	0,49556	0,116529	2,16114	0,881893	2,45057	0,020105	
X9	4,12606	1,604227	0,93734	0,364441	2,57199	0,015127	
x <sub>11</sub>	0,86424	0,189989	0,01247	0,002741	4,54889	0,000078	

**Table 9.** Results of the Low Income Countries Regression for a Dependent Variable — the Prosperity Index

The largest directly proportional effect is made by the GDP volume (6.83), balance of payments (0.76), foreign direct investment (0.85), economically active population (4.12), and final consumption (0.86). The inverse proportional effect is carried out by the population (-3.61), the life expectancy (0.29), and the inflation rate (0.24).

#### Conclusions

Regression analysis has revealed positive and negative factors of population welfare in member countries of international integration associations. Grouping countries by income allows comparing priorities, strategies and trends depending on the level of socio-economic development. The main factor of population welfare of the richest EU-12 countries (Austria, Belgium, Great Britain, Denmark, Ireland, Italy, Luxembourg, the Netherlands, Germany, Finland, France, Sweden), USMCA-2 (USA, Canada), ASEAN-1 (Singapore) is their economically active population (regression coefficient of 9.48), which characterizes the high economic culture and entrepreneurial activity of the society. People realize that welfare depends on the effort spent on its achievement. The Gini index, foreign direct investment, the poverty rate have weak

negative influence. Other positive factors: consumption, wages, life expectancy, environmental safety, and human potential testify to the liberal, motivational model of countries' development. The countries with the similar level of GDP per person demonstrate absolute convergence.

GDP volume (3.51) plays the biggest role in the level of life in middle-income countries. Then average wage (1.27), economically active population (0.39); human development index (0.3); and environmental performance index (0.3) have their positive impact in the group. There are EU-13 (Greece, Estonia, Spain, Cyprus, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia, Slovenia, Hungary, and the Czech Republic), ASEAN-1 (Brunei), MERCOSUR-1 (Uruguay). Their policy is based on economies of scale and the internal market policy leads to welfare achievements.

The poverty rate, (-2,37), unemployment rate (-0,81), final consumption (-0.55); and Gini index (-0.21) carry out the inverse proportional effect on the standards of life. Although the balance of payments (-0.52) and the life expectancy (-2.75) have negative impact on the happiness index. It may be caused by industrial pollution and poverty threats.

The dominant factor of population welfare in low-income countries is total population (4.46). The human development index (0.88), foreign direct investment (0.1), average wage (0.56), economically active population (0.4), final consumption (0.24), and GDP (1.91) have a positive impact on welfare in the group EU-3 (Bulgaria, Romania, Croatia), USMCA-1 (Mexico), ASEAN-8 (Vietnam, Indonesia, Cambodia, Laos, Myanmar, Malaysia, Thailand, Philippines), MERCOSUR-5 (Argentina, Brazil, Venezuela, Paraguay, Bolivia), EAEU-5 (Russia, Belarus, Armenia, Kazakhstan, Kyrgyzstan). The inverse proportional effect is carried out by the life expectancy (-0.83), Gini Index (-0.64), poverty rate (-0.29), and balance of payments (-0.25). The factors of welfare achievements in low-income countries indicate the trend to socializing economies, the member states need more human resources, especially high skilled workers who rather leave the country searching for higher level and quality of life.

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# **Theory and Practice of E-Currencies Emission by Central Banks**

## ANDRII BLINOV<sup>8</sup>

**Abstract:** The next wave of R&D revolution combined with the further development of Internet has largely expanded the horizons of information exchange. Among others, the key element of such exchange is the contemporary international monetary exchange. This paper aims to describe the potential of non-fiat currencies and other non-traditional asset use by wider public which is the consequence of cryptography and electronic signature available. The article analyzes the theoretical possibilities of electronic money (e-currencies) issue by central banks within the framework of centralized and decentralized systems. The practice of bureaucratizing these processes by some of the world's central banks is also outlined.

**Keywords:** Innovations • Fintech • Sharing Economy • Blockchain • Cryptocurrencies • Central bank digital currency • Digital fiat currency • Non-fiat currencies • Virtual (digital) currency

### Introduction

The development of the Internet has dramatically expanded the horizons of information sharing. Among other things, the contemporary international monetary exchange has become an element of such an exchange. It prompted an offshoot of traditional cash and non-cash issued by central banks. The last 20 years have witnessed that many global services have become widely accepted with dramatically changing our experience of financial engagement. In today's international economic relations, not only the technology of payments has changed; instead of carrying out paper transactions exclusively at a bank branch or in specialized treasury systems this can be made through a typical client-bank system by transmitting data via the Internet. And the application for operation can be submitted at any time of the day and night (24/7).

In the twenty-first century, with the onset of the Industrial Revolution 4.0 (Kagermann et al., 2011), the wider public found it possible to use non-fiat money and other non-traditional assets. They were cryptography and digital signatures with a public key that made the electronic money possible.

It is known from central bank theory that modern electronic money can exist within centralized and decentralized systems (Mykhailovska et al., 2006, p. 313). Centralized ones imply a control point for money supply, while decentralized controls of supply can come from different sources or a network of sources.

Decentralized systems are also known as free banking. This is an environment where there is no special banking regulation and regulators, and banks are subject to the same regulation as conventional companies.

There are such features of free banking:

• competitive issue of money, including electronic signs which are subject to maturity;

• mutual recognition and acceptance of banknotes at face value by different entities; indirect redemption (clearing) of banks' money through exchange of their currencies;

• competition between financial companies in the field of keeping customer accounts and providing other banking services;

• absence of state monopoly of "legal payment units" on the markets and for citizens;

• no central bank claim for minimum reserve requirements, as it is usually required from commercial banks; at the same time, possible arrangements (convention) can be reached between the issuers of electronic

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money for the procedure of such payment means circulation, obligations of the counterparts, formation of reserve (insurance) funds, etc.

#### **Literature Review**

Theoretical and practical aspects of the issue were investigated by a number of domestic and foreign scientists, but a number of significant points are not clarified or contradictory. Primarily, there are international organizations, regional unions and national governments which determine e-currencies.

Basel Committee on Banking Supervision determines (Risk Management for Electronic Banking and Electronic Money Activities: 1998, p.3) electronic banking as the provision of retail and small value banking products and services through electronic channels. Such products and services can include deposit-taking, lending, account management, provision of financial advice, electronic bill payment, and provision of other electronic payment products and services, such as electronic money (defined separately, below). And electronic money refers to "stored value" or prepaid payment mechanisms for executing payments via point of sale terminals, direct transfers between two devices, or over open computer networks such as the Internet.

Core Principles for Systemically Important Payment Systems were clearly stated by Bank for International Settlements (2001). Later the term 'virtual (digital) currency' was clarified by European Central Bank (2012), European Banking Authority (2014).

Customers' component was well studied by Pfitzmann et Waidner (1997), Camp (2001), Sumanjeet (2009), Carbunar et al. (2011), Zhang et al. (2012), Mbiti et Weil (2013), and Li et al. (2014). Issuance of electronic currency by mining, supply, withdrawal, load of new electronic currency was analyzed by Pfitzmann et Waidner (1997), Azariadis et al. (2001), Carbunar et al. (2011), Hu et al. (2012), and Li et al. (2014).

Participants of the domestic financial market and scientists are increasingly raising questions about the possibility of using virtual currencies in Ukraine. Kovalchuk and Palyvoda (2014) consider digital currency as a virtual source of dummy capital in their research. Lukyanov (2014) focuses on cryptocurrency as an attribute of Internet communications.

Naumenkova et al. (2018) defined the advantages and limitations in the use of digital currencies, as well as peculiarities of regulation of their circulation in different countries of the world. Also the researchers have studied digital currencies in the context of public confidence in money.

Some elements of the influence of digital currencies of central banks have been studied, systematized and summarized by Kochergin and Yangirova (2019). In particular, they paid particular attention to the potential of such currencies to affect the monetary system, compared the properties of central bank digital currencies compared to other forms of money, and looked into the incentives for issuing central bank digital currencies.

#### **Basic Results of the Research**

We know that electronic money is the balance of money saved electronically on a valuesome-card or remotely on a server.

The main difference between e-money and virtual (digital) currency is that e-money is a narrower concept. E-money doesn't change the value of the fiat currency (euro, dollar, yuan, yen, rouble, etc.); on the contrary, the digital currency is not the equivalent to any fiat currency. In other words, all virtual currencies are electronic money, while electronic money is not necessarily a virtual currency.

Electronic money is essentially a requirement that is not linked to any particular account. Common modern examples of electronic money are bank deposits, non-cash fund transfers, payment processors and digital currencies. Electronic money can also be stored (and used) as the payment account on the Internet. The most common and widely used mobile subsystems are Google Wallet and Apple Pay.

Like traditional currencies, the electronic ones can be divided into soft and hard (in the scientific literature one can find different classification of currency types depending on the degree of convertibility: 'hard' means such money has a free exchange for any foreign currencies, 'soft' are partially converted and

unconverted (closed) national currencies, see Krasavina, 1994, p. 12-13). But the principles are somewhat different. Hard electronic currency supports irreversible transactions. That is, changing a transaction, even in the event of an error detected and acknowledged by all parties, is impossible. Such e-currencies are more focused on retail operations. Examples of hard electronic currencies are Western Union money, KlickEx, or Bitcoin. On the other hand, within the framework of soft electronic currency it is possible to cancel the payments when fraud or disputes. Among the examples is the money transferred via PayPal and credit cards.

One of the purposes of this study is to determine what is happening with the regulation of this activity since it is obvious that the rapid advance of Industry 4.0 with the introduction of electronic money could not be left aside by national governments as sovereigns. Hong Kong was among the first jurisdictions where electronic money regulation was implemented, where only licensed banks were allowed to issue stored value cards.

This brought the necessity of regulation of the issuance, monitoring and prudential oversight of electronic money institutions in Europe. European Union adopted the relevant Directive (E-Money Directive) in 2009. In 2012, the European Central Bank referred to virtual money (currencies) as "a type of unregulated, digital money that is typically issued and controlled by its developers and used and accepted among the members of a specific virtual community" (Virtual Currency Schemes, 2012).

This online exchange facility (by its very nature – the intermediary) has properties similar to physical currencies. At the same time, it allows instant transactions and transfer of ownership regardless of boundaries. Banks and customers use their keys to encrypt (for security) and sign (to identify) digital data blocks, which are wire transfers. The bank monitors remittances with its private key, and clients and merchants verify signed remittances using a public key. In turn, customers sign operations and withdraw funds using their private key, and the bank uses the client's public key to verify transactions.

The range of modern virtual currencies is represented mainly by cryptocurrencies, game money, or tokens. The virtual currency distribution environment is mostly the online world, because its benefits can be best realized and constraints can be minimized there. Giants like Apple, Dell and PayPal have already announced their plans to integrate cryptocurrencies as a payment method. The rest are likely to follow the leaders.

Today, the most popular digital currency is Bitcoin, whose capitalization peaked, according to coinmarketcap.com, over US \$300 bn. This typical cryptocurrency is based on representation of the centralized chain of records of all transactions known as a blockchain. It is a secure, distributed storage technology for records of all transactions that have been completed. Blockchain is a chain of data units, with steadily increasing volumes as miners add new blocks with records of the most recent transactions. It occurs every 10 minutes. Blocks are recorded in blockchain in linear chronological order (Swan, 2017, p. 22). This open source software allows all network partners (peers) to check every transaction that has ever been made within the system and serves as the protector of this central ledger.

The blockchain toolkit can also be implemented as a system for securing contracts and non-financial applications, including registries. The latter serve as a widespread opportunity for blockchain within the framework of modern e-governance.

There are many comparative advantages to this system of generating money and making payments compared to a regular form of real-time financial transactions. The key is to use one source, namely the Internet.

At the same time, there are many warnings that virtual currencies can be used to finance illegal transactions with goods and services, fraud and money laundering. The anonymity associated with the use of virtual currencies, such as bitcoin, increases the potential for possible critical misuse. A report by Rand Corp. (USA) on the National Security Implications of Virtual Currency published in late 2015 state that potential anonymity of VCs such as Bitcoin supports "the potential for terrorist or insurgent group usage in a manner resilient against efforts by local and global law enforcement, military, and intelligence organizations" (Rand Corp., 2015, p. ix).

At the same time, apologists of the opposite view argue that unregulated virtual currencies due to the essence of blockchain technology are a great tool in combating theft of personal data and the leakage of personal financial information.

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What is the basis for discussion of the need to regulate the electronic currency market and the possibility for central banks to issue their own e-money? In 2001, the Bank of International Settlements defined the basic principles for systemically important payment systems (BIS, 2001).

I. The system must have a sound legal basis in all relevant jurisdictions.

II. System policies and procedures should allow participants to clearly understand the impact of the system on each financial risk they incur through participating in it.

III. The system should have clearly defined credit and liquidity risk management procedures that identify the respective responsibilities of the system operator and participants, and provide appropriate incentives for managing those risks.

IV. The system should provide immediate final calculation of the asset's value on the relevant day, preferably during the day and at least at the end of the day.

V. The system where the multilateral transaction takes place at least must be able to ensure that daily calculations are completed on a timely basis if the participant with the largest single commitment to such a transaction is unable to calculate.

VI. Assets used for calculations should preferably be central bank requirements; where other assets are used, they must have little or no credit risk.

VII. The system must provide a high degree of safety and reliability of operations and must have emergency mechanisms to complete daily processing in-time.

VIII. The system should provide payment methods that are user-friendly and cost-effective.

IX. The system must have objective and publicly announced eligibility criteria that allow fair and open access.

X. System management procedures should be effective, accountable and transparent.

Today, most cryptocurrencies do not fully meet these requirements. In particular, this concerns the soundness and unity of legal framework, lack of financial risk management procedures, and possibility of forks. The latter means an offshoot of a cryptocurrency using a software project codebase as another startup. Each branch can develop independently of the main project; one branch can realize opportunities that were not in the main project. Most forks are either exact replicas of the base cryptocurrency, or differ only within the limit and emission rate and/or the hash algorithm. At the same time, this is not the rule and fork can be a fundamentally new project.

In 2014, the European Banking Authority (bank regulator) gave the most accurate, in my opinion, definition of virtual currency as a "digital representation of value that is neither issued by a central bank or a public authority, nor necessarily attached to a FC, but is accepted by natural or legal persons as a means of payment and can be transferred, stored or traded electronically" (EBA/Op/2014/08).

The central bank of the future economy number one – the People's Bank of China – announced in early 2016 that it was considering launching its own virtual currency. Beijing believes that it will promote transparency of economic activity, as well as reduce money laundering and tax evasion.

According to Yao Qin, Director of the Institute for Digital Currency Research at the People's Bank of China, the goal is to ensure that the national digital currency not to have disadvantages that characterize both fiat money and ordinary cryptocurrency – the lack of pegging to real values (Danylyshyn, 2017).

The Central Bank digital currency (also digital fiat currency or digital base money, CBDC) is a fundamentally new economic entity that has become possible on the next wave of the science revolution with introduction of Industry 4.0. Today, the professional community of central banks and academics are focused on this topic.

According to the definition of the International Monetary Fund, the CBDC is a digital form of the existing fiat money that is issued by the central bank and is the legal tender (Griffoli et al., 2018). Therefore, such currency should be exchanged without restrictions for cash or non-cash in 1:1 ratio.

Central banks consider 4 basic types (Yarova, 2019) of the CBDC and their hybrids:

1. (most famous) is essentially a digital form of cash, having the same properties: this digital currency is anonymous and no interest is accrued on it;

2. exclusively intended for companies and can be used for interbank payments;

3. accrues interest, so this currency can be used as a monetary policy tool;

an account for an individual, which is opened and maintained by the central bank. 4.

For the CBDC implementation central banks are considering the use of Distributed Ledger Technology (DLT) or classic databases. Today central banks actively study the risks inherent to the CBDC. They pay the most attention to: technology risks, cybersecurity risks, monetary policy risks, financial stability risks, and reputational risks of the central bank.

Judging from the monetary theory view at the CBDC, one can see a new form of money, different from cash and non-cash. If considered in terms of positioning within the payment services market, a digital currency should be considered as an innovative payment instrument.

Today about three dozen countries are conducting research on the CBDC. These include Australia, the United Kingdom, Denmark, Canada, China, New Zealand, Norway, South Africa, Thailand, Uruguay, Sweden, and Ukraine.

The Bank of England explores different models of interest-gain CBDC emission as a monetary policy tool (digital currency is considered as the equivalent of bank deposits). In its research, the central bank pays considerable attention to the impact of the CBDC on the sustainability of the banking system.

In China, a specialized laboratory is engaged in the study of the CBDC potential. Two types of digital currencies are being considered: for interbank payments and cash equivalent. In the last year alone, the People's Bank of China has registered more than 40 patents related to various aspects of the CBDC system creation (technology, electronic wallets, etc.). The possibility of a pilot test is being considered.

Interesting is Sweden's experience, where the share of cash is minimal. Riiksbank is about to issue the e-cruna, the digital cash equivalent. Such electronic cruna, at the expense of convenience and velocity of its use, should become more attractive than banknotes and coins, and therefore, will allow cash not to disappear from circulation at all, but to evolve into a new digital form. According to polls, this tool is the most clear for young people.

The financial regulators of Estonia, Ecuador, Japan (together with the European Central Bank) have abandoned the idea of issuing their own digital currency for various reasons. The central banks of Switzerland and South Korea also have skeptical views on the prospects of issuing the CBDC. Among the probable causes, these countries cited the unpredictable impact of the CBDC on the macroeconomic situation and financial stability.

There are few countries which decided to implement the pilot projects. Singapore's MAS supervisor implements the 'Ubin' Project which involves the use of the CBDC for interbank payments. A similar 'Jasper' Project is being implemented by the Bank of Canada. Within the partnership, the regulators of these two countries conducted the first cross-border operation with CBDC. In a joint statement, they announced that the purpose of the projects was to increase speed and security, as well as to reduce the cost of such operations.

Notwithstanding hyperinflation, Venezuela's experience is of particular interest. In 2018, the government of this Latin American country launched the El Petro cryptocurrency which is a publicly available, identifiable and profitable tool. However, it cannot be considered a CBDC, since its quotations are tied not to the country's currency but to the price of energy resources. In addition, the issuer is the government, not the central bank.

The CBDC pilot projects implementators mainly pursue two goals: (1) to increase financial inclusion, and (2) to reduce cash use. Another goal declared by researchers – to reduce operating costs of payments – is least in demand.

In Ukraine, this trend has some specific features. It is not possible to make 24/7 interbank instant payments using bank accounts, and payment cards are the most common national payment tool with the appropriate infrastructure. These fix a tendency for card-to-card (P2P) transfer operations to increase.

As the part of NBU's Electronic Payment System modernization and transition of the Ukrainian payment infrastructure to the international standard ISO 20022, the National Bank informed about its consideration to introduce instant payments (National Bank of Ukraine, 2019), which will significantly increase the speed of such payments.

In 2016–2018, the central bank of Ukraine implemented a pilot project studying the possibility of launching its own CBDC – the "electronic hryvnia" ('e-hryvnia'). №9, 2019

The CBDC scheme as cash equivalent was chosen for the study, which provides that:

- e-hryvnia is considered as digital money issued by the NBU;
- e-hryvnia is fiat money;
- e-hryvnia should be exchanged without restrictions to cash or non-cash in 1:1 ratio;
- e-hryvnia is not a profitable instrument (i.e. it is a payment, not accumulation tool).

The National Bank considered issuing both anonymous and identified e-hryvnia, as each option had its advantages and disadvantages. The project considered two alternative options for top-level participant interaction models: centralized or decentralized.

The centralized model (Fig. 1) assumes that the National Bank is the sole issuer of e-hryvnia and that commercial market participants perform service (agency) functions. E-wallets are accounted in the single centralized registry of the Platform, owned and operated by the only NBU. The decision to include any transaction in the register (transaction validation) is made solely within the National Bank's information resources.



**Figure 1.** Centralized Model of Issuance and Circulation of e-hryvnia Source: The National Bank of Ukraine.

Other banks and non-banking financial institutions under this scheme are the agents of payment and distribution of e-hryvnia, provide users the access to the Platform through their online resources, and provide clients with other services: secure key storage, providing applications for mobile devices, convenient provision of information about customer operations and more. E-hryvnia wallets can be both identified and anonymous, which can affect the size of e-hryvnia transaction limits compared to e-money transaction limits.



**Figure 2.** Decentralized Model of Issuance and Circulation of e-hryvnia Source: The National Bank of Ukraine.

In case of a decentralized model (Fig. 2), banks and non-bank financial institutions would be entitled to issue e-hryvnia under the control of the National Bank. With this model, e-wallets of clients, traders, agents are conducted in a decentralized manner – separately in the information systems of each issuer. The NBU provided the possibility of using e-hryvnia in the networks of traders and/or agents when executing settlements of other issuers. Issuers in their e-hryvnia service systems could support both no e-hryvnia user identification model and the partial/full user identification.

E-hryvnia, issued by commercial market participants, will no longer fall under the definition of the CBDC, but will be a digital currency in terms of its properties, similar to electronic money.

The National Bank conducted a practical pilot project, within which a limited amount of e-hryvnia (equivalent to UAH5,443 which was about US \$200) was issued, transactions were tested by NBU staff and members of the initiative group only.

There were such operations successfully tested: operations such as e-wallets opening on the blockchain platform, putting money on e-wallets and repayment of e-hryvnia (reverse exchange for traditional hryvnia), P2P transfers between users, as well as trading operations. In particular, it was possible with e-hryvnia to top up the balance of a mobile phone (mobile operator LifeCell) or make a charity contribution to help the soldiers of the Ukrainian Army.

The testers of the project could manage e-wallets through mobile E-hryvnia applications for smartphones. All operations with e-hryvnia were performed instantly and for free.

Summing up the results of the pilot project, the NBU came to the following conclusions (National Bank of Ukraine, 2019, p. 36-37):

1. E-hryvnia, as a tool for instant retail payments, has the potential to become an alternative to the existing means and tools of retail payments, such as cash, payment orders, payment cards, and electronic money. The advantages of e-hryvnia include ease of use, safety (repayment and settlements are guaranteed by the NBU), as well as the speed of acquiring the user status and the settlement speed.

2. Considering that the Pilot Project had a limited list of transaction types and a limited range of users, as well as the minor quantity and volumes of executed transactions, the project did not fully uncover the instrument's attractiveness and the potential level of involvement of Ukraine's population in using it. Thus, it is hard to predict the number of Ukraine's citizens to become e-hryvnia users if the decision to implement e-hryvnia at a national scale is taken.

3. E-hryvnia may be considered as the disruptive technology, since it has the potential to change the ecosystem of Ukraine's payment market and reassign the current roles of market participants.

4. Implementation of e-hryvnia is impossible without major investment and time needed to upgrade the payment infrastructure for this instrument. The reason is that Ukraine's market of payment services is characterized by high competition and concentration as well as the established infrastructure.

5. For e-hryvnia to become a truly mass product, it should be promoted to the population bearing in mind the existing customer habits.

6. Implementation of e-hryvnia in Ukraine's payment market should be in line with the possible implementation of other innovative payment instruments, including instant payments and new Open Banking instruments.

7. The distributed ledger technology (DLT, blockchain) can be used as a platform for e-hryvnia issuance and circulation. However, main advantages of the technology, including the absence of a single centre of trust and the capability of any person to check any transaction, cannot be used together with the centralized e-hryvnia issuance model. Thus, it is not critical whether this technology is used if the centralized model is chosen. The mentioned advantages would be more efficient for the decentralized model of e-hryvnia issuance versus the centralized one.

8. The private version of the Stellar blockchain protocol, which has been tested under the Pilot Project, was functioning in the regular mode and may be used in local (bank-level) electronic money systems after some finalization. We cannot use that version to build the national-scale system, as it is practically impossible to update it following the development of the basic Stellar blockchain protocol. Instead, the national-scale system can be designed on the basis of one of the public versions of modern powerful blockchain protocols.

9. On the one hand, involvement of volunteers in the Pilot Project helped save money considering the high cost of software solutions and high labour costs, but on the other, it turned out to be ineffective. External participants of the Pilot Project prioritized their commercial activities over the work on the project.

10. The business model requires further thorough consideration by the payment market participants. The Pilot Project's participants and the NBU had not reached the consensus regarding an e-hryvnia tariff/commission model in the course of respective consultations. Zero commission fees were set for all e-hryvnia transactions for the period of pilot testing.

11. The NBU showed its capability to implement similar projects. The Pilot Project involved limited personnel from eight structural units (the internal working group). Bringing the project to the national level requires major human resources.

12. Only anonymous e-wallets were used in the Pilot Project, however, the further development of e-hryvnia may come with the full or partial user identification under the KYC principles, inter alia, to increase the transaction limits. The further implementation of e-hryvnia should incorporate the AML/FATF requirements to the limits on the balances of e-wallets and the volumes of transactions.

13. The implementation of e-hryvnia should be regulated by law.

14. E-hryvnia may be implemented in Ukraine's payment market using one out of two alternative models of interaction: the centralized and the decentralized models. Under the decentralized model, e-hryvnia will no longer be classified as CBDC, since it will be issued not by the central bank but by payment market participants under the regulator's control. For both models, the issue of choosing an optimal basic technology remains open. The main benefits of the distributed ledger technology (DLT) may be leveraged more effectively with the decentralized model versus the centralized one.

15. If the centralized model is chosen, the NBU will perform non-typical duties of working with individuals (including the dispute resolution).

#### Conclusions

The introduction of an inclusive, cheap, secure and functional retail payment tool remains the challenge of the international payment market. In the context of the existing needs, digital currency, and in particular the CBDC, can be considered as an alternative tool for making payments to individuals and legal entities when making routine purchases.

Introduction of digital currency by central banks will increase the convenience of transactions in digital systems. Special software devices, including electronic wallets might be used for this purpose, which allow to save money, add money to the accounts and make purchases on Internet portals. This can be done without using a "main" bank account.

When creating a reliable and high-speed system of verification, clearing and payments, the share of digital trade in goods and services will definitely increase. Moreover, it will intensify the global economy's shift towards cashless economy.

The issue of digital currency by central banks will effect on reducing the banking fees via international and national payment systems (due to increased competition). This will not only have a positive impact on sellers of goods and services, but also reduce customer costs.

Unlike the launch of alternative digital projects, implementation of CBDC will not remove monopoly of money emission from central banks. At the same time, introduction of the central bank digital currency will require careful prescribing of the peculiarities in the legislation with the necessity to fill the legal gaps, as well as preserve the ability to settle and keep assets in other, more traditional (conservative) forms.

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# Safety and Risk Management Aspects of **Oil and Gas Pipeline Operation**

# **ARGYRIOS KRANIAS<sup>9</sup>**

Abstract: The paper concentrates on in-depth analysis of safety and risk management principles and methods of oil and gas pipeline operation and how the hazard identification, risk assessment and successful contractor relationship can improve the process of safety management. Regarding the methodology, the article is based on a comparative critical analysis associated with the effectiveness of specific safety and risk management practices, models and performance indicators that are applied by Oil and Gas multinational companies so as to keep their pipeline operations reliable and safe. The case study of this paper consists of two Oil and Gas pipeline owner Companies. The first Company is going to operate its Greek pipeline project in Northern Greece crossing Albania and the Adriatic Sea, before coming ashore in Southern Italy. The second Company is responsible for planning, construction and operation of its Russian pipeline project through the Baltic Sea that will transport gas from the world's largest reserves in Russia. The pipeline projects have not yet operated and they are currently in the construction phase. The research findings and conclusions will answer the research purposes, delineating the critical views of the author.

Keywords: Safety and Risk Management Practices and Models • Hazard Identification • Risk Assessment • Contractor Relationship • Oil and Gas Pipeline Companies • Pipeline Operation

## Introduction

The safety and risk management field has created a significant concern in all midstream activities of the oil and gas industry value chain in association with pipeline operation. The safety is now front and centre in this segment. It has a great bearing on risk analysis and hazard identification and its associated effects on the Company's business activities, performance and reputation.

Statistic surveys have indicated that occupational accidents result in nearly 2.3 million deaths daily and incur economic costs over 2.8 trillion dollars globally. According to the Training Institute of the Occupational Safety and Health Administration (OSHA, 2014), nearly 3 million serious work related injuries and diseases were reported by private industry employers in 2012 and more than 4,000 workers were killed on the job. Currently, an average of 12 workers dies daily and injuries occur every 9 seconds.

According to the Bureau of Labor Statistics of U.S. Department of Labor (2017), occupational injuries involving transportation incidents remained the most common fatal event in 2016, accounting for 40% (2,083) compared to 2015 (2,054).

Hence, ensuring that pipelines work in a safe, reliable and effective way is crucial to the oil and gas industry and transportation. It is the irreplaceable premise for oil and gas companies to undertake a wide range of safety methods and measures and risk assessments in order to prevent and mitigate accidents and incidents from occurring on their pipeline operation.

The purpose of the research is twofold. The first purpose is to investigate how the multinational oil and gas Companies can effectively prevent the associated safety hazards and risks around the pipeline operation and mitigate possible harmful effects to their workforce, business environment, financial performance and reputation. The second purpose is to examine how the hazard identification, risk assessment and successful contractor relationship can improve the process of safety management in oil and gas pipeline operating system.

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#### **Literature Review**

The oil and gas industry and transportation is considered as one of the most dangerous and hazardous industries globally and the need for effective safety and risk management is crucial to Companies so as to protect physical security of workers, create more reliable and safe workplaces and keep their pipeline system integrity. The safety and risk management methods and practices play a fundamental role in tackling safety and risk challenges, improving personnel safety and mitigate workplace risks, creating better, more reliable, efficient and safer working environment. The effective preventative measures by risk assessment, hazard identification, training; stronger personal protective equipment (PPE) and proper human factor can reduce occupational accidents, permanent disabilities and economic losses (OSHA Training Institute, 2014).

The pipeline sector is highly exposed to safety hazards and certain specific risks related to the accidental release of oil and gas or any potential gas leakages and oil spillages, ruptures, explosion incidents, inappropriate construction of equipment or any operational problem in the pipeline that are daily occurrences within the midstream activities of the oil and gas industry (Kassinis, 2015). The pipelines can be also exposed to external impacts (third party damage), human error hazards and natural safety threats, such as extreme weather conditions, earthquakes and hurricanes. As such, an effective corporate safety management system is crucial to prevent these pipeline failures (Goodfellow and Jonsson, 2015).

With the recent rapid economic and technological globalization, the safety aspect of the oil and gas pipeline operation has taken on such importance that many developed countries and Government Agencies have instituted laws and regulations in order to help and provide a safe, healthful and reliable working climate (Zwetsloot, 2003). The subject of safety covers a wide context of important issues like safety of workers and managers, an effective safety management system and pipeline integrity management. The desire to develop safe and productive work conditions, which produce happier employees, managers need to install a comprehensive safety and implementable management programme that ensures a safe and reliable environment where accidents and diseases are mitigated and incidents are prevented properly (Gustin, 2008).

Inkpen and Moffett (2011) also mention that oil and gas companies argue that personnel safety is at the forefront and they claim that safety is an essential tool for business because safe operating working conditions create a discipline that is transferable to other aspects of the project. The workforce can be staffed with safety professionals, and education of national workers on safety will be an important field for project development, especially when projects are in countries that have had limited industrialization.

Goodfellow and Jonsson (2015) argue that a safety management system must be implemented consistently across operational programmes, like personnel safety, asset integrity, damage prevention, emergency management, premises and geographic regions. This management system should be also significantly integrated to share information and knowledge to promote a better decision-making process.

Mohammadfam et al (2016) have evaluated the performance of the Occupational Health and Safety Assessment Series (OHSAS) 18001 specification in certified companies in Iran and they found that the performance of certified companies in terms of occupational health and safety management practices is significantly higher than that of noncertified companies and the companies with the certification of OHSAS 18001 have a greater level of occupational health and safety in the workplaces.

The safety concern can be very difficult and complicated task for Oil and Gas multinational companies (MNC's), which do business worldwide, expanding their activities through entry strategies like joint ventures and they employ hundreds of workers and working with contractors from different countries with different cultural practices in relation to the education, learning, training and skill level. All these differences may have a profound impact on the safety policy of international business.

Oil and Gas MNCs vary along a whole number of cultural dimensions in the field of safety, involving management commitment, teamwork, work pressure, communication, compliance and conformance with rules and procedures, or organizational learning and training. The effectiveness of the corporate safety management system is based on the intention of top management to demonstrate a long-term serious commitment in order to prevent any occupational injury and incident or disease.

Lu and Yang (2010) have mentioned that a strong safety culture can be achieved in an organization by the supervisors' leadership skills. The supervisor's attitude plays a significant role in preventing the acceptance of health and safe work practices, policies and procedures. The supervisor's task, as a leader, is to identify potential safety hazards and suggest methods to address or eliminate them (OSHAcademy, 2016). Safety culture, thus, is considered as an important leadership implication for the company and the key to eliminating pipeline failures and human errors that cause many incidents (CEPA, 2016).

According to the Ground Accident Prevention Program (2007), developing and maintaining, effectively, a safety pipeline management system is not solely the responsibility of the safety senior manager or coordinator, but it is the responsibility of everyone within the company. The understanding and acceptance of everyone within the company can significantly contribute to the success of safety management system.

The effective development of a Pipeline Integrity Management System (PIMS) is essential for incident or failure prevention, which can cause important financial costs to the company, such as maintenance and production costs. Such system can reduce the likelihood of asset risks around the pipeline pressure equipment, block valve and pigging stations. The success of such management system incorporates a strong foundation of safety culture.

Each oil and gas pipeline Company, as a regulator, should apply a set of golden rules of safety to eliminate any hazardous situation that can occur throughout its pipeline system. A number of these safety rules are crucial to the way in which every worker carries out tasks safely and reliably (Shafiyev, 2016).



**Figure 1.** Basic Set of Safety Golden Rules Source: compiled by the author based on (Shafiyev, 2016).

As shown in Figure 1, all the golden rules of safety are applicable to the oil and gas pipeline operating system in order to inspect along the pipeline by driving a vehicle or to check the block valves and pigging stations in confined space entry.

Every year, pipeline owners handle regular inspections and monitor to prevent oil spills and gas leakages or any other pipeline failures by ensuring pipelines are built and operated to be as safe as possible (CEPA, 2016). One most common way of pipeline inspection is the inspection through intelligent pig, a barrel shaped device that is travelling inside the pipeline using sophisticated magnetic sensors to identify and quantify anomalies on both the inside and outside of the pipeline wall, such as ruptures and welding defects.

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Monitoring and defect detection also play a significant role in operating a safe pipeline system. Pipeline owners are continuously monitoring their pipelines 24 hours per day and 365 days per year from their remote control centres, which have been regarded as the hub of pipeline operating system (CEPA, 2013). Monitoring through Supervisory Control and Data Acquisition (SCADA) systems to gather information from sensors installed along the pipeline route. This information is then transmitted back to the control centre. In the control room they evaluate the data and decide if necessary action is required to keep the pipeline integrity, minimizing any leakage.

According to OSHA (2018), one of the main causes of occupational pipeline accidents and injuries is the failure to identify or define related hazards that are present or that could have been expected and they can cause harm to personnel, damages to assets and major losses of revenue. Therefore, developing an effective risk pipeline management that incorporates hazard identification and assessment of risk incidents prevention and mitigation barriers is crucial to avoid any pipeline failure or explosion incident.

The implementation of a safety barrier status panel has become an increasingly important aspect of risk pipeline management. Major accidents and diseases can occur, as presented in the Figure 2, by 'cheese slices with holes' in the so-called *Swiss Cheese Model* (Hoem et al. 2017). These holes can be characterized as barrier failures or weaknesses and the barriers are considered as a physical risk control or reduction measures, such as pigging devices and SCADA systems. Accidents occur when all these barriers fail (Shafiyev, 2016).



**Figure 2.** The 'Swiss Cheese' Hazard Barrier Model Source: compiled by the author based on (Reason et al., 2001; Hoem et al., 2017, p.77).

Another effective risk analysis method for risk control and mitigation can be developed through a *Bow-tie model*. This model includes operating and technical hazard analysis, external and natural hazard analysis as well as human error hazard analysis (Shafiyev, 2016).

The *Bow-tie model* is based on a fault tree which presents the causes or the risk factors of a hazard or failure and an event tree which shows the consequences of a hazard. The fault tree and event tree comprise the effective graphical methods in this model (Lu et al. 2015). Figure 3 shows the basic structure of a general Bow-tie model.

The fault tree of this model includes the preventative barriers which prevent risks of major incidents or accidents. The left side of the model represents the event tree that incorporates the mitigation barriers which decrease the accident or incident consequences. However, there could be some gaps, omissions or problems that seem like holes in barriers (Lu et al. 2015).

Lu et al. (2015) analyzed the consequence assessment system of the bow-tie model into three categories: personal unwanted occurrences, losses of revenues and environmental damages. Personal unwanted occurrences can be always applied to evaluate the consequence caused by explosion or combustion and they can lead to potential harm to surrounding people workers and residents. Accidents can cause materials and equipment degradation or production loss as well as major financial loss, including maintenance costs.



**Figure 3.** Risk Analysis Method through Bow-tie Model Source: compiled by the author based on (Rheinboldt, (no date); Lu et al. (2015), p.125).

The Bow-tie model is always applied to the oil and gas pipeline operation in order to avoid or reduce serious leakages, spillages or explosion accidents, defining and eliminating the risk level of its operating system because natural gas diffuses and combusts easily, resulting in a potential explosion accident (Lu et al. 2015). For instance, Figure 4 illustrates Bow-tie model application to a potential combustion or explosion accident.



**Figure 4.** Bow-tie Model Application to Oil and Gas Pipeline Operation Source: compiled by the author.

Hence, all the above barriers should be adequately maintained and monitored to be reliable and effective (Shafiyev, 2016). In order to ensure an efficient risk management, it is important everyone involved has to fully understand why all these barriers must be always in place at any time.

The execution of tasks, activities and technological services that are essential for implementation of a large-scale interstate pipeline to transport oil and gas across countries is a staggeringly complex and capital intensive process. It is difficult for an Oil and Gas Company to accomplish the project goals and challenges regarded to timely completion, quality, costs and revenue. The process of successful and reliable contracting can contribute significantly to the future success of the pipeline project (Schramm et al. 2010).

There are thousands of companies worldwide of all sizes, ownerships and business activities that provide specialized services, equipment and materials needed in this midstream segment. Thus, each oil and gas company requires working with many contractors and subcontractors, building a reliable and safe relationship during development, construction and operation of the pipeline asset (Inkpen and Moffett, 2011).

A successful oil and gas contractor relationship shall take account of the contractor selection criteria. The total management of an Oil and Gas Company, that understands the importance of safety, can use these criteria in order to take a more effective decision that is not based solely on cost. The OSHAcademy (2016) emphasizes on five criteria:

• *Total Recordable Incident Rate* (TRIR). This indicator is used to report occupational injuries. It is considered as the average number of work-related injuries incurred by 100 employees during an accounting period and compares accident and injury statistics across industries, segments and from one year to the next. This indicator quantifies the company's safety performance. It is important to record all hours related to company's operations and verify that occupational injuries actually occur (Chappel, 2018). This rate can be calculated as follows:

TRIR (Total Recordable Incident Rate): 200,000 X number of recordable injuries divided by the total number of worked hours. The lower TRIR is the better safety performance. If the number of worked hours is increased without any more recordable injuries or incidents, the TRIR improves and goes down (Chappel, 2018).

- Past safety performance
- Site Specific safety plan development
- *Key management and worker experience*

Using these selection criteria will not only result in working with higher level of contractor safety, it will also result in choosing a contractor that will be more professional, creating a more reliable relationship and engendering trust in all the contracted activities that will be performed.

#### **Research Results**

This paper tries to delineate a comparative critical analysis associated with the effectiveness of specific methods, models and performance indicators that are applied by Oil and Gas multinational Companies to their large-scale interstate pipeline projects on the basis of the safety and risk management principles. The first Greek pipeline project will transport natural gas from Azerbaijan to Europe via Northern Greece that crosses Albania and the Adriatic Sea, before coming ashore in Southern Italy. The second Russian pipeline project through the Baltic Sea will transport gas to Europe from the world's largest reserves in Russia.

The Greek pipeline project has tailored its management system to the requirements of OHSAS 18001 in relation to occupational health and safety performance. This project has applied a model that is based on the Plan-Do-Check-Act (PDCA) cycle in effective pipeline integrity management. The PDCA cycle is described in Figure 5.



**Figure 5.** The PDCA Model Source: compiled by the author.

The first arrow (Plan) of the model is the planning process, which refers to the hazard identification and risk management, legal and other requirements, objectives and programs. The second phase (Do) allocates responsibilities, roles and resources and includes training, communication, consultation and stakeholder management, as well as documentation and record management and emergency response. The third phase (Check) comprises:

- The performance measurement, monitoring and reporting
- The conformance/compliance evaluation and auditing
- Incident reporting and resolution.

The phase of Act analyzes the management review. There is a continuous improvement process between the arrows plan and act (TAP Project Health and Safety Plan, 2017).

The Greek pipeline project has developed eight Golden Rules of Safety, which serve as simple reminders on conducting the work safely and keep people safe both at construction sites and when travelling.



Figure 6. Greek Pipeline Project's Golden Rules of Safety

Source: compiled by the author based on (BP's Golden Rules Booklet, 2015).

Following all the above eight golden rules will help anyone, like managers, workers or contractors who carry out, or are responsible for, eight activities:

- Conduct better pre-job risk assessments
- Facilitate safety inspections
- But most importantly prevent injuries and accidents

Figure 7 illustrates the risk analysis method through the Bow-tie model to the Greek pipeline project in order to reduce the probability of risk of an extraordinary event or an explosion incident. The preventative barriers in Figure 7 describe the risk factors of this project and the mitigation barriers develop a consequence assessment to minimize the incident consequences.



**Figure 7.** Bow-tie Model Application to Greek Pipeline Project Source: compiled by the author.

The contractor selection criteria of the Greek pipeline project are based on performance measuring indicators, such as the Total Recordable Incident Rate (TRIR) recorded by 1.98 in 2017. The TRIR was calculated and reported by the Company per million worked hours, and the contractor's certified health and safety management system, in 2018, to international standards of the OHSAS 18001 (Bonatti, 2018).

Weekly the management of the Greek pipeline project and contractor clarification meetings will be held to ensure the Contractors Health and Safety Management System principles are applied to the project's requirements as specified above. This could take the form of a mini-review or workshop (TAP Project Health and Safety Plan, 2017).

On the other hand the corporate management system of the Russian pipeline project has been certified in 2014 to OHSAS 18001:2007 requirements and it was successfully recertified in 2017 (PJSC Gazprom annual report, 2017). This management system is regularly audited for compliance with OHSAS 18001:2007 standards by the Russian Register Certification Association for natural gas and oil exploration, production, transportation, processing and storage. These certifications and audits improved the occupational

health and safety performance of the Russian project, decreasing significantly the occupational accidents and injuries.

The management of the Russian pipeline project cooperates with contractors willing to improve constantly their safety culture and achieve their goal of safe working environment with zero incidents.

This contractor relationship has developed a programme of ten specific golden safety rules designed to keep safety. This programme is presented in Figure 8. Each of these rules focuses on top hazards giving clear guidance on how to avoid serious injuries and even death.



**Figure 8.** Russian Pipeline Project's Golden Safety Rules Source: compiled by the author.

The managers of this project monitor the contractor compliance to its own golden safety rules. The Contractor strives to make the everyday perfect health, safety and environment (HSE) day to return in their family with no injuries, no accidents or no harm to the environment. These ten rules are an important piece of the corporate safety culture.

Figure 9 presents the risk analysis method through the Bow-tie model and mitigation to this pipeline project in order to avoid unwanted events or explosion incidents. The preventative barriers in the above figure can reduce the probability of the risk to personnel and pipeline assets. The mitigation barriers can minimize the human impact and losses of revenues.



**Figure 9.** Bow-tie Model Application to Russian Pipeline Project Source: compiled by the author.

The contractor selection criteria of the Russian project are based on the health and safety performance indicators of the contractor against industry benchmarks published by the International Association of Oil & Gas Producers (IOGP) and the International Pipe Line and Offshore Contractors Association (IPLOCA) as part of the evaluation. The management of this project has taken into account all the health and safety performance metrics to select the contractor. For instance, the Total Recordable Incident Rate (TRIR) recorded by 0.39 in 2017 (BHGE HSE Annual Report 2017).

## Conclusions

The article focuses on how multinational oil and gas companies can effectively manage the associated safety threats and risks around their large-scale interstate pipeline operation and what they are doing to ensure their pipeline integrity and their personnel safety. This paper, also, analyzes how the hazard identification and an effective risk analysis can improve the process of safety management through the *Swiss Cheese* and *Bow-tie* barrier models.

The strongest preventative barrier of risk analysis for the Russian pipeline project is the process safety management through pigging procedure and leak detection. The project, especially, applies a multibarrier control of people, processes and equipment to avoid safety hazards throughout the pipeline project. This project has, also, developed an employee health and wellness programme that enhances the safety attitudes and behaviour. On the other hand, the strongest pranentative barrier for the Greek pipeline project is the implementation of a defensive driving safety program through the In-Vehicle Monitor System (IVMS) to each project vehicle, reducing more effectively the risk of a serious car accident. This project, also, has more effectively managed the pipeline integrity with the development of the PDCA model, inspection schedule that should be recorded with any corrective actions undertaken and the Behavior Based Safety (BBS) process to manage any unsafe work.

This paper has also found that a successful contractor relationship for the design, construction and operation of the pipeline system contributes importantly to the future success of the project integrity and safety. The comparative critical analysis of the article indicated that the management of the Russian pipeline project has more successful contractor relationship based on selection criteria than that of the Greek pipeline project. The contractor of the first project has presented much better safety performance indicators, such as TRIR, and has acquired more certifications and external audits around the occupational health and safety management system as well as many qualifications in pigging services and leak detection that are important contributing factors to pipeline failure prevention.

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# **Strategic Planning for Overcoming External Market Entry Barriers**

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Abstract: The purpose of the article is to summarize the strategic planning processes at each stage of an enterprise's entry into foreign markets. Based on the study of the set of barriers to entry into foreign markets and the cost of overcoming them, strategies for overcoming barriers to entry into an external market are summarized, which are: adapting to the requirements of the external market; evasion strategy to overcome barriers to entry into a foreign market; indirect entry into a foreign market; and prolonged entry into a foreign market. The matrix of choice of strategy of overcoming barriers is formed depending on the barrier level of the external market and the subject of influence on possibilities of overcoming these barriers of entrance. The hierarchical ordering of strategic planning processes has been formed. Stages of entry of the enterprise into a foreign market are generalized, barriers that arise at each of the stages are identified and strategic measures to overcome them are formed.

Keywords: Strategies • External Market • Overcoming Entry Barriers • Planning • Market Entry Stages

### Introduction

In the current economic conditions, the growth of national production volumes necessitates expansion to markets for its realization. However, along with the growing potential of national production, Ukrainian export opportunities to traditional foreign markets are limited. In view of this, one of the ways to implement a business growth strategy is to enter new foreign markets that have significant consumption potential, but, like traditional markets, these are protected by a set of administrative, economic, cultural, and organizational barriers.

Investigation of the system of enterprises' overcoming entry barriers has identified high export barriers to new foreign markets, which confirms the need for joint efforts of the government and exporters to assess the height of barriers and develop strategic measures to overcome them. Government efforts should be aimed at forming a number of interstate agreements on economic cooperation, in particular, on coordination of veterinary certificate forms, granting preferences in trade relations, mutual approval of currency conversion procedures and terms, etc.

The structure and dynamics of external market entry barriers are currently changing; both the number of non-tariff import restrictions is increasing and the nature of requirements for products exported to foreign markets are changing, which necessitates the need to manage barriers based on the existing strategies and long-term plans for their implementation.

Therefore, the efforts of the exporter should be implemented in the field of development of an economically sound strategy for the enterprise's entering into a foreign market based on complex analysis and evaluation of market entry barriers and assessing the possibilities and abilities of the enterprise to overcome them.

The authors rely on and analyse recent research and publications where the problem is solved and select previously solved parts of the general problem to which the article is devoted. Strategic approaches to overcoming foreign market entry barriers have been explored in scientific research by Baldyniuk, A. (2013;

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2015), Kovtun, E. (2017), Kuzmina, O. (2000), Lipich, L. (2011), Lomiychuk, V. (2015), Marchenko, V. (2017; 2019), Fatenok-Tkachuk, A. (2011). At the same time, despite considerable scientific interest in the study of entry barriers, the theoretical and methodological support of the process of enterprises' overcoming entry barriers into new foreign markets require further scientific development. The presence of the different nature of the origin of barriers in external markets necessitates development of a portfolio of strategies to overcome them and a set of measures for their implementation.

#### **Research Results**

The strategy of overcoming external market entry barriers should be interpreted as a systematic logically orderly set of actions to choose the approach, methods, tools for fulfilling the set of administrative, customs, economic, market requirements on the way of entry of enterprises into external markets.

Formation of the strategy of overcoming external market entry barriers is based on the following axiomatic provisions:

- each foreign market has a set of characteristics which have developed under the influence of evolutionary, cultural, religious, economic patterns of their development;

- each foreign market has a different degree of attractiveness for business entry;

- the attractiveness of the external market is formed under the influence of a number of both common to all markets and specific indicators of attractiveness;

- the choice of the strategy of overcoming entry barriers is influenced by both types and height of barriers in each external market;

- the criterion for choosing an external market is the ratio between the revenues from implementation of the market entry strategy and the cost of overcoming barriers to such entry;

- a foreign market entry strategy is based on the estimated height of entry barriers and the cost of overcoming them.

Given the need to overcome external market entry barriers, the exporting strategy to new foreign markets is implemented by carrying out the following tasks: fulfillment of administrative requirements of foreign markets (certification and licensing); change of production technology in accordance with the consumer preferences of external markets and safety criteria; search of indirect ways of entering the market of the selected country; prolongation of terms of beginning export activity.

The strategy of overcoming entry barriers is determined by the external market barrier level and the internal capabilities of the company to overcome the set of the existing barriers. Since external markets differ in the nature and origin of the barriers, as well as their carriers and height, which shapes different strategies and behaviour of enterprises. Therefore, it is possible to form a portfolio of strategies to overcome external market barriers in accordance with the export tasks.

Based on the study of the set of external market entry barriers and the cost of overcoming them, strategies for overcoming entry barriers to external market are summarized. They include a strategy for adapting to the requirements of the external market; a workaround strategy to overcome external market entry barriers; a strategy of indirect entry into the foreign market; and a strategy of prolonged entry into the foreign market.

The strategy of adaptation to the requirements of the external market is a set of actions related to the formation of a plan to fulfill the requirements that are a prerequisite for entry into the relevant external market, in particular the requirements for the subject of a future agreement regarding implementation of administrative procedures and ways of organizing the entry of the subject of the agreement ( products, investments) into the external market.

The strategy of adaptation to the external market is implemented by adapting the subject matter of the agreement and procedures for entering the market to both official requirements and market traditions.

A workaround strategy for entering an external market is a set of actions to achieve the strategic goals of enterprise's entering a high-barrier foreign market by choosing a way to enter through transit markets.

Workaround entry into a closed foreign market is implemented in a cascading way, by importing products into markets with low barriers to entry (transit markets, or hubs) and then supplying them to the target import market.

A workaround strategy for overcoming entry barriers works through the use of several methods, including through industrial cooperation with the enterprises of the transit country, through direct investment in capacity building in the target market country, or through combined use of the above opportunities. Businesses have experience in using the last way to implement this strategy in entering the EU market to organize the supply products with tariff quotas to the target market.

The strategy of indirect entry into external markets is a set of actions to build multi-channel logistics chains of product distribution with participation of international and national intermediaries.

Given that oligopolistic trading companies operate in most foreign markets, this method of penetrating an external market is sometimes the only way to enter.

The strategy of prolonged entry into the external market is a logically generalized model of actions that realize the goal of preparing production and goods for future exports. Production preparation consists of a set of actions to meet the relevant requirements of the target market in terms of providing technological features of production (drying, conformity of production to international standards, certification of raw material suppliers, etc.).

Generalization of enterprise entry strategies has made it possible to investigate the appropriate sequence of their implementation, depending on the level of the barrier of the external market and the company's internal capabilities to overcome external market entry barriers.

The availability of all the necessary resources to overcome the external market entry barriers allows enterprises to implement a workaround or adaptive strategy.

The choice of the strategy of overcoming external market entry barriers to is conditioned not only by the term of realisation of the strategic goal, the barrier level of the external market, but also by the subject of influence on the possibilities of overcoming the entry barriers. Indeed, if the company has the capacity and ability to overcome external market entry barriers, workaround and adaptive strategies provide the opportunity to get the best export performance.

Providing that barriers can be overcome with the participation of the exporting country in the form of intergovernmental economic cooperation agreements, with the veterinary authorities of the importing country on the form of the veterinary certificate, the enterprise can implement a prolonged or indirect entry strategy through the use of international intermediaries.

If barriers arise in the territory of the importing country (organization of distribution channels, currency, payment, barriers to competition, etc.), enterprises implement the strategy of prolonged entry (in case of bans on imports of products), the strategy of indirect entry (on condition of monopolization of retail trade, high competition, barriers to currency conversion, etc.) and a workaround strategy (in case of trade preferences in third countries).

The matrix approach of expressing the relationship between the barrier level of the external market and the subject of influence on the ability to overcome entry barriers allows choosing strategies that are consistent with the potential of enterprises to overcome barriers and entry into the foreign market (Table 1).

**Table 1.** Matrix of Choice of Strategy of Overcoming of Barriers(depending on the external market barrier level and the subject of influence on possibilities of overcoming<br/>entry barriers)

External market	Subject of influence on possibilities of overcoming entry barriers					
harrier level	Overcome by exporters	Overcome by exporter's	Overcome by importer's state			
	Overcome by exporters	state				
High level	Workaround Strategy	Prolonged Entry Strategy	Prolonged Entry Strategy			
Medium level	Adaptive strategy	Indirect Entry strategy	Indirect Entry strategy			
Low level	Adaptive strategy	Indirect Entry strategy	Indirect Entry strategy			

Source: developed by the authors.
The formed strategies of overcoming external market entry barriers allow choosing the type of strategic behaviour of enterprises that corresponds to the level of barriers of the external market and the internal capacity of enterprises to overcome the set of the existing barriers.

Strategic planning includes development of strategic decisions (in a form of forecasts, programme projects and plans) that provide for formation of such goals and strategies for behaviour of respective management units whose implementation ensures long term effective functioning of enterprises and their rapid adaptation to changing business environment.

Planning of overcoming external market entry barriers measures is an important part of implementation of the strategic plan of the enterprise (Fig. 1).

The essence of strategic planning to overcome entry barriers lies in formation of a set of organizational, marketing, economic measures to meet the requirements for enterprise's products' access into external markets and determine the amount of resources required for their implementation.

Barriers arise at different stages of the enterprise's entry into external markets. The stages of this entry are devide into time periods within the total time of implementation of the export strategy.

The main stages of an enterprise's entry into a foreign market are: foreign market research; preparation for market entry; market entry; fixing oneself on the market.

Each stage of the enterprise's entry into an external market is realized through fulfillment of a set of tasks in order to perform a complex of analytical and organizational work. Each task solves the problem of overcoming the barriers that arise in the way of the company's entry into foreign markets.

Thus, at the stage of foreign market research, a potential exporter deals with a set of tasks, such as: analysis of mental, cultural, historical barriers; tariff and non-tariff restrictions on exports; competition barriers; interstate agreements that facilitate intensification of foreign economic relations between different entities; and peculiarities of doing business in the importing country.





- 1. Reputational
- 2. Organizational
- 3. Competence-based
- 4. Contractual
- 5. Diplomatic

# Ways to overcome external market entry barriers

- 1. Fulfillment of requirements
- 2. Production cooperation

3. Transfer of obligations to a third party

4. Production in the importing country

**Figure 1.** Hierarchical ordering of strategic planning processes Source: developed by the authors.

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Assessment of the external market entry barrier system an external market generates an information sample for calculation of the market barrier index. The purpose of this stage, which is to select the most potential markets, is achieved on the basis of comparative analysis.

The barriers to implementation of the stage of foreign market research are existing standards and eating traditions in the importing country; absence of interstate agreements; lack of the embassy of the exporting country in the importing country; absence of country's membership in regional customs and other economic unions; high rates of import; availability of non-tariff restrictions and tariffs on imports; low purchasing power of the population; low per capita consumption of meat; high requirements for certification of products and production; currency barriers; special packaging and labelling requirements, and more.

Taking into account the existing entry barriers, the solution of the tasks is based on implementation of planned measures aimed at overcoming the barriers based on an objective assessment of the barrier level of potential markets.

Strategic measures to overcome market entry barriers during the foreign market research phase are: research on external market entry barriers; creating a list of countries with defined barriers; calculation of the market barrier index; forming a list of advantages of entering the relevant market; comparative analysis of countries by barrier level; and forming a sample of potential markets.

In the strategic plan of export of products of meat industry enterprises, the stage of preparation for entering the market accomplishes the tasks of choosing the strategy of overcoming entry barriers to selected potential markets and planning of logistics infrastructure abroad.

The whole set of planned activities at this stage is aimed at overcoming the barriers to its implementation. Based on generalization of an array of enterprises' external market entry barriers, the following are considered to be most significant among them: lack of strategy for external market entry; overestimation of the potential of the enterprise; technological mismatch of products to the needs of the foreign market; low level of consumers' awareness of planned for export products; low level of organizational culture of product sales; monopolization of production distribution channels; and lack of export infrastructure. Strategic measures for overcoming entry barriers at the stage of preparation for entry are: setting export goals; choosing export strategies and strategies to overcome the relevant market entry barriers; preparing presentation materials in the language of the importing country and in English, which take into account the mentality and national characteristics of the cooperation region; defining consumer requirements for products in the target market; assessing competitive advantages of exported products; determining the conformity of quality parameters of products to the needs of foreign market consumers; possible technological improvements of products; brand and product promotion; search for potential partners; establishing contacts with potential buyers; arranging meetings with potential buyers and business partners; packaging and labelling of products according to the requirements of the potential foreign market; establishing contacts with potential partners - distributors, buyers, logistics and other companies that will provide business infrastructure abroad; building up a plan of delivery of products; monitoring possible delivery methods: modes of transport, choosing optimal and alternative delivery routes.

The market entry stage is the period of time during which the set of organisational and financial actions ensuring the exporter's access to the target market is realized. This stage is implemented due to organizational and financial planning of actions to overcome the respective barriers. Financial barriers to entry into the target foreign market are low profitability of products in this market; high logistics costs; problems of converting the currency of the importing country into foreign currency; failure to meet the deadline for payment for delivery; financial fraud and more.

The main financial planning measures are developed in the action plan to calculate the aggregate costs associated with exporting products; ensuring compliance with pricing and overcoming entry barriers strategies; and managing payment and currency risks.

Organizational planning to overcome entry barriers is a system of actions to secure and legalize the exporter in the external market.

Barriers to planning a set of organizational measures are: restricted access of foreign investors to national production; participation of the counterparty state in the authorized capital of the newly created enterprise; and international laws not applied on contractual relations.

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Set organizational measures used by exporters when entering an external market are determined by exporters' goals (long-term or short-term consolidation in the relevant market), financial capabilities of the exporter, determined by the time of implementation of the chosen strategy. The organizational planning system uses both measures related to planning of opening a representative office in the target foreign market and the mergers, acquisitions or construction of new meat processing enterprises. Legal position in the external market allows a company to attract foreign financing and crediting of international economic contracts.

Successful realization of a set of preliminary stages of an enterprise's entry into the foreign market provides opportunities for anchoring of the enterprise in the given market and growth of its export potential. The main barriers to securing an enterprise in the foreign market are competitive barriers, limited potential for market share growth, low growth in numbers, income, purchasing power of the population, growth in consumption per capita and so on. Strategic measures to overcome barriers at the stage of market entry should include: calculation of costs of entry into potential markets, choice of pricing strategy for exporting products to the relevant market; choice of method of calculation of export price within the chosen price strategy, comparative analysis of export price and prices of meat products of potential foreign market, calculation of the effectiveness of the future agreement, choice of methods and forms of payment for the delivered goods, organization of commercial representation in the country of import, construction of an enterprise abroad , mergers and acquisitions, a joint venture.

Overcoming external market entry barriers at the consolidation stage is carried out by a complex of marketing measures to support, expand and activate product sales. Strategic measures to overcome the barriers at the stage of consolidation of the enterprise in the market are: protection of intellectual property; intensification of a set of marketing tools for product distribution; expansion of product range; geographical diversification of exports; building trust and positive business reputation; arranging meetings with potential buyers and business partners, etc.

#### Conclusions

Enterprise's entering into a relevant market is a long-term process of overcoming entry barriers of this market, which, as defined above, can be overcome by a set of organizational, technological, and economic actions aimed at meeting the requirements of the external market to implement exports based on an appropriate strategy for overcoming foreign market entry barriers.

The process of entering an external market is generalized implementation of a certain set of actions at each of the aggregated stages: foreign market research; preparation for market entry; market entry; and consolidation on the market. Since a set of administrative, organizational, financial, mental, logistical barriers occurs at each of the stages, these stages are implemented successfully only if the set of planned actions is aimed at achieving the purpose of each stage.

Generalised and systematised measures of the strategic plan of overcoming entry barriers into new foreign markets allows enterprises to develop a set of actions of the exporter upon entering the foreign market for each of the presented strategies, and based on this to form a road map, operating schedule and cost structure for their implementation.

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**RESEARCH MATERIALS** 

## **Change Management for Oil and Gas Supply Chain by Exploiting State of Art Information and Communication Technology**

MICHAEL CONSTAS<sup>12</sup>

Crude oil is delivered in two ways, either through specific pipelines or loaded onto ship tankers and/or rail freight. Along the Supply Chain, the crude oil is usually transported and stored in specific tanks. Transport conditions cannot prevent complete sealing of tanks, resulting in Greenhouse Gases (GHG) being eliminated into the atmosphere. The emissions of GHG in the atmosphere are proportional to the quantity and mode of crude oil transportation.

The most common and practical way of transporting gas is through distribution pipelines. Through the compression stations, the Natural Gas is distributed throughout the pipeline system. GHG emissions are related to the number and size of compression stations along the transmission pipeline system.

As it is known, in spring and autumn, which are low demand seasons, NG is stored in underground formations or as LNG is stored in tanks above the ground. The rest of the times, when there is great demand, NG is available through the system either for processing or for consumption. (US Environmental Protection Agency, 2016).

However, technology is divided into many types and kinds of implementations. According to Wikipedia, technology is defined as the collection of techniques, skills, methods, and processes used in the production of goods and services. Technology starts from the scientific investigation, which is based on the knowledge of scientific knowledge, processes, and integration. Essentially, technology depends heavily on the applied science, which should have as a fundamental purpose to improve the human daily life in every way.

Nevertheless, the successful implementation of new technological innovation in the business depends on any factors. A new technological infrastructure requires an especially great deal of attention on the part of the enterprise Administration, as there is the risk of failure. A possible failure could lead to painful results for the company's sustainable future, as thoroughly presented in the Section.

Digital Opportunities for Oil & Gas Supply Chain Sector. The oil and gas supply chain sector has reached the pinnacle of the turning point of era with substantial changes. Digital transformation promises new interesting opportunities for operators, service companies, and suppliers – however, it is a double-edge sword. The digitalization is focused on a particular group of companies. The opportunities which digitalization offers at this stage are expected to have a strong impact of the operators.

the sector (Deloitte in Scotland, Clark, No. 2017).

The development of Information Technology (IT) has given enterprises an additional competitive advantage to an extent that affects their sustainable future over their competitors. The Supply Chain sector is primarily a business sector which needs for big data to work properly (Jadhav, 2015, p. 369).

For example, a gas company could receive a notice of any gas supply disruption from dwellings and specific points where the problem occurs, identifying the source of problem more easily. The software would show to the map, the point of occurrence of a possible leak.

The combination of these scientific disciplines opens the developments of autonomous programmable systems combining robotics and machine learning for designing robotic systems to be autonomous. It is in this area where autonomous functions and IoT can realistically allocate Internet of Robotic Things (IoRT) technology (Vermesan, 2016b).

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For industry analysis methods of PESTLE (Political – Economic – Social – Technological – Legal – environmental) Analysis and SWOT will be used. Nowadays, the economic and business environment is unstable; it is rapidly and constantly changing. For this reason, the contemporary companies are forced to implement a business strategy. 'Strategy is the direction and scope of an organization over the long term, which achieves advantage in a changing environment through its configuration of resources and competences' (Johnson et al., 2009).

In this sector the European political environment for the oil and gas supply chain industry will be analyzed. The energy needs of the European market in liquid and gaseous fuels require large and durable supply chains.

This means that the European energy market requires large-scale investments to this sector. There are many important differences in the oil and gas distribution way.

The gas supply chain consists of Exploration and Production:

• Delivery to connected transmission pipelines or liquefaction, sea transport, import, gasification and input to transmission pipelines;

• Transmission, storage and bulk supply to large consumers directly connected to the transmission system and to distribution companies;

• Distribution, storage and retailing of gas to industrial, commercial and residential consumers.

• The rest of the developed world expert for the US, the price of natural gas is affected by the supply chain and distribution way to the end-user. Gas is usually traded on long-term contracts. This feature is the major difference from oil products.

Thus, the European Commission adopted specific legislation on Third-Party access and open access to the infrastructure. The commensurate EU Regulations govern the competition in gas distribution which is applicable in the EU pipeline system.

The oil supply chain comprises:

- Exploration and production;
- Transportation by pipeline, rail or ship;
- Refining of petroleum products;
- Storage and distribution of products by pipeline, rail, road tanker or ship;
- Retailing to final customers.

In addition, management of human resources, i.e. attraction of the suitable skilled career staff, is a very serious issue. Unfortunately, a large part of the current skilled staff is near retirement. The existing know-how should be transferred to the new generation of staff in conjunction with new expertise. To a very large extent, the recovery of the oil and gas industry requires selection of the right human resources (Wall Street Journal, 2017).

An important issue that has an economic impact is development of environmental responsibility by the industry companies. This development is a factor of pressure on O&G companies by both governments and civil society. Therefore, the O&G companies have to invest in environmental protection programmes to reduce the negative impact of their activities (Lakhal et al., 2009).

In addition to environmental protection, the O&G companies should contribute to socio-economic prosperity in the regions where they operate. Investing in the Corporate Social Responsibility (CSR) programmes is a factor that will positively contribute to building a relationship of mutual respect between the industry companies and the wider society (Sadaghiani, 2014, p. 24-25).

According to the US Energy Information Administration for November 2017 Short-Term Energy Outlook (STEO), it is estimated that the price difference between West Texas Intermediate (WTI) crude oil price at Cushing, Oklahoma, and Brent, the global benchmark of crude oil price will reach about \$6/barrel through the first quarter of 2018 before narrowing to \$4/b during the second half of 2018. WTI averaged \$2/b lower than Brent price through the first eight months of 2017 and averaged \$6/b lower than Brent price in September and October (EIA, 2017, p. 1a).



**Figure 1.** GERD as a percentage of GDP Source: developed by the author based on (OECD, 2017).

The WTI price spread with Brent reflects the transportation costs associated with bringing crude oil from Cushing to the U.S. Gulf Coast and with exporting crude oil to Asia, the marginal market in which Brent and WTI crude oils compete (EIA, 2017, p. 2a).

The oil and gas sector is one of the most important sectors that these are involved in development and promotion of Companies' Social Responsible (CSR). This is obviously due to their activities dangerous for the environment and social wellbeing, as there have been quite a few accidents causing major damage to the environment and wider areas.

The procurement of raw materials is a starting point that affects the SCM and sustainability practices (Mehregan et al., 2014). The industry must maintain good relations with the respective governments which

have the political, economic and legal power to enact and enforce regulations (Edwards et al., 2010).

This pressure is a challenge for companies, which have to adapt their operation. A factor that would certainly help in this direction is the educational institutions. Another pressure factor is the competitors trying to gain more market share. The cooperation with competing companies to explore sustainability solutions and improve their profitability is imminent (Sadaghiani, 2014, p. 28-29).

The Information Systems need to interconnect various individual functions of the Supply Chain. It becomes clear that the IS supports decision-making. The continuous improvement of such systems is a really difficult challenge for software companies (Lima, Relvas et al., 2016, p. 1).

As shown on Figure 1, there has been Gross domestic expenditure on R&D (GERD) for new technologies as a percentage of GDP. If Switzerland's line is excluded, all the rest are stable. The lowest line belongs to Turkey and ranges between 0.80 and 0.88 degrees of axis Y. Axis X shows the years 2010 -2015.

The role of the Management IS is to facilitate making appropriate and effective decisions in real time. It is very important to choose the right IS for decision-making, which will be able to cooperate with the other enterprise IS. Suitable management information systems are able to process data from individual business segments and direct management to set targets for the next five years.

The issues that the digital transformation should focus on are the following four bullets:

• Digital asset life cycle management – Through computer applications, a typical business can gather data that will allow it to have a flexible strategy in the decision-making process.

• Circular collaborative ecosystem – Integrated embedded systems can enhance cooperation between the stakeholders in the company's ecosystem, contributing to the development of innovation, the cost reduction, and increased transparency in transactions.

• Beyond the barrel – Specialized customer service models offer flexibility and personalized packages. The new technological innovations create value for customers with new opportunities for the industry companies.

• Energizing new energies – The electronic management of energy systems helps new energy sources by upporting optimization of energy trading models. These possibilities offered by technological innovations must be fully understood by the industry. (World Economic Forum, 2017a, p. 4).

For instance, modern offshore drilling platforms have approximately 80,000 sensors exporting about 15 Petabytes or 15 million Gigabytes of data of them. This data volume provides information for the lifetime of the asset. This information may be useful for subsequent drillings by the company. Since the optimal data management requires a powerful distributed network as a server.

It is estimated that 36% of companies are making investments in this direction. However, only 13% of them seem to have set their business strategy and policy as the main goal of the technological evolution of their companies. This relative inactive on the part of the companies proves that the executives have not been particularly well informed about the usefulness of digitalization. However, full digitalization could benefit corporate productivity and efficiency. (World Economic Forum, 2017b, p. 9).

A remarkable example of usefulness of AI is the Mohaghegh software, which allows the shale analysis to be exactly 135 times more than the traditional way. It is a hybrid modelling software that combines artificial neural systems, fuzzy set theory, and genetic algorithms. (Braswell. 2013a, p. 3b).

The operation of terminals is regulated by the relevant public agreements. In Norway, the legalized system on oil and gas transportation and storage is regulated by the Petroleum Act. Part of the oil activities fall ithin the scope of the instrument (Lexology.com, 2017).

During the period of 1990-2008, the oil market showed growth of around 0.2% a year, culminating in 2005. Three- years later, until 2008, it showed a fall of 3% (EU, 2010a, p. 7). The eight-year period (2000-2008) saw an increase in the supply of heavier fuels from third countries by 5%. One reason that influenced dependence on third countries was the reduction of the North Sea crude oil production from 6.4 mbd (2000) to 4.3 mbd (2008).

Greenhouse gas production, gas venting and flaring, release of hazardous/volatile gases and greenhouse gases, odour, and climate change are some of these factors. Also, dust and noise in local air quality cause:

• Natural hazards and risks such as eruptions, inflammation and explosions, land and water pollution, and toxic spillages;

• Contamination of the aquifer from the drill muds and cuttings;

• The cost of living organisms from the pressure on natural resources;

• Climate changes, such as extreme weather, sea level rise, temperature rise and water availability;

• Regulatory risks – increasing regulatory burden as development moves into new and more challenging geographies and less well-known technologies.

The main objectives of technological development should not be only commercial and industrial efficiency, but should also help to improve environmental awareness. Especially in the O&G sector, it has to make major contribution to its more environmentally friendly operation. Improving environmental quality is a great challenge for technology (Roland, 1998, p. 1a).

The impact of technology on energy markets has profoundly affected the costs and quality of supplying energy services. In our days, one kilowatt-hour of electricity can be delivered to individual households at a much lower price, with greater regularity, with less variance in frequency, and often with less harm to the environment than only 2 or 3 decades ago (Roland, 1998, p. 1b).

In the coming years, the industry is expected to experience a great challenge as mankind begins to turn to most environmentally-friendly and efficient solutions for energy production. The main alternative suggestions are development and dissemination of RES and use of nuclear energy. The greatest prospects are revealed in the use of hydrogen, fuel cells, upgraded nuclear power technological innovations, and natural gas (Roland, 1998, p. 2).

The potential of the above challenge is faced through the revolutionary technological developments. The exploitation of shale rock for oil and gas production has reduced the demand for oil from OPEC countries, a group of the world's major oil-exporting nations, to influence global oil prices (Brooking.edu, 2017a).

Three additional areas have been relatively untouched by innovators but could be huge market opportunities (Venturebeat.com, 2012):

1. Mineral extraction innovation Only a fraction of venture investment goes into energy technology, and only a small portion of that goes into hydrocarbon related technologies. Even fewer dollars go into supporting mining and minerals industry.

2. Financial innovation to manage commodity volatility Oil and energy prices are extremely volatile.

3. Improved pipeline technology The world needs cheaper, easier, and more environmentallyfriendly pipelines. Pipelines are incredibly expensive to install – so much that outside the United States, it is rare for them to be financed without any type of government sponsorship (either direct or indirect).

Unmanned Flying Vehicles or Drones could have an environmentally friendly effect, as they could carry out aerial surveys on the safety of pipelines, means of transport, ground and marine installations, and storage and fuel stations. The drones can travel at 150km/hr for 70 minutes and can detect leaks, vandalism, vegetation and encroachment on the pipeline.

The oil and gas sector currently depends on road vehicles and helicopters to detect any damage or threat. However, both these methods are more expensive, and less efficient than drones. A drone collar enables round-the-clock, unlimited data collection, which can be provided in real time and offers more information for users (hydrocarbonstechnology.com, 2017).

As a result, it is expected that they will avoid many unpleasant situations to save many human lives and to avoid the dangerous exhaust gases. This potential is expected to save both business and financial resources for the enterprise. A phrase says that "Prevention is better than destruction". When something can be prevented this can be avoided.

In recent years, self-driving vehicles are growing rapidly to the point that many of the largest automakers are studying how to apply this innovation to their line production. When driving conditions get bad, autonomous trucks will be better, and safer, than those with a human behind the wheel. A typical example of difficult conditions for a conventional driving truck is the Canadian highways with the frozen road surface (cbc.ca, 2017a).

The autonomous trucks will change the operation of typical supply chains in most industries. Many goods and things must be transported via the road traffic system. These roads are very dangerous for the human factor. The electronic assistance systems may help drivers to pass these difficult points with more security for their lives (cbc.ca, 2017c).

According to Statistics Canada, truck driving provides nearly two per cent of all Canadian jobs, more than three per cent of jobs for men. There is still shortage of drivers, but as autonomous trucks flood into the market, the demand for those workers will plunge (cbc.ca, 2017g).

Much like the evolution of smartphones and tablets, wearable technology has been well received by early dopters and it is now poised to grow into a leader of the consumer electronics market. Wearables are devices worn on the body for extended periods of time that have advanced circuitry and independent processing capability (Hanuska, 2016, p. 1a).

Nowadays, new technological innovation has been developed that is expected to influence the future working conditions for many economic sectors. In the near future, the smart clothes could inform in real time the current situation of a worker, who will be found on the road with his truck and he will transfer products to other places. Through the biometric sensors, the exact situation of the driver will be recorded.

For example, if he is very tired, he should stop to relax. The crew on a tanker ship wearing the specific smart vests will be absolutely safe as its real-time health status will be monitored 24 hours a day.

The Energy, Power and Natural Resources industry is simultaneously experiencing resurgent growth in traditional resources through new exploration and generation technology, while also facing the pressure and opportunity for renewable and smart energy in the future. While each sub-sector faces different issues, one thing is common, the data can take advantage of it along with the data virtualization for oil and gas benefits (Denodo.com, 2017a).

Figure 2 illustrates the proposed model for the relationship of these technological trends.



**Figure 2.** The Relationship between technologicsl trends Source: developed by the author.

On ice-covered roads, the driver is exposed to the risk of either sticking to snow or slipping on ice. With the assistance of a powerful Drone, the weather and road conditions can be recorded along with the route that an be estimated. If the further journey is quite dangerous for the driver, a sort of automatic pilot fitted to truck could take over.

In this case if the Drone shows that the point is very dangerous and, therefore, inaccessible to signal the driver to stop at the point where it is located in order not to risk its physical integrity. The use of the smart vest would inform the business of the driver's health status, the data from Drone and the truck's computer could help to better understand an accident or a particular driver's problem. The combination of Drones and virtual reality with the help of special cameras reflects the inside and current state of oil and gas pipelines.

The analysis of the data is expected to develop some type of Mechanical Knowledge, which will provide mechanical learning and information in the enterprise. The competitive advantage, which will arise, is a wealth of real scenarios that could help to solve similar problems in the future.

#### Conclusions

The international community wants to decrease the GHG emissions. The main reason is to reduce the negative and harmful effects of the Greenhouse phenomenon. Of course, technology is a promising tool to achieve the desired reduction.

1. Which are the difficulties and opportunities of Change Management Process in the O&G Supply Chain sector in the modern and technological era?

- The environmentally friendly difficulties and opportunities of new era sector;

- The administration should have defined the goal, vision, and purpose. First, leadership should define the clear vision of the desired situation from the goal for change;

- Business communication is not only useful to customers, but it is equally necessary with employees and executives. And in this case, there are a few companies that failed to change due to the poor or non-existent communication between the administration and the staff.

2. Which are the technological trends that influence the future and modern businesses? How do they influence the transformation of the specific sector?

- Digital opportunities will influence the future of the whole spectrum of the supply chain;

- The Internet of Things, smart devices, mechanical learning, and robotics are taken into consideration.

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3. How these technological trends will influence the environmentally friendly transformation of Oil and Gas Supply Chain Sector?

- This is expected to combine other special information on meteorological, traffic, and current cargo status data. And, of course, it will help optimize decision-making. On the one hand, this could assist in the safety of the human agent who drives the truck whenever he is aware of the weather conditions ahead of him. On the other hand, it will help to secure the load;

- The appropriate software with censors at the closest checkpoints from the leak point would detect a loss of pressure and alert the company's manager accordingly by means of an application on their smartphone. At the same time, the software will instruct the valves to isolate the pierce of the faulty pipeline automatically without human interference, by alerting people that are near the point via sonic shadow.

4. Conclusions of PESTLE Analysis:

The predominant way of gas transportation is through the specific pipelines where large-scale investments are required. For years, the European gas market had operated as a monopoly. This caused the need for broadening of the gas market. Thus, the European Commission had adopted specific legislation on Third-Party access and open access to the infrastructure.

The modern business era is expected to be affected by new technological innovations and requirements of environmentally friendly global policy. This sector has been charged with a large proportion of environmental pollution worldwide;

The above bullet has some main reasons for technological change management in this sector. The natural disasters have caused several environmental accidents in the oil and gas sector around the world. Perhaps, the technology could help the sector to improve its safety and efficiency for the reduction of its environmental impacts.

The main objectives of technological development should not be only commercial and industrial efficiency, but it should also help to improve environmental awareness.

5. How the combination of technologies and technological trends could affect the operation of the Oil and Gas Supply Chain Management sector?

- Appropriate technological inventions have been already developed to cooperate with each other. New technological innovations lead to artificial intelligence. In this case, all the technological achievements are designed to interact with each other;

- The technological combination will influence every financial transition that is relative with the technology. The entire of oil and gas industry is a sector that has direct need for IT support;

– It is next that the subsector of Oil and Gas Supply Chain Management will be affected by the technological changes in the industry.

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## **Review of Contemporary Practice of Plastic Marine Pollution Abatement**

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#### Introduction

The twentieth century was characterized by intensive development of industry, transport, energy, and industrialization of agriculture. All these processes have led to the fact that the human impact on the environment has become global.

The world ocean has experienced the biggest impact of human activity. As a source of life it needs to be conserved and protected. But now the oceans are at real environmental stress caused primarily by human lives and activities. For example, a study of the North Sea showed that about 65% of the pollutants found there were brought by rivers from factories. Another 25% of pollutants came from the atmosphere (including 7,000 tons of lead from vehicle emissions), 10% from direct discharges (mainly wastewater), and the rest from overflows and waste discharges from ships (Buskey, White, & Esbaugh, 2016).

The oceans play an incremental role in the functioning of the biosphere, due to the fact that 70% of all oxygen on the Earth is produced as a result of plankton's photosynthesis that affects the climate and weather. The world ocean, with oceans, closed and semi-enclosed seas, is the most important source of life support for the world's population.

The main reasons for ocean pollution are localization of large agglomerations in coastal areas (more than 60% of all major cities are located on the shores of the seas and oceans), large-scale and uncontrolled fishing, systematic destruction of whole ecosystems, e.g. coral reefs, contamination from household and industrial waste, pollution from harmful and toxic substances, etc. Ocean water is polluted from oil and petroleum products, iron, phosphorus, lead, pyrite, phosgene, radioactive substances, pesticides, plastics, and various metals. The most polluted areas are the waters of the Persian Gulf and the Gulf of Aden, as well as the waters of the Northern, Baltic, Black, and Azov Seas.

One of the largest pollutants of ocean water is oil due to the collapses of oil carriers; accidents at offshore oil fields and oil extraction from the seabed. Oil spills contribute to 12% of the oil in the ocean, while 36% of the oil comes from runoff sources from cities and companies. Oil waste poisons the sensitive marine and coastal organic substrate interrupting the food chain on which fish and sea creatures depend and on which their reproductive success is based (Buskey, White, & Esbaugh, 2016). Also, oil floating on sea currents and sailing to the coast made many resort zones unsuitable for rest and bathing. In addition, radioactive ocean contamination is constantly occurring through leaks in nuclear reactors or

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from sunken nuclear submarines leading to radiation changes in the flora and fauna. Many nuclear states, such as the USA, Great Britain, Japan, and South Korea have used the oceans to deploy nuclear submarine missile warheads and dump spent nuclear waste.

Every year the waters of the oceans are increasingly polluted by waste from the chemical industry. Thus, a tendency of increasing amount of arsenic in ocean waters was noticed. Ecological balance is significantly disrupted by the heavy metals of lead and zinc, nickel and cadmium, chromium and copper. All sorts of pesticides, such as endrin, aldrin, and dieldrin, also have a detrimental effect on marine inhabitants.

Plastic waste is one of the tremendous threats to the world ocean. Almost one million plastic bottles are consumed every minute worldwide. According to a study done by the University of Georgia, 18 billion pounds of plastic trash ends up in our oceans each year (Cózar et al., 2014). Subject to scientists' survey, if this process is not stopped, then by 2050 the mass of plastic in the water will exceed the mass of all fish in the ocean. In our project, we would like to emphasize the problem of plastic as one of the greatest obstacles of global water preservation.

#### **Research Results**

*Impact of Plastic Pollution on Oceans.* Plastic is a major global ocean pollution source (Fig. 1). It is spread across all oceans with wind and global ocean currents and can be found in remote locations such as the Arctic, Southern Ocean and deep oceans. Marine plastic pollution is a disturbing problem due to its complexity, permanent growth and the pervasive impacts on all aspects of ecosystems. The issue requires urgent environmental remediation solutions at a global scale.



Figure 1. Major Activities and Objects of Infrastructure Directly Contributing to the World Ocean Pollution.

Source: Adapted from (Kershaw, 2018, p. 35).

Every year, about 8 million tons of plastic worldwide flows into the ocean creating a disruptive influence on the health of the ocean and sea life (Fig. 2). Plastic decomposes for more than 450 years but some scientists believe that plastic does not decompose at all – it just breaks down into pieces, which eventually become smaller and smaller. If no actions are taken, our planet will be covered with plastic even before it begins to decompose.

Furthermore, in 1950, people produced about 1.5 million tons of plastic waste. After 65 years, according to the UN research data, this number has increased 200 times – 300 million tons, with a significant part of this rubbish remaining not recycled (Ritchie & Roser, 2018). In 2010, the total amount of unprocessed plastic weighed 32 million tons. By 2025, scientists predict an increase in the total volume to 100-200 million tons, and the volume of plastic rubbish by 2050 can grow to 33 billion tons. Subject to the UN study, more than half of the plastic ocean waste comes from five countries: China, Indonesia, the Philippines, Vietnam, and Sri Lanka. The most polluted part of the world ocean is the northern part of the Pacific Ocean.



**Figure 2.** Estimated amount of plastic invading the marine life and its location in the ocean. Source: Adapted from (Pravettoni, 2018).

Floating on the surface of the water, plastic garbage blocks sunlight, which is dangerous for the life of plankton and algae. They play an essential biological role in the food chain and ecosystem maintenance, producing the necessary nutrients. The extinction of plankton and algae, which are food for other sea creatures, will entail the extinction of other species, including those consumed by humans. In addition, plastic is dangerous since it does not decompose in water for a long time, cools and it is covered with algae. Sea garbage becomes dangerous food for local inhabitants (the plastic fills their stomachs, they cannot digest it and starve to death), and also often causes their physical damage (entanglement in nets, packaging materials, etc.). For example, when a whale died in 2018 in Thailand, 80 pieces of plastic rubbish weighing eight kilograms were found in its stomach. Scientists predict that by 2050, 99.8% of seabirds will be exposed to plastic consumption. Taking small plastic granules for eggs, the birds feed them their cubs, which leads to their early death. Plastic also has the ability to accumulate toxins in its granules, which are transmitted to marine inhabitants that consume them instead of food; this results in genetic problems, poisoning, and accumulation in bodies. Thus, through the food chain, it is transmitted to other animals, and also reaches humans. There are many surveys proving that plastic is contained in human bodies.

Simultaneously, plastic marine pollution has negative social impacts. Firstly, it reduces recreational opportunities, since plastic pollution can discourage people from visiting affected areas or using coastal areas for swimming, diving and a number of water sports. Secondly, a coast littered with plastic does not look as pretty and welcoming as a pristine beach. Moreover, plastic garbage is a threat for public health and safety as entanglement of anchors in abandoned fishing gears and fouling of a vessel's propeller are sometimes the cause of vessel breakdowns and in extreme cases, can lead to loss of human lives (Van Sebille, Spathi, & Gilbert, 2016).

According to scientists, the volume of garbage in the oceans is constantly increasing, and this process is accompanied by the growth of "garbage patches" – huge clusters of waste created by ocean currents. Such major currents are present in six points of the world ocean: North Pacific (east and west currents), North Atlantic (in the Sargasso Sea), Indian (in the central Indian Ocean), South Pacific and other tropical ocean currents that collect garbage. The largest garbage island, known as the Great Pacific

Garbage Patch, occupies up to 1% of the Pacific Ocean. Subject to the estimates, 80% of the garbage comes from ground sources, 20% is thrown from the ships in the open sea. Scientists claim that waste from the west coast of North America moves to the centre of the whirlpool in about five years and from the east coast of Asia in a year or less.

Such huge waste production has serious consequences both for the environment and for the world economy: according to the UN calculations, losses from the pollution of the seas and the world ocean make about \$ 8 billion annually. This takes into account the damage caused by ocean rubbish in such areas as fishing, aquaculture, sea tourism, as well as the cost of cleaning. Thus, every year the sea garbage is worth 622 million dollars in the tourist industry, and the annual losses of the fishing fleet of the EU reach 81.7 million dollars a year. If governments in different countries manage to save the biological diversity of the ocean, they can get different benefits from its development, for example, new raw materials or even cures for cancer. The most dynamic areas of the 'ocean economics' are use of sea wind energy, cultivation of various aquaculture (fish, seaweed, etc.), and fish processing.

Development of the World Plastic Recycling Market.

Plastic recycling is a mechanical and/or chemical process of recovering plastic waste or scrap discarded during plastic product production (pre-consumer plastic waste) or after the use of these products by consumers (post-consumer plastic waste). Plastic recycling is not only economical, but also helps to reduce carbon emissions (Gu, Guo, Zhang, Summers, & Hall 2017).

Way of recycling	Description	Advantages	Disadvantages
Mechanical	Converting discarded plastic into new products, principally by melting and molding. This process takes plastic back to liquid form and then reshapes it into new products to be sold on the market.	The macromolecular nature of the polymer is not destroyed, so that the degradation reactions that directly affect the physical and chemical properties of the polymer and, at times, and its appearance, are minimized and controlled. There is an 80 to 90% reduction in energy consumption by producing recycled plastic compared to producing plastic from virgin materials (oil and gas).	Only high-quality plastic can be recycled through this process in order to be effective (commonly PET or PP).
Chemical	Focuses on destabilizing of plastic back to its original compounds. Uses depolymerisation and decomposition reactions to convert polymers into low-molecular- weight products. This is the process of intense heat, pressure and chemicals, such as acids or alkalines that break down plastics back down to their original form.	Creates important products like oil or gas that can be used as a fuel or in creation of any kind of plastic.	Hazardous nature of chemical products themselves.
Energy	Energy recycling basically uses high temperatures to incinerate plastic to be used as energy in forms of steam and electric power.	One of the easiest processes of recycling that doesn't require much sorting and sifting and can use plastics of lower quality.	No new products are produced.

**Table 1.** Basic Ways of Plastic Recycling

Source: Adapted from "Life Cycle Assessment of a Plastic Packaging Recycling System" by U. Arena, M. Mastellone, & F. Perugini, 2003, *The International Journal of Life Cycle Assessment*, 8(2), p. 92.

Plastic recycling has obvious advantages. Plastic recycling substantially decreases the energy usage, consumption of fresh raw materials, water pollution, and air pollution by reducing the need for conventional waste disposal and it diminishes greenhouse gas emissions as well. On the other hand, the market for recycled plastic has a number of drawbacks. The limited volume and liquidity of the market are among them. In addition, the scope of trade is insignificant and prices are highly unstable. The share of plastic recycling is also small compared to the total plastic output; it is also much lower than recycling of other materials, such as steel, aluminium, and paper. Plastic recycling rates, as well as plastic types, are distributed unevenly around the world.

Opening borders for plastic waste will make recycling more efficient. Different countries can carry out different processes in accordance with their comparative cost advantages, thereby significantly augmenting the share of plastic wastes being exported (4% in 2015) (Gourmelon, 2015).

There are several ways in which plastic can be broken down and recreated. The first one is through mechanical recycling. It is the process of converting discarded plastic into new products. The second way is chemical that implies very high temperatures and chemicals. The third one is energy. It is simply conversion of waste into energy.

The recycling process includes plastic collection, sorting, sifting, cleaning, and remaking. There are different types of plastics, that is why sorting and sifting are inevitable part of the process. Plastic can be divided into the following categories: polyethylene terephthalate (PET), high density polyethylene (HDPE), polyvinyl chloride (PVC), low density polyethylene (LDPE), polypropylene (PP), polystyrene (PS), and others. Plastic can be filtered manually as well as automatically. During the latter the system analyzes the chemical structure of wastes and speeds up the process. Most of recycled plastic belongs to the HDPE that includes plastic bottles and packaging products. The second largest category is PET which mostly consists of the plastic bags (Floyd, 2016). Cleaning is usually carried out using high temperatures. It can also be useful to evaporate excess moisture. When the wastes are already sorted and cleaned, they are to be recycled.

The total value of the global plastic recycling market was \$34.80 billion in 2017 and it will expand in the next years. That will be driven by the growing demand for recycled plastic in different industries such as packaging, textile, automotive, and construction. Asia Pacific accounts for major share of the global plastic recycling market, with China leading the market. China used to be the leading importer for waste plastics: almost 56% of the global import of plastic waste and 40% of the world plastic production. The largest exporters of plastic waste to China were Hong Kong, the United States, Japan, Germany, the United Kingdom, France, Canada, and Italy in 2016. Taken together, G7 countries accounted for around half of all the exports of plastic waste to China in 2016. The monetary value of this trade amounted to \$0.9 billion. China imported plastic because it required affordable secondary plastics to meet the increased demand for plastic products. China plastic recycling greatly depended on the import but the situation has changed. In 2017 the People's Republic of China renounced the WTO and the Basel Convention about the Transboundary Movement of Hazardous Wastes and Their Disposal related to imports of solid waste that have significantly affected trade. In 2017, Beijing issued a list of 24 kinds of solid waste that it would no longer accept from the beginning of 2018, including plastic and paper. Total solid waste imports fell by 48 percent in 2018, and China eventually aims to block all imports that have readily available domestic replacements (Walker, 2018). The stated rationale for both regulations was protection of the environment and of human health, which is consistent with China's rights and obligations as a Party of the Basel Convention (Geyer, Jambeck, & Law, 2017).

The disruptions resulting from recent restrictions on the import of plastic waste to China highlights the poor functioning of domestic markets for recycled plastics. There is a basic co-ordination failure lying at the heart of this issue. Potential suppliers of recycled plastics do not invest sufficiently in sorting and recycling capacities because profitability of these operations is limited. Potential buyers have limited incentives to use recycled plastics as inputs because of uncertainty about their availability and quality. Market outcomes could improve significantly if these issues were addressed.

Many domestic recyclers have tried to move their facilities to other Southeast Asian countries (Stanway, 2019). But change of the waste plastic flows could be problematic, especially for mixed plastic waste collected from households which is very difficult to recycle. If recycling capacity and treatment standards are less stringent in the recipient country than in China, this could lead to an increase in regional and global environmental impacts. It will also hinder investment in domestic facilities capable of producing higher quality recycled materials.

One of the main problems of plastic recycling industry is present virgin plastic production. It is very difficult for recycled plastic producers to compete with traditional plastic manufacturers. To deal with this, governments should develop a policy aiming to support plastic recyclers. Such measures will level the opportunities for both fields. It may include taxes on the use of virgin plastics; reform of support for fossil fuel production and consumption; implementation of recycled content standards, targeted public procurement requirements, or recycled content labelling; creation of consumer education and awareness campaigns in order to stimulate demand for products containing recycled plastics.

#### Undertakings within the Framework of Ocean Plastic Contamination.

The majority of garbage pollution in the world ocean consists of plastic products. These products can be divided into macroplastics (>1 m), common macroplastics (<1 m), microplastics (<2.5 cm), and nanoplastics (<5 mm). In general, macroplastics derive from lost fishing nets, traps and agricultural equipment, whereas common macroplastics originate from plastic bags, packaging, and fishing boats; microplastics come from plastic parts, pellets and bottles (Rochman, Hoh, Hentschel, & Kaye, 2013).

Considering the incremental importance of the issue the world community is currently seeking to solve the problem of marine litter. The efforts involve several worldwide initiatives: the Global Partnership on Marine Litter (GPML), the Honolulu Strategy and the G7 states. GPML encompasses civic organisations, scientists and policymakers, as well as representatives of the private sector, trying to coordinate their actions and catalyse them. The Honolulu Strategy is based on cooperation to prevent and control the impact of ocean garbage on the global economy, population and environment. To reduce such impact the organisation has decided to pursue the following three objectives: to decrease the amount of land litter and solid waste; to reduce the amount and adverse consequences of ocean debris (fishing gear, lost goods, vessels and their parts); to mitigate the impact of such debris on shorelines and natural habitats of marine animals. The G7 countries acknowledge the existence of the marine litter problem and place it high on their environmental agenda.

Simultaneously, the increased influence of the marine pollution on the habitat of human beings in the coastal regions shared by different countries has promoted establishment of regional initiatives. The Waste Free Environment (WFE) Programme is directed towards higher rates of recycling and more responsible behaviour among citizens of Gulf countries while disposing of litter. The Programme is created and developed by the Gulf Petrochemicals and Chemicals Association (GPCA) and through school children and volunteers provided by other educational institutions the Association encourages more and more people across the region to clean up the environment. Participants of the Programme act within the scope of *Reduce, Reuse and Recycle* concept thereby studying in detail the plastics' production cycle, implications of its disposal for both nature and human beings. Under the Programme governments of corresponding states organise clean-ups in the largest cities of the region, in particular those situated near the sea.

Europe is considered one of the regional leaders in the area of decreasing both land and marine plastic pollution. *The Project 'Zero Plastics to Landfill by 2020' (PlasticsEurope)* is mainly concerned with the problem of plastic products ending up in landfills once having lost their practical importance. In accordance with the data of PlasticsEurope, European countries have become more resource-efficient, thereby reducing the amount of plastic waste through the commitment to recycle and re-use plastic products. However, despite some progress already achieved in the field, 10 EU Member States still dispose 60% of their plastic products by burying them in soil. These countries, as well as states with even higher rate of landfill plastics disposal (UK, Italy, Poland, Spain, and France), are the target countries of the Project. To accomplish its objective PlasticsEurope supports the legislative initiatives in European countries to ban landfilling of high-calorific plastic products by 2020. At the same time, the Project serves as a platform for energy-from-waste and recycling initiatives helping them by seeking indispensable funds and engaging stakeholders, officials and even manufacturers.

*The Australian Marine Debris Initiative (AMDI)* comprises schools, companies, local communities and public authorities that cooperate so as to decrease the amount of plastics washed down into the ocean. The Initiative transmits data on litter gathered during beach and river clean-up days to the AMDI Database and then it seeks to provide feasible solutions to stop the problem. Therefore, the AMDI not only diminishes the amount of rubbish through organisation of clean-up events, but also helps locals take care of the coastal ecosystems through provision of resources and cooperation with corporations and government agencies to secure changes at the national level (Kosior, Mitchell, & Crescenzi, 2018).

At the corporate level companies have already been trying to ensure reduction of plastics in the ocean by developing bio-degradable or plastic-free products. *A soap company Method* directs its efforts towards raising awareness on the problem of marine pollution and transforms its business model to prove that the business itself can function with profit while tackling the issue of environmental pollution. The company is supported by local clean-up groups of volunteers gathering beach plastics. Then the company delivers collected plastics to the recycling company Envision Plastics where plastic litter is turned into "ocean plastic bottles". In fact, these bottles combine both ocean and post-consumer plastic products.

Through this programme the company seeks to demonstrate that an innovative approach and design can help solve the problem of marine plastic contamination and that the post-consumer recycled plastic is a sufficient alternative to traditional plastic products.

*Net-Works* is a project created through cooperation between the worldwide tile producer Interface and the Zoological Society of London (in particular, the conservation charity). The project consists of initiatives to solve the issues of discarded fishing nets in the coastal communities of some developing countries. By participating in the Project local residents gather discarded fishing nets and then sell them back to the world market where Interface turns such nets into carpet yarn. The initial phase of the project took place on several beaches in the Philippines and proved to be cost-effective. In a month the campaign managed to gather more than 1,000 kg of fishing nets, whereas the total amount of litter gathered in the Philippines coastal communities exceeded 80,000 kg (Notten, 2018).

At the government level several initiatives have already succeeded in both reducing the amount of marine litter and proving themselves to be economically viable. *Deposit-refund systems in the USA* generate incentives for adequate disposal of pollutants through synthesis of a product charge (i.e., a deposit) and a subsidy for recycling or disposal (i.e., a refund). Costs borne by producers and sellers to handle returned products are compensated by the interest on deposits as well as the sale of collected items. Deposit-refund systems have appeared to result in lower costs than other waste reducing systems, for example, recycling subsidies. Simultaneously, the deposit-refund initiative entails more materials returned and less contamination faced.

Another government initiative to tackle the marine plastic pollution problem is *the Extended Producer Responsibility (EPR)*. This system is aimed at reducing plastic waste, by boosting recycling and lowering dependency on raw materials. Through this system the cost of handling recovered products is to be borne by producers rather than local authorities. Therefore, while producing plastic items the manufacturer bear liability for their recycling and disposal. Like the product viability law, this system makes manufacturers turn their products into eco-friendly ones while improving their design and enhancing reusability potential. EPR legislation hampers the process of waste penetrating land and subsequently marine ecosystems while increasing the lifecycle of reusable products and mitigating their impact on the environment (Watkins & ten Brink, 2017).

Around the globe some states have already launched container-deposit legislation to decrease the amount of plastic disposal. In Canada most of the provinces have implemented their own deposit refund systems. Deposits themselves depend on the resource material and volume of containers. The government of Denmark has enforced deposit legislation in respect of cans and plastic bottles ranging from 0.5L to 1L. Finland has successfully introduced a deposit-based return system for beverage packages thereby maximizing the efficiency of the recycling process. Deposits for plastic containers make customers give back beverage packages for recycling. The Netherlands have developed their container deposit legislation back in 1993 and currently it encompasses plastic and glass products (refillable and non-refillable) with deposits not exceeding 1 dollar per single bottle (Kosior, Mitchell, & Crescenzi, 2018).

The aforementioned initiatives as well as numerous public organizations insist on the fact that enhancement of wastewater and solid waste collection to provide a viable short-term solution to the problem of ocean pollution. Reducing the amount of such waste requires construction of corresponding infrastructure and implementation of appropriate practices to increase public awareness of the problem and educate people accordingly. In the long-term perspective the issue of ocean plastic pollution is to be solved through the lens of circular economy in which waste is not considered waste rather a new resource to be utilized in further production cycles without harming the environment. The notion of "circular economy" entails introduction of sustainable consumption patterns and practices, for example, decreased consumption of single-use plastic products or more organic elements in cosmetics. However, reducing the amount of plastics, in general, requires technological, institutional and behavioural changes at both government and corporate levels considering plastic products, their lifecycles, utilization, maintenance and release into the global ocean. This approach envisages proper actions by all the stakeholders concerned to modify the existing urban infrastructure, product design and consumption as a whole.

Innovative Technologies as a Tool to Reduce Marine Plastics.

The current state of affairs concerning marine plastic pollution demands actions on different levels so as to achieve the highest possible efficiency and rational utilization of available resources. Therefore, it has led to numerous research efforts made by scientists and innovation hubs around the world. Despite the difficult character of the task, numerous aspects of the problem to be taken into account simultaneously and limited resources at disposal, such undertakings have already developed economically feasible and prospective technologies which can be applied anywhere in the world ocean.

Cleaning oceans through traditional tools is insufficient to decrease substantial amounts of plastics floating in the ocean. Even with the help of nets the process of collecting such litter appears to be both time and resource consuming. *The Ocean Cleanup* develops cutting edge technologies aimed at cleaning up 50% of the Great Pacific Garbage Patch every 5 years. The system comprises a 600-meter-long floater that drifts at the ocean surface and a tapered 3-meter-deep skirt under the surface. The floater provides a mechanism to prevent plastic from flowing over it whereas the skirt underneath captures litter under the surface. The systems deployed by the Ocean Cleanup can capture different types of ocean plastics: from small pieces (millimetres in size) to large debris (for instance, discarded fishing nets). Researchers claim that, subject to their estimates, the launch of Ocean Cleanup systems in every ocean will lead to reduction in the amount of marine plastics by 90% in 20 years. Such systems have already proven their numerous benefits, in particular:

- autonomous character of work. Algorithms utilized help to determine optimal deployment locations. Real time telemetry allows scientists working in laboratories to monitor performance, conditions and trajectory of each system;
- scalable roll-out. The modular fleet of systems can be implemented gradually, thereby allowing researchers to assess the efficiency of systems during the process while modifying and improving the existing technologies;
- energy neutrality. The Ocean Cleanup systems do not rely on external energy sources, except for natural forces of the ocean itself. The electronic components of the systems (lights and automatic identification systems) are powered through solar energy;
- durability. The structure of systems allows them to withstand ocean force. Due to their flexibility, systems simply follow wave movements and can drift when exposed to high current speeds;
- safeguarding sealife. The systems do not hamper the marine life through their low speeds (ocean creatures can swim away), impenetrable screen (it captures only floating plastic), no nets and regular removal of plastic products (people check the presence of marine inhabitants before picking up the plastic from the water) (Slat, 2014).

*Plastic Tide* is trying to harness the existing technologies to reduce the amount of plastics in the ocean. The strategy of this company is to utilize drones with cameras to measure the scale of the problem as well as to exercise surveillance over the efficiency of initiatives to overcome plastic pollution. The photos taken by drones then lay the foundation of training for an AI algorithm to recognize images of plastic trash and, consequently, to make a distinction between shells, marine animals, and plastic products. The project encompasses not only devices and technologies, but also volunteers and scientists to tag the plastic they come across on coastlines and to take part in the process of machine learning dealing with the issues of plastic identification.

The expected outcome of this project is an accurate, open-source map of the worst-polluted coastlines. The technology has already proven to be of global application meaning that it can be used anywhere around the world without significant increases in costs. In the short-term period the map will help with the organization of clean-up events, whereas the long-term objective of the project is to build a platform that documents the areas contaminated with plastics nearly in real time. The map will be the indicator of the impact of certain environmental policies (Cheshire, 2017).

*The Seabin Project* is a garbage bin floating in the water near docks, wharfs, ports and other areas with significant amounts of plastic products. Water is absorbed from the surface and passes through the special net inside the Seabin. Then this water is pumped back into its environment leaving plastics and debris in the catch bag, with these remnants being disposed of later. At the same time, the Seabin may collect oils and other chemicals floating on the water surface.

The first version of the Seabin is powered by a special waterpump and costs approximately US \$1 a day to operate. Next versions of the invention will be larger in size enabling the Seabin to catch more garbage. Currently, Seabins are deployed in the USA, Canada, Finland, Spain, France, United Kingdom, the Netherlands, etc. Despite its designation for ports and commercial areas, the Seabin is aimed to be implemented in the open ocean as well, with viable modifications already being tested (Myers, 2018).

#### **Operational Concept Project "Oceanum"**

The problem of ocean pollution generally hampers further development of the global community. Extraction of numerous raw materials, increasing volumes of ocean transportation, and incremental growth of marine economy threaten establishment and proper operation of viable ocean ecosystems possibly leading to significant challenges to be overcome by next generations. Among all the problem, issues of marine plastics are of the greatest importance. Global population and, consequently, consumption of plastic grow exponentially, the same goes for the global plastic production. High volumes of production along with augmented durability result in widespread accumulation of plastic products around the global ocean. Commercial fishing vessels, cargo ships (discharging containers and garbage), and cruise ships constitute another part of the issue.

The impact of plastic pollution is obvious: invertebrates, fish, seabirds, and mammals ingest large plastic particles leading to higher death rates (with a substantial amount of animal deaths remaining unobserved). Coral reefs are damaged through abrading or breakage when marine litter entangles a coral. Different species of fish are entrapped in lost or abandoned gears (traps, cages, and pots): this process is known as ghost fishing. Moreover, plastic facilitates expansion and transportation of invasive species ("rafting" organisms). Except for the aforementioned, marine plastics negatively affect the economic development of coastal areas through loss of coastal tourism and recreational opportunities, vessel damages, increased cleaning costs and higher risks during storms and other natural phenomena. At the same time, higher levels of marine debris damage local aquaculture, fisheries as well as entail augmented costs to ship the litter and organize a proper disposal process (Watkins & ten Brink, 2017).

The world community has already taken some measures to tackle the problem in terms of international legislation, national environmental policies, and corporate sustainability frameworks. However, these steps have a formal character, whereas the problem of marine plastics demands real-time solutions based on feasibility, economic rationality, and long-term results. Therefore, our "*Oceanum*" concept project combines latest technological advancements with proper utilization of available resources and corresponding government and corporate initiatives. Our idea will create a solid basis for further developments within the framework of marine plastics reduction. The initiative itself merges sustainability approaches, eco-friendly arrangements, societal dimensions, and economic impact so as to alleviate the burden of the global plastic pollution dilemma and its implications.

Our idea lies in creation of a special management system encompassing commercial vessels, coordination and distribution centres, certain infrastructural objects linked through the proper communication system. The central part of the "Oceanum" is the sustainable platform in a particular ocean region created to act as a distribution point through the procedures of gathering marine litter delivered by special ships, processing plastic products in an eco-friendly way, and dispatching processed materials to designated handling and trading hubs located at ports. To ensure proper functioning of the network, it requires the application of satellite technologies, advanced robotics, artificial intelligence, and sensor systems connecting all the parties engaged in the process of garbage identification, collection, delivery, transformation, dispatch, and further circular utilization in respective sectors of national economies.



**Figure 3.** General Scheme of the "Oceanum" Concept Project Source: Concept created by the authors

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Consequently, the initiative is to incorporate smart technologies and latest innovations in the fields of data collection and management, monitoring and navigation systems, logistics management, communication technologies, modern devices and tools in general. In particular, we decided to concentrate on digital industrial technologies known as Industry 4.0, i.e., to merge cloud computing, the Internet of Things (IoT), sophisticated sensors, data capture and analytics, information and communication technologies so as to enhance predictability, competitiveness, and interconnection of the crucial elements comprising the system.

The core vision is to enable seamless information exchange to streamline transport operations, increase safety, improve efficiency, and reduce the environmental impact. Better connectivity between ships and shore infrastructure will help ship owners to diminish costs, prevent costly repairs and strengthen operational productivity. Digitalisation, sensors and automated processes and introduction of "big data" in maritime operations will lead to optimising energy use and fuel efficiency, vessel performance and condition monitoring, and real-time weather data and routing. Interconnectivity between sea-based operations and shore-based operation centres will promote growing assistance and control from the shore. This will require systems and operations to be secured against cyber-attacks.

The communication system of our concept is to utilize the 5G mobile network. This latest development in the field of Internet technologies has the following features: bandwidth to reach 1GB per second, multi technological character, decreased latency times, energy efficiency, massive machine-type communication, and greater network capacity. The global 5G market has been growing rapidly recently. China, South Korea, Japan, Sweden, and Estonia have already launched or are set to introduce this technology in certain fields. Logistics information acquisition system based on 5G technology performs the following functions: automatic recognition, storage and transmission, data protection, error identification, parameters measurement, self-inspection, initialisation, and real time storage (West, 2016). The 5G network would provide such benefits for the "Oceanum":

- faster speeds;
- greater capacity;
- lower latency;
- flexibility;
- lower energy consumption.

Algorithm of functioning: The satellite monitors the location of garbage patches in the ocean and transmits the necessary information to commercial vessels designated for marine debris collection. These data are supplemented with photos by drones applied in the AI algorithm trained to recognize particular types of plastic litter. Then corresponding ships search for plastic products and gather them using modern navigation technologies.

The vessel contains an excavator barge, marsh excavator, fast landing craft, and collection booms. In addition, it will have four smaller vessels to be used for ocean clean-ups as well as particular nets not harming marine inhabitants. The ship has to be energy efficient, thus, special solar panels and smaller energy turbines can be integrated into the ship structure to substitute for its extensive energy usage. The thing is that the process of marine debris collection has to be carried out through ships rather than the floating platform due to lower costs and higher mobility of the former. The collected garbage is to be transported either to the platform or to the nearest ports for further processing and utilization. It is worth mentioning that plastics at ports can be transformed not only into its raw form but also into fuel for ships (e.g., the Port of Amsterdam project).

The core element of "Oceanum" – the floating platform (Fig. 4) – also operates within the aforementioned communication system so as to provide information on its spare capacities, acceptance and discharge periods, possible issues, etc. The platform has waterside cranes collecting containers of debris delivered by commercial vessels and wagons to transfer containers with litter to the processing plant situated in the middle of the square platform. The plant has to assort this plastic and process it for subsequent shipping. However, the processing of such products is energy-consuming, thus requiring the integration of the platform into the electricity network. To make this construction completely sustainable and self-sufficient it needs to exploit some renewable sources of energy, in our case – mix of wind and solar energy. The deployment of wind mills (both horizontal and vertical axis) and solar panels would provide a reliable source of energy considering the strength of winds and the amount of solar radiation

received in some ocean regions. Recovered plastic is to be transported to countries with a substantial demand for this raw material (e.g., Southeast Asian countries, India).



**Figure 4.** The Processing Platform as a Core Element of the "Oceanum" Concept Project Source: Concept created by the authors.

In addition, the concept is unique in its nature, whereas similar existing proposals have some flaws (e.g., significant implementation costs, inefficiency in capturing plastics, or vulnerability to weather conditions). "Oceanum" is designed to solve these problems and to secure proper plastic-reduction processes through application of modern technologies. Our project has the following exclusive features:

- $\Rightarrow$  utilization of artificial intelligence and IOT devices to track the location of marine litter as well as to provide real-time data concerning the equipment, its depreciation, performance, and workload (through special sensors);
- $\Rightarrow$  interconnected logistics system;
- $\Rightarrow$  no negative environmental impact;
- $\Rightarrow$  global and local scalability;
- $\Rightarrow$  neutrality to natural disasters;
- $\Rightarrow$  the platform mobility after completion of works in a particular area;
- $\Rightarrow$  possibility to perform additional functions (e.g., to clear up oil spills and recover fuel);
- $\Rightarrow$  constant and stable information flow to be utilized by scientists of onshore laboratories;
- $\Rightarrow$  neutrality to natural disasters.

The project successful application will influence significantly various aspects of everyday life. The concept has the following advantages:

• Economic benefits:

1) *New business solution.* Our concept is a new way to solve the ocean and sea pollution problem as well as supply the economy with recycled plastic. This model is a way to attract new capital in the environmental sphere and establish new relations between businesses and public authorities;

2) *Energy efficiency and independency.* Due to the use of renewable energy for functioning of the platform and fuel produced from the collected plastic wastes, we provide an efficient and independent energy consumption system. Work will not stop for the reason of problems related with the external fuel supply and due to introduction of different types of renewable energy sources the platform is not weather dependent;

3) *High performance level.* Along with implementation of 5G technology and satellite data collection vessels will choose the most relevant ways and destinations with the highest waste concentration. This feature will let us collect and process maximum amount of plastic waste.

• Ecological benefits:

1) Ocean ecosystem rescue. The world ocean is a source of food on one hand and producer of the oxygen on another. Plastic pollution elimination is a necessary factor for the survival of the ocean inhabitants and plants. Our idea provides such cleaning without harm to marine inhabitants;

2) Cut of the  $CO_2$  emission. An increase in scale of collection and processing of waste plastic allows to reduce the volume of production of the new one, since primary plastic production emits more  $CO_2$  into the atmosphere than recycling;

3) *Fast response.* In case of large-scale natural or mechanical disasters, the whole system can move to the place of disaster. It may include oil spill response or fighting the consequences of major cataclysms.

• Social benefits:

1) *Job creation.* The construction and maintenance of a fleet of forty ships (or more) will lead to the creation or preservation of thousands of jobs in naval construction. The project itself will employ several thousand people (ship crew and onboard factory personnel);

2) *The removal of dangerous work.* For that reason, such operations are mechanized within our project, however, controlling functions will still depend on human labour.

Recent studies have found out that the Great Pacific Garbage Patch (the largest garbage island in the world) layers range from 0.7 to 1.4 million square kilometers. According to our calculations, "Oceanum" could clean an area of such a patch in 5 years, and with supplementary ships, such a complex of vessels can treat up to 4 such patches in 10 years. The conservation of 90% of the polluted world ocean area is likely to require at least 10 garbage collecting systems around the world. This ambitious plan can be successfully implemented by 2045. Having regard to the fact that by 2050, scientists predict an increase in the total volume of plastic rubbish to 33 billion tons, our project is incremental and integral component of the global ocean conservation.

However impressive the "Oceanum" capabilities might be, we realize that 100% removal of marine contamination is not a realistic expectation. Nevertheless, it is of paramount significance to eliminate the greatest possible amount of waste (90% or even more) with a view to stopping and preventing future inevitable global pollution that would require centuries for oceans to recover from.

Major benefits of the project by 2050 in numbers:

- 93% global ocean area conserved;
- 99,8% seabirds and sea creatures saved from plastic consumption;
- 80% recreational areas free from garbage;
- \$168 billion of saved world economy funds.

The major benefit of our proposal is its global and local applicability. The project is aimed at solving one of the most significant issues of the world – ocean plastic pollution. It leads to higher levels of cooperation between states and regional organizations as well as creation of a common platform to provide viable solutions to the modern issues sent. On the other hand, the concept is scalable and can be rolled out in different regions across the world suffering from plastic pollution, for instance, in the Pacific Ocean or near Southeast Asia. The universal character of the project makes it an element that can be easily integrated into the ecosystems of different areas with further successful utilization.

Subject to studies released by the World Wide Fund for Nature, the world's oceans have an economic value of 24 trillion dollars corresponding to the wealth generated by the most highly developed countries. *What kind of economic value will the oceans have in 2050 if nothing is done to end the expansion of plastic pollution*?

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## **Industry Orientation of International Trade Flows**

## PETRO YAREMOVICH<sup>18</sup>

**Abstract:** The article deals with sectoral orientation of international trade flows in the context of the Sustainable Development concept, as well as with the provisions of the EU-Ukraine Association Agreement. Relevance of foreign economic activity in world economic relations is highlighted. The current state of European trade relations is analyzed, their main problems and prospects for development are investigated. The article also examines the essential features of the world commodity market functioning; directions of international trade flows in the conditions of globalization; and peculiarities of formation and strategic benchmarks of geo-regional trade group development. The main purpose of the article is to study the industry orientation of international trade flows in the time of the 4th Industrial Revolution.

**Keywords:** Industry Orientation • International Trade Flows • Foreign Trade Activities • Trade Networks • International Transport Corridors • Logistics Complexes • Sustainable Development

#### Introduction

The world economy reflects economic ties of modern civilization. It reveals manifestation of socio-economic functioning of the society at the level of multinational enterprises, integration groups, households, and it inevitably has an international component. The emergence of the global economy as a coherent system occurs under conditions of developed, innovative international trade, which plays a significant role in the current conditions of development of world economic relations.

International trade, as a form of international relations, is an important component of economic development; contributes to improving competitiveness of national economies and living standards; and has a significant impact on the economic and political course of the country and globalization of the world economy.

Research of theoretical and applied principles of globalisation of the world economy in conditions of modern international economic relations, development of Euroregional cooperation of cross-border territories, experience of application of progressive integration models is an actual and important scientific task in the context of modern dynamic development of the European integration process. The transformed policy of promoting transboundary functioning of international trade flows is aimed at ensuring progress of production factors in certain territories; rational use of the resource potential of the countries of the world community; creation of proper conditions for the population's normal life; observance of environmental security; and improvement of territorial innovative production of the 4<sup>th</sup> Industrial Revolution.

#### **Research Results**

Modern scientific literature pays great attention to the tendencies of development and structure of international trade relations, its dependence and efficiency on world integration processes. Much emphasis is paid to the issues of sectoral development of international trade flows, their focus on the network of international transport corridors, problems of geo-regional trade relations and cooperation.

Despite considerable research on international trade relations, and particular sectoral focus of international trade flows, it is necessary to note the need for a new methodological toolkit for assessing changes in foreign trade patterns and their correlation with intensity of structural changes in the structure of international trade flows. The growing monopolization of the economy, emergence of so-called closed

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markets, when agreements are concluded among the limited number of economic entities at the georegional and regional levels, have a significant impact at the present stage of development of international economic relations. The impact of globalization on social production development in the world community occupies one of the leading places in the areas of study of the current stage of evolution of the international economy. Undoubtedly, these include formation of globalization preconditions, qualitative shifts, and diversification of the structure of world commodity markets. Today, globalisation causes significant changes taking place in the conditions of creation, functioning and redistribution of world commodity markets, redirection of sectoral international commodity flow movement in the scale of the world economic space, which has a positive impact on the economic development of the world community.

It is worth noting that the current state of growth of the domestic economy, foreign economic activity, and integration processes do not assist Ukraine in achieving its goal for European integration. Among the main problems of Ukraine's low competitiveness in the geo-economic space are inefficient public administration, a significant scale of corruption at all levels of decision-making, and lack of opportunities for low-cost sources of foreign investment. Today, foreign investors are reluctant to invest in this country's transport and logistics infrastructure, in particular, development of international transport corridors and international economic logistics complexes. As a result, world transport and logistics companies send their sectoral international trade flows to bypass this country, despite the fact that the world practice shows a steady tendency to improve freight transportation technology. It is related to concentration of transport flows and growth of container transportation through international intermodal transport corridors, which form the basis of the 21st century unified global transport network, whose creation and operation are one of the main tasks of the Eurasian geo-regional cooperation policy. The inclusion of Ukraine in the globalization processes is characterized by restructuring of the world economy, changing balance of its economic centres, the growing role of sectoral economy, development of innovative technologies, digitization of all transport and logistics processes, and processes of production of goods and services. On the one hand, this restructuring will create new opportunities for the Ukrainian economy in foreign economic integration development and expansion of positions in the world commodity markets. On the other hand, it will increase the requirements for its competitiveness, ability to innovate renewal and large-scale investment attraction. The prospects for demand for infrastructure and transport and logistics services, in order to ensure the efficient movement of sectoral international trade flows, make it possible to formulate their problems. They include:

1. absence of European-level roads, which does not allow the flow of goods to move at maximum speed. Along with this, bad roads and inability of drivers to rest in a timely manner along their route create traffic risks on the roads;

2. shortage of modern international economic logistics complexes and capacities of terminal and warehouse facilities for transshipment and processing of international commodity flows in the border territories negate all efforts of cross-border cooperation;

3. imperfection of the legislative and regulatory framework for creation of competitive conditions for operation of domestic haulers in the international freight market;

4. shortage of skilled personnel in all links in the transport and logistics chain. The current processes of society digitization, in our opinion, should contribute to solving this problem.

These problems are conditioned by inconsistency of actions of all participants in the international transport and logistics process. The lack of a domestic job creation programme contributes to the outflow of skilled personnel abroad. Therefore, it is advisable that the relevant governmental structures develop a long-term strategy for development of multi-purpose complex cross-border flow infrastructure. It should take three interrelated approaches: national, sectoral and regional. Based on the above, it should be noted that the priority of strategy formation should be a national approach based on the principles of ensuring concentration of resources and efforts to solve the key problems of transition to innovative and socially-oriented infrastructure development in Ukraine in order to ensure the efficient movement of cross-border trade flows.

A number of reasons has caused increased attention to the infrastructure of sectoral international commodity flows. The main among these are:

• the global economic crisis, which has led to decreasing public funding of such an important aspect as functioning of European regional transport and logistics infrastructure, international economic logistics complexes, in particular;

• the importance of their development, as they depend on sectoral development of countries as a whole;

• the search for innovative ways to develop production with formation of new economic models;

• the processes of globalization of the economy of the countries of the European community;

• the need to involve the private sector to form new economic models and to finance European transport and logistics infrastructure development.

Therefore, today we can confidently claim that sectoral international trade flows are an important tool for geo-regional development and they provide natural cohesion and effective promotion of international trade flows.

Globalization processes and the global economic crisis are forcing governments to look for ways to develop the economy through mutual cooperation. Active participation of Ukraine in international cooperation creates the opportunities to be active participants in programmes to attract investment in domestic transport and logistics infrastructure formation. Continuous growth of volumes of goods movement, development of new routes of transport movement on international transport corridors, improvement of processes of logistics of transportation, storage and transshipment of cargoes, attraction of new logistic, transport-logistic and development companies make these actions of the country important on the way to its European integration.

The present developed European network of international economic logistics complexes allows implementing a system of large-scale route transportation, and to ensure high quality of transportation between international economic complexes through the use of international methods of information processing, digitization of management of transnational logistics systems operating within international transport corridors. The advanced international economic logistics complexes also accelerate the process of innovative development of national economies, causes the rise of innovation, strengthens the ability of European enterprises to compete in the world market.

Concerning the problem of formation of the structure of the world commodity market it is necessary to distinguish its following components:

1. the world commodity market includes national foreign trade potential of the countries of the world, which is primarily focused on the sale of innovative industrial goods and consumer goods in which partner countries are interested;

2. geo-regional components should be distinguished in the world commodity market. We are talking about commodity markets operating within integration groups first of all;

3. institutions operating at mega level play a decisive role in the structure of the world commodity market. These include international commodity exchanges, international auctions, and more.

An important feature of the development of the world commodity market is the increasing influence of monetary and financial factors which are amplified in the existing conditions of floating exchange rates. The major instruments of monetary policy pursued in world commodity markets are the devaluation and revaluation of exchange rates. Sudden shifts in exchange rates often give rise to rather significant transformation of international trade and changes in the turnover between countries. Particularly often and noticeably similar changes take place in periods immediately preceding a fall in the rate of any of the currencies of large developed countries. A sharp increase in demand can lead to changes in the world commodity market, in particular, to rising prices for the corresponding products.

Given the large role of the currency factor in the development of modern markets, individual countries are trying to influence them by conducting transactions with exchange rates. However, the effectiveness of these measures is rather doubtful, and their final result is only a further strengthening of the anarchy of the monetary system of these states. Such increased uncertainty, which already prevails in the foreign exchange markets, is particularly affecting long-term foreign trade transactions. Therefore, there are additional obstacles to specialization and cooperation of production on an international scale, the development of world commodity markets.

In today's context, the dynamics and structure of world commodity markets are most likely affected by the uncertainty of three factors, namely, economic growth; new configuration of the world financial system; and world environmental development. On this basis, it is worth noting the following priorities for development of world commodity markets including their component of sectoral international trade flows. First, they are becoming more global as new sovereign players claim their rights to natural resources. However, sectoral international trade flows are increasingly complicated. Along with conventional products, a narrow line of high-tech products and high-tech services – so-called integrated products of intersectoral cooperation – is emerging in narrow mono-industries.

Second, developed countries focus on production of high-tech products according to modern world standards and take into account environmental requirements. In this context, the following consequences are possible: a) increased trade in the structure of sectoral international trade flows; b) increased trade between developed countries; c) complex high-quality products and services will be exchanged not only for raw materials, but also for ordinary basic necessities.

Third, it is logical to assume that the cost of living labour, especially highly skilled one, will increase. One of the requirements of the world society will be to reduce energy and material consumption of products in order to reduce production costs and increase the competitiveness of goods.

Fourth, a new stage in the fight for scientific and technological leadership in the world is likely to begin. A country which really transforms the potential of knowledge economy into everyday life of the society will become a leader that will be reflected in the structure of sectoral international trade flows.

Fifth, geo-regional commodity markets are expected to gradually erase the line between military and civilian products as a result of use of dual technologies and integration of innovative potentials. As a result, diversification of goods will increase, updating of manufactured products will accelerate, and intellectual capacity of world commodity markets will increase.

Sixth, cross-border rivalry in the use of information, communication, space, bio and nanotechnology at all stages of production, from design to disposal, is likely to increase. Supply of innovative technologies and goods, degree of their intellectualization, and possibility of implementation into the European market get an increasing role in the competition.

The European Union's current spatial planning policy places particular emphasis on finding new forms of cross-border cooperation in order to enhance the transformation of sectoral international trade flows, cooperation and creation of a full-scale integrated space. For example, 'European territorial cooperation groups', 'cross-border partnerships', 'cross-border clusters' and 'cross-border industrial zones', etc. have begun to operate at European borders. They become 'growth poles' in peripheral border regions which confidently compete with central and metropolitan regions. It should be noted that the main purpose of all these new forms is to accelerate economic growth by combining the efforts of industries, promoting efficient movement, distribution, functioning of sectoral international trade flows, ensuring the competitive advantages of regional transport and logistics infrastructure, and world trade networks. Of all the above-mentioned organizational forms of cross-border cooperation in Ukraine, in particular, there is experience of introducing only 'cross-border clusters', 'cross-border industrial zones' and European trading networks. Their further development and increase of efficiency of functioning, in particular in western regions of Ukraine, will promote efficient development of sectoral international trade flows in export-import directions, revival of economic activity and will stimulate economic growth of the country, which will have a positive impact on equalization of indicators of socio-economic development on the EU market.

Due to large-scale expansion of the EU to the east and formation of a new border between the EU and Ukraine at the beginning of the 21st century the format of cooperation between the countries of Central and Eastern Europe, and the border regions in particular, is also changing. Transformation in the nature of economic and political relations due to qualitative and quantitative changes in the structure of the EU have a direct impact on formation of a new system of sectoral cooperation, relations between the border regions of Ukraine and the new EU member states.

One of the mechanisms for effective functioning of sectoral international trade flows is the development of international transport corridors and transport-logistics infrastructure as a response of the world community to current challenges of fundamental phenomena and processes in the sphere of production and trade on different continents. These processes are objective and global in nature. They trigger a new state of the world trade system and international division of labour and affect creation and

functioning of the global financial system. Over the last 30 years, a new concept has germinated – a concept of creating a single planetary transport and logistics system based on integration of continental transport and logistics communications of strategic importance in provision of freight and passenger transportation between Europe and Asia, Asia and Africa, Europe and Africa has conceptually matured. The Europe-Asia direction has been the focus. This is due to the fact that between the poles of the Western European and Asian-Pacific regions, there is a vast area with over 3 billion population where major international trade events are unfolding.

The advancement of the Euro-Asian world transport and logistics system is conditioned by two macroeconomic factors. One of them is instability and uneven use of the achievements of scientific and technological progress in different sectors of the world economy, which causes uneven development of different industrial production sectors in the world economy. The other is the accelerated growth of integration processes in Europe. The first factor is manifested in short-term downturns in some regions that specialize in certain industries with simultaneous increase in others. This keeps the world trading system in tension provoking rather sharp fluctuations in its economic environment. As a rule, this process is a source of stable regional financial crises with points of rapid growth in different regions of the globe.

The sharp fluctuations in the market conditions have led to significant structural shifts in certain directions of movement of sectoral international trade flows leding to intercontinental reorientation of their strategic directions and segmental changes in the structure of the world market of goods. As a result, since the mid-1980s, there has been a steady upward trend in trade between the countries of Western and Central Europe, on the one hand, and the Asia-Pacific region, Southeast Asia and the Indian subcontinent, on the other. The average annual growth rate was 5-13%. In our view, these objective changes in the international trade system have contributed to the integration processes aimed at creating the single European economic space.

The stable development of international business logistics complexes began in the early 1980's in Western Europe due to high growth dynamics of freight and passenger transportation in the conditions of globalization of world commodity markets. Increasing competition among producers has forced them to look for additional opportunities to reduce the transport and logistics component in the final price of goods. This required creation of new equipment, development of transport infrastructure, introduction of modern transport and logistics technologies, which ultimately resulted in reducing the transport and logistics component in the final price of goods to 8 - 10%, and the producers' total cost for transport and logistics services by 10 - 20%.

The present developed network of international economic logistics complexes allows implementing a system of large-scale route transportation, and by applying international methods of information processing for management of transnational logistics systems operating within international transport corridors to ensure high quality transportation between national and international economic logistics complexes. According to UN recommendations, about 70-80 consolidating centres are needed for international transport flows to function effectively in the global transport infrastructure. Development of international economic logistics complexes also accelerates innovative development process in national economies, causes the rise of innovation, and strengthens the ability of national enterprises to compete in the world market. Economic development and innovation are closely linked affecting economic performance and living standards.

It should be noted that, Directorate-General for Regional Policy within the EU was established in 1968, it is responsible for strengthening economic, social and territorial cohesion by eliminating inequalities in development of EU regions and member states. In 1975, the European Regional Development Fund (ERDF) was created to support infrastructure development, invest in job creation, mainly in the field of entrepreneurship, and support projects that promote regional development. It also finances measures to overcome existing regional imbalances in EU countries through participation in development and structural adjustment of regions lagging behind industrialized areas.

It should be noted that the problems of cooperation in infrastructure development are mainly connected with differences in the laws of the participating countries and cannot be corrected. Language barriers also play their negative role. However, the world community is being focused on reducing such obstacles. In today's environment, more and more countries around the world are creating international economic logistics complexes and integrating them into the world transport and logistics network. These evolving facilities are beginning to influence achievement of a higher level of regional and national

development, formation and regulation of national innovative systems. Therefore, it can be argued that the development of a network of economic logistics complexes is one of the forms of effective promotion of sectoral international trade flows, economic and innovative development of the countries of the world.

Therefore, the following should be noted among the trends that cause acceleration of development of sectoral international economic complexes in the world:

1. erasuring borders, which is exacerbating competition and forcing more effective strategies and forms of interaction between multinational enterprises to redirect sectoral international trade flows;

2. strengthened role of global competition and complexity of its mechanisms, which makes it impossible for enterprises alone to compete effectively in both external and internal markets;

3. globalization of the economy, which leads to greater integration of economic entities, and global economic, political and cultural integration and unification. The main consequences of this process are international division of labour, migration of capital, human and industrial resources across the planet, standardisation of legislation, economic and technical processes, and convergence of cultures of different countries.

This objective process is of systemic nature, i.e. it covers all spheres of life of the society. As a result of globalization, the world becomes more connected and dependent on all its subjects. Both the number of problems common to groups of countries and the level and types of integrated entities are increasing. In our view, globalization cannot be a one-stage action, it is a product of competition in the free trade process which has a positive impact on the development of sectoral international trade flow transformation in the era of the 4th industrial revolution.

#### Conclusions

The strategy of formation of a single world transport and logistics infrastructure, in particular, development of international transport corridors and construction of international economic logistics complexes, effectively facilitate development of infrastructural support for the movement of sectoral international trade flows. The number of national infrastructure objects is reduced in the conditions of free movement of sectoral international trade flows within the integrated world market; they are replaced by single international economic logistics complexes, thus optimizing elements of transport and logistics infrastructure, digitisation of all processes of movement, processing and storage. Along with formation of regional distribution centres, large commodity companies are creating infrastructure facilities which accumulate, process, maintain, separate and supply their products to worldwide trading networks, and new transnational sale channels.

The processes of integration of continental transport communications stimulate creating a unified world transport and logistics system where the Euro-Asian world transport and logistics system has advanced to the forefront. This contributes to the development of the economies of Europe and Asia and effective international cooperation of manufacturers. A unified world transport and logistics system will allow them to accelerate and improve functioning of sectoral international trade flows, which will inevitably affect cost and increase competitiveness.

Modern trends in development of transport and logistics services determine the basic principles of functioning of international economic logistics complexes – complex development of infrastructure, joint use of telecommunication networks and systems of electronic document flow, harmonization of economic interests of carriers and logistics intermediaries, digitization of all movement processes of international trade flows.

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# **Current Issues of Regional Economic Integration: USMCA, EU and ASEAN**

### SVITLANA RADZIYEVSKA<sup>19</sup>

**Abstract:** The paper focuses on theoretical and practical aspects of integration processes on a regional level. Foreign trade of USMCA, EU and ASEAN are analysed.

**Key words**: Integration • Regionalization • Regional Integration Grouping • GDP • Population • Exports • Imports.

#### **Research Results**

In the beginning of the 21st century the world economy is characterized by various factors, among which are intensification of the international division of labour and internationalisation of social production; rapid development of science and technology resulting in the fourth industrial revolution, international capital movement and hyperfinancialisation. Of particular interest are globalization and regionalisation processes as a result of successful development of integration processes on the regional and global levels.

There are obvious reasons behind the international division of labour. These are the peculiarities of countries' possessions of land, natural resources, climatic and geo-economic conditions, achievements in science and technology, etc. Theoretically, participation in the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the international division of labour gives benefits to all involved, but to different extent. The classical approach to the nature, driving forces, factors, and vector directions of the integration processes the contribution of the following Ukrainian researchers should be mentioned: Yu.Pakhomov, D.Lukianenko, B.Gubsky (Pakhomov et al., 1997) focusing on the national economies in the global competitive environment; A.Filipenko, V.Budkin, A.Dudchenko (Filipenko et al., 2004) devoted to the modern international integration processes in Europe.

The 21<sup>st</sup> century international division of labour is an outcome of globalization, viewed as an ongoing geographic reorganization of production which finds its origin in the ideas of global division of labour – spatial division of labour which occurs when the process of production is no longer confined to national economies (New international division of labour).

In our opinion, in the conditions of globalization, the main goal of the national economy is first of all, to produce goods and provide services with lower expenses and of better quality; secondly, to expand the range of products paying special attention to the economic specialization of the country in order to increase its global market share. So, choosing 'the right partners' for signing regional trade agreements is becoming an imperative under the challenging globalization conditions, since it is well known that specialization and cooperation are the main forms of the international division of labour and it is evident that trade objectively creates possibilities for specialization and co-operation between the countries strengthening their interdependence and leading to their integration.

In the scientific literature the notions of "regional economic integration" and "economic regionalization" are used interchangeably; they are defined as the international economic integration (process) on the regional level, or integration on macro level (as opposed to transnationalisation taken place on the micro level) which means that in the world economy occurs closer economic relations between independent nation-states, described as the process leading to unification of these states into a single entity (regional state).

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Integration processes are evolving through formation of regional integration organisations/groupings on the macro level and formation of transnational corporations of the micro level of the world economy. The integration on macro level is based on the ideology of regionalism which dominates the territorial development of the world economy, replacing to some extent even the state and making all reconsider the role of the nation-state as the main player in the modern international relations.

Some scholars note that international economic integration is regional in its nature. It comprises mainly neighbouring countries which are geographically close. No wonder, culturally, historically, economically or ethnically close nations feel a natural inclination to mutual co-operation, and determine trends of economic regionalization. Consequently, economic regionalisation is the process of progressive creation of a common market and geographically reproductive area by historically and culturally related countries, accompanied by harmonisation of conditions of trade, reduction and elimination of reciprocal restrictions to enhance economic efficiency and to address global competition (Novitsky, 2003). B.Balassa is famous for his description of the stages of the integration development: free trade area, customs union, common market, economic union, economic and monetary union, and complete economic integration (Balassa, 1962). Integration theory identifies the economic effects – short-term static and long-term dynamic.

With regard to the notion of regionalism, it is defined as the doctrine, the way of thinking and acting which is based on the concept of region, viewed in the international economy as the set of territories of several nation-states that form this region. The process of singling out the region is the process of formation of the regional integration organization/grouping by uniting some countries. Theoretically, to form an integration organization, the countries have to integrate economically which means to strengthen economic ties and to increase the volume of trade that serves as the indicator in the integration processes. That is why even the countries' signing of the preferential trade agreement is already viewed by some researchers as regionalism since international trade is a prerequisite and consequence of the international division of labour, which is the basis of integration in general and regionalisation in particular.

As J.Witkowska mentions, integrating countries should fulfil some economic and political preconditions before entering into any stage of integration. The major ones are related to the healthy economic fundamentals of their economies, competitiveness, and the ability to stand up to the consequences of restructuring processes (Witkowska, 2016). The formation of the regional integration groupings is objective, since it is determined by the law of international division of labour while the process of their formation and development is of subjective nature, which is explained by the peculiarities of the signed regional trade agreements.

Moreover, the contradictory view on regionalisation is dominated in modern research: mainly it is considered to be the key factor in shaping globalization and, at the same time, all the forms of regional cooperation between states are seen as manifestation of globalisation itself. Theoretically, regionalisation processes should result in signing of the political agreement following the regional state establishment, and the new regional identify formation.

Since regionalization processes diminish the role of the nation-state, it should be assumed that they might promote introduction of regional currencies. An important peculiarity of regionalization processes is the variety of forms of regional integration groupings and the possibility of transition from one to another, changing the stage of integration of nation-states. Thus, the objective prerequisites for formation of regional integration groupings is deepening internationalisation and transnationalisation, expansion of economic globalisation, diversification of the information component of economic development. In terms of conceptual development of world trade theory, integration can be evaluated in the context of whether it is a step towards freer trade, or vice versa, towards additional limitations to the intensity of trade flows. And, of course, in this sense, along with integration, there are also reverse processes of disintegration, localization of member states, and their separation. The term 'disintegration' has been used since 1938 to characterize the international division of labour in the context of the global economic crisis (Filipenko et al., 2018).

The theory of regional integration developed under conditions of new regionalism defines the region not only as the territorial entity, but also as the functional structure. Regionalism is viewed as a well-ordered, multilateral interdependence controlled by the states within regional space, resulting in various regional projects and institutions corresponding to them (Shnyrkov et al., 2016). The

regionalisation processes are based on the voluntariness and mutual interest of nation-states in unification and aim at improving the capacity to secure national interests and strengthening rather than weakening their national sovereignty.

The calculated GDP and population of the major thirteen regional integration blocs covering Europe, Asia, North and South America, as well as Africa is presented in Table 1.

**Table 1.** GDP and Population of the Major Regional Integration Groupings/Organizations of the World,2015-2017\*

	GROSS DOMESTIC PRODUCT		POPULATION			
Regional integration groupings/ organizations	Nominal gross domestic product of the regional integration organization, 2015, millions of dollars	Regional integration organization gross domestic product i total world domest product 2015, %	Per capita nominal gross domestic product of the regional integration organization, 2015, millions of dollars	2015, millions	2016, millions	2017, millions
	L	EUROPE AND A	SIA	1	1	
1. The European Union – EU	16 067 827	21.49	31686.7	507	510	510
2. Eurasian Economic Union – EEU	1 550 510	2.07	8636.2	179	180	180
3. Association of Southeast Asian Nations – ASEAN	2 453 031	3.28	3879.5	632	641	648
4. South Asian Association for Regional Cooperation – SAARC	2 802 915	3.75	1607.3	1744	1766	1788
5. The Cooperation Council for the Arab States of the Gulf, originally known as the Gulf Cooperation Council – GCC	1 725 744	2.31	32751.5	53	53	55
	NORTH A	MERICA AND SO	UTH AMERICA	-		
6. North American Free Trade Agreement – USMCA	20 648 136	27.62	42266.7	489	490	494
7. Southern common market ( El Mercado Comun del Sur) – MERCOSUR	3 504 079	4.69	11982,1	292	294	295
8. Andean Community of Nations – ACN	632 204	0.85	5937.6	107	108	109
9. The Pacific Alliance (Alianza del Pacifico) – AP	1 874 041	2.51	8344.9	225	227	228
AFRICA						
10. East African Community – EAC	154 208	0.21	887.9	174	180	186
11. Common Market for Eastern and Southern Africa – COMESA)	613 884	0.82	1418.6	433	446	459
12. Southern African Development Community – SADC	608 983	0.81	2444.3	249	260	268
13. Economic Community of West African States – ECOWAS	663 670	0.09	1900.8	349	359	369

\*World GDP 2015 - 74753058 mln. US dollars

Source: author' calculations, based on (UNCTAD Handbook of Statistics, 2016; UNCTAD Handbook of Statistics 2017; UNCTAD Handbook of Statistics 2018).

The analysis allows to make the following conclusions: USMCA is the most powerful integration trade bloc since it occupies the first place according to the nominal gross domestic product of the selected regional integration organisations in 2015 which is \$20,648,136 million. The EU takes the second place with 16,067,827 while MERCOSUR comes the third with \$3,504,079 million.

USMCA is also leading according to the regional integration organisation GDP in total world domestic product in 2015 with 27.62%. EU is the second with 21.49 while MERCOSUR is the third with 4.69%.

Finally, if we take per capita nominal gross domestic product of the regional integration organizations, USMCA takes the first place with 42266.7 million dollars. The Cooperation Council for the Arab States of the Gulf occupies the second place with 32751.5 and the EU is in the third place with 31686.7 million dollars.

South Asian Association for Regional Cooperation enjoys the first place in terms of demographic achievements with 1788 million people in 2017, ASEAN comes second with 648 million inhabitants and the EU is the third with 510 million in 2017.

	2017	2018	Growth rate, %	
Merchandise exports	2376,5	2564,5	7.9	
Merchandise imports	3282,8	3559,9	8.4	
Exports of commercial services	892,1	928,3	4.0	
Imports of commercial services	664,1	685,1	3.2	

Table 2. Exports and Imports of USMCA, billion dollars

Source: World trade statistical review 2019. – P. 144, 145.

As it is shown, USMCA's merchandise exports increased by 7.9%, merchandise imports – by 8.4 while exports of commercial services increased by 4.0 and imports of commercial services – by 3.2%.

Table 3. Exports and	Imports of the	European Unior	n (28), billion dollars
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	2017	2018	Growth rate, %
Merchandise exports	5909,6	6465,4	9.4
Merchandise imports	5883,3	6494,2	10.4
Exports of commercial services	2329,7	2525,3	8.4
Imports of commercial services	1975,1	2152,8	9.0
	0 0 1 1 1 1 1		

Source: World trade statistical review 2019. – P. 144, 145.

Merchandise exports of the EU (28) have increased by 9.4%, merchandise imports – by 10.4 while exports of commercial services have grown by 8.4 respectively, and imports of commercial services – by 9.0%.

It is necessary to mention that ASEAN is considered to be the most developed integration organisation in Asia. It has widened its initiative (+3, +6, +8), involving East Asian and other pacific partners, including China and India. ASEAN is also the key element of a broad network of institutional cooperation within the region due to the range of new initiatives, structural formations, forums of various formats, etc. ASEAN has a great potential of economic development.

	2017	2018	Growth rate, %
Merchandise exports	1315,8	1447,3	10.0
Merchandise imports	1257,8	1435,6	14.1
Exports of commercial services	366,5	398,4	8.7
Imports of commercial services	352,8	375,1	6.3

Table 4. Exports and Imports of ASEAN, billion dollars

Source: World trade statistical review 2019. - P. 144, 145.

ASEAN's merchandise exports have increased by 10%, merchandise imports – by 14.1, and exports of commercial services have grown by 8.7 while imports of commercial services –by 6.3% respectively.

The results indicate that a negative merchandise balance of foreign trade is observed in the EU and USMCA, while ASEAN demonstrates positive merchandise balance of trade and positive balance of foreign trade in commercial services. All the three regional integrations groupings the EU, USMCA and ASEAN have increased their exports of commercial services and have achieved positive balance of foreign trade in commercial services. All in all, the three integration trade blocs are making some progress in commercial service trade.

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