

Integration and Interaction of National Economies in the Context of Modern Global Challenges: New Development Paradigms

Natalia Chaplynska

PhD in Economics,
Assistant Professor
Ng Teng Fong Sino Group Belt
and Road Research Institute,
Hong Kong Chu Hai College,
Hong Kong SAR, China
Associate Professor
International Economic
Relations, Business and
Management Department,
Ukrainian-American Concordia
University, Ukraine
nm.chaplynska@gmail.com

Iryna Moskvichenko

PhD, Associate Professor
Department of Management and
Marketing, Odesa National
Maritime University, Ukraine
moskvichenkoirina4@gmail.com

Yuliia Romanovska

Doctor of Science (Economics),
Associate Professor
Department of Finance,
Vinnitsia Institute of Trade and
Economics of State University of
Trade and Economics, Ukraine
bogdana32rom@ukr.net

Yuliya O. Lutzik

PhD in Economics, Associate Professor
Department of Economics and
Financial Support, Institute of
Troops Support and Logistics of
National Defense University, Ukraine
Julia.Lutzik@gmail.com

Tetiana Chebanova

PhD, Associate Professor at the Department
Department of Entrepreneurship and
Tourism, Odesa National
Maritime University, Ukraine
ChebanovaTetiana@outlook.com

Abstract

Integration of national economies caused by globalisation currently has new development paradigms. The presented study is aimed at testing the paradigm of increasing the influence of digitalization within the framework of cooperation of national economies. Since the governments of many countries declare the transition from an industrial economy to a digital one, a mechanism is needed to ensure this transition both in the national economy and international economic relations. The study was conducted using data provided by European governments to Eurostat. The study is based on the methodology of analyzing statistical information by grouping in the case of the average percentage of the information and communication technology sector from the gross surplus value and determining the correlation, and by forming regression equations in the case of studying the impact on the gross domestic product of various areas of enterprise cooperation within the framework of the integration of national economies. According to the results of the study, it was found that an increase in the percentage of the information and communication technology sector in the gross surplus value does not affect the gross domestic product per capita, which means the possibility of continuing the development of the information and communication sector without a negative impact on the domestic economies of countries. The obtained equations of the linear dependence of the gross domestic product of European countries on the balance of operations for the provision of services in the field of ICT, engineering and technical services, and scientific research and development show that the scientific sphere has the most effective impact on GDP, in contrast to ICT and engineering, which motivates the governments of European countries to increase attention to the development of information and communication technologies in countries. The study shows that a change in the paradigm of the development of integration of national economies from industrialization to informatization takes place, but is associated with some difficulties due to the lack of established mechanisms for interaction in this area.

Keywords: Economic Interactions, Globalization, Competitiveness, Integration Processes, International Trade, Economic Development, Innovation, Regional Integration

Introduction

In modern conditions, it is impossible to imagine a national economy separated from other economies, which manifests the growing importance of globalization. The conditions of modern development dictate new paradigms for the development of relations between national economies (Nguyen, Nguyen, Nguyen, & Luu, 2024). First of all, the emergence of new development vectors is due to intra-economic changes caused by the transition from an industrial economy to a digital economy (Hilty & Aebischer, 2014). However, this does not mean a complete rejection of the industrial components of the economy but consists of the formation of a supra-industrial information technology superstructure, which, with consistent development and application, will maximize the efficiency level in using limited resources to obtain maximum profit (Vonnegut, 2018). Such a symbiosis of industrialization and informatization is a relevant vector of integration and development of interaction between national economies.

Despite the large number of studies conducted to study the integration of national economies, this phenomenon has not been fully studied, as a result of which there are certain disproportions in the formation of interethnic economic ties, especially in light of the formation of new paradigms for the development of globalization processes (Brende & Sternfels, 2024). For transnational corporations operating in conditions where adaptation instructions are developed in each country in which they operate, taking into account local characteristics, the study of fundamental differences in national economies is carried out for a specific task, and not for studying integration processes (Grewal, Kopalle, & Hulland, 2024).

The processes of integration interactions at the level of small and medium-sized businesses are poorly studied. One-time studies are not systematic, which affects the quality of integration processes. An example is the situation

with the study of the number of enterprises engaged in exporting and importing various services in Europe. This study was conducted only once in 2021, and only 16 countries took part in it. The lack of systematic monitoring of integration processes leads to a deterioration in the quality of government work in this direction. The presented study uses extremely scarce statistical data since there is no system for collecting, processing, and publishing information related to the progress of integration processes.

The study of the interaction of national economies makes it possible to identify the strengths and weaknesses of economies, which can serve as a basis for adjusting the strategic and operational goals of domestic economies of various countries. The purpose of the presented study is to identify the impact of economic informatization on economic processes in the context of globalization. The solution to the problem is carried out by checking the presence of a dependence of the gross domestic product per capita on the percentage of coverage of information and communication technologies in the gross added value, as well as the dynamics of this dependence for countries with different levels of involvement of information and communication technologies in the domestic economy, that is, the openness of the information technology market as a means of integrating national economies.

Since industrial components have their influence on the interaction of national economies, the impact of the balance of engineering services on the gross domestic product of a country indicates the degree of openness of a country or group of countries to active interaction in this area, which is similar for both the sphere of information and communication technologies and the sphere of scientific developments. To identify these dependencies in the presented study, mathematical models of linear dependence were constructed for sixteen European countries that provided their data in 2021 on the number of enterprises purchasing and supplying services within the framework of international cooperation in various areas of economic activity.

Literature review

Many researchers consider the processes of integration of national economies, and attention to globalization processes is constantly increasing. Researchers such as Georgieva (Georgieva, 2024) and Suprunenko (Suprunenko, Pishenina, Pitel, Voronkova, Ryabovolyk, 2024) point to an increase in the possibilities of integration in various areas of international interaction as a result of the influence of globalization processes on the economy as a whole. In their opinion, integration was a consequence of an increase in the level of specialization of national economies, which gradually formed an international prototype of the economy in which there are centers of local and global specialization (Beridze, Baranik, Dashko I., Khamova, Tkachenko, 2021). The authors also found this information only within the borders of 150 countries that are part of the Belt and Road Initiative. Among the countries participating in the initiative, 17 are members of the European Union. (Chaplynska & Zhytkovich, 2023)

As the analysis of the history of globalisation presented by Roy shows, obtaining integration links became an objective necessity as a result of the increase in the level of internal development of economies due to the emergence of excess production of goods, which in these economies had a higher quality than in others, which prompted the formation of globalization processes (Roy & Riello, 2018). Eichengreen also points to the catalysis of globalization processes as a result of the development of the system of international settlements, which facilitated international cooperation of small and medium-sized enterprises, as a result of which integration processes began to proceed more smoothly (Eichengreen, 2019).

Some researchers, such as Moak (Moak, 2017), Ramge (Ramge & Schwochow, 2018), Vonnegut (Vonnegut, 2018), and Coppola (Coppola, Maggiori, Neiman, & Schreger, 2021), note that national economies benefit from globalization because they can raise the level of their rather developed enterprises, which allows them to obtain more competitive goods in the goods market, and, as a result, higher profits (Verbivska, Zhuk, Ievsieieva, Kuchmiiova, & Saienko, 2023). Researchers such as Nikolla (Nikolla,

2024), Annushkina (Annushkina&Regazzo, 2020), Canto (Canto, 2018), Baboyan (Baboyan, 2023), and Dowlah (Dowlah, 2018) draw attention to the increase in the efficiency of using various types of resources, both exhaustible and inexhaustible, with an increase in the level of integration, which is reflected in the formation of resource security for future periods for the functioning of national economies.

In examining the problems caused by globalization processes, Brende (Brende & Sternfels, 2024), Cui (Cui, 2024) and Reinsch (Reinsch, Goodman, Miller, & Caporal, 2020) note the surges in migration processes that harm the national and cultural development of nations. Such researchers as Bayar (Bayar, 2019), Sabry (Sabry, 2024), Grewal (Grewal, Kopalle, &Hulland, 2024), and Chand (Chand, 2021) focus their attention on the insufficient planning of processes caused by globalization phenomena and the resulting economic losses. Researchers such as Wong (Wong, 2020), Nguyen (Nguyen, Nguyen, Nguyen, & Luu, 2024), and Pascalau (Pascalau, 2018) draw attention to the problems of the development of national economies as a result of the negative impact of globalization, in particular as a restraint on the development of certain industries due to their low competitiveness in the global market, but which are socially significant for certain regions (Kryshtanovych, Akimova, Akimov, Kubiniy, &Marhitich, 2021).

However, according to researchers such as Popkova (Popkova, Ragulina, &Bogoviz, 2018) and Foster-McGregor (Foster-McGregor, Alcorta, Szirmai, &Verspagen, 2021), further industrial development is impossible without large-scale integration (Trachenko, et al., 2021). Since industrial development is accompanied by the emergence of environmental problems that have no borders, the creation of environmental safety conditions is one of the main tasks within the framework of globalization, according to Koval (Koval, et al., 2022) and Mia (Mia, et al., 2022). Since the transition from industrialization to informatization is accompanied by the rapid growth of information technology, then according to Hilty (Hilty&Aebischer, 2014), Hirna (Hirna,

Haivoronska, Vlasenko, Brodiuk, & Verbytska, 2022), and Gorgoni (Gorgoni, Amighini, & Smith, 2018), without integration in terms of effectively uniting specialists in the field of digital technology development, development processes will proceed unevenly, which will lead to the emergence of disproportions in the development of technologies (Koval, et al., 2022). Since the increase in information support for all national economies in the process of globalization will lead to the emergence of new marketing tools, then according to Grewal (Grewal, Kopalle, & Hulland, 2024) and Chkhaidze (Chkhaidze, Makharadze, & Devadze, 2023,7), these processes will be actively introduced into existing national economies (Bank, 2022a).

Methodology

Conducting a study to study the integration processes in the field of economics, carried out for groups in one geographical area of the country since they have more access to direct cross-border supplies of goods and communications in the development process. Since the main driving force of the modern economy is digitalization, it is necessary to start a study with certain countries in which the percentage of the information and communication sector in the gross added value is recorded (Ikeda, Iyetomi, & Mizuno, 2022).

Since not all countries carry out such recording, some countries cannot be studied in this direction, which can motivate the governments of these countries to study this area of the national economy (Dyvik, 2024). When conducting a study, it is advisable to study the longest possible period to obtain the average value of the percentage of the information and communication technology sector from the gross added value (Markovic & Alcchi, 2019).

To group countries by the level of the percentage of the information and communication technology sector from the gross added value, it is necessary to determine the average percentage for the period under study. Grouping of countries is carried out by forming three equal intervals of the percentage of the information and communication

sector from the gross added value (Tsounis & Vlachvei, 2020).

For each group of countries, the coefficient of correlation between the percentage of the information and communication technology sector from the gross surplus value and the gross domestic product per capita is determined (Tsounis & Vlachvei, *Advances in Longitudinal Data Methods in Applied Economic Research: 2020 International Conference on Applied Economics (ICOAE)*, 2021). Gross domestic product per capita is chosen as a factor characterizing the efficiency of the national economy (Kryvovyazyuk, Vakhoviych, Kaminska, & Dorosh, 2020).

To determine the dependence of the gross domestic product on the balance of the percentage of enterprises engaged in the export and import of information and communication technology, engineering and technical services, research, and scientific development, it is necessary to do the following. Initially, it is necessary to establish the number of enterprises in each of the countries of the selected group of countries of a certain region engaged in the purchase of services abroad and the supply of services abroad in all areas in general, and in the specified areas in particular (Nazarova, Kashchena, Nesterenko, Kovalevska, & Kashperska, 2022).

After receiving the necessary primary information, it is necessary to calculate the percentage of exports and imports separately for each of the following areas: information and communication technology, engineering and technical services, research, and scientific development (Reva & Demchenko, 2024). After determining the percentage separately in exports and separately in imports, the balance is determined for each country by subtracting the corresponding percentage of imports from the percentage of exports (Baank, 2021).

To obtain functional dependencies for the gross domestic product on the balance of the percentage of enterprises engaged in exports and imports, the available data are supplemented with the values of the gross domestic product for a certain year, and a linear relationship is determined between each factor separately and the gross domestic product.

Results

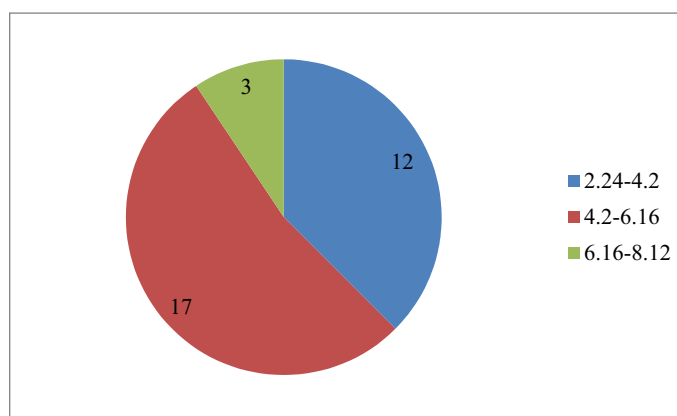
Europe was chosen as the region under study. To determine the percentage of the ICT sector in gross added value, the results presented by the governments of European countries for the period from 2016 to 2021 were considered. Among all European countries, the following countries constantly monitor and record the percentage of the ICT sector in gross added value: Belgium, Bulgaria, Czechia, Germany, Estonia, Greece, France, Croatia, Latvia, Lithuania, Hungary, Malta, Austria, Poland, Romania, Slovenia, Slovakia. The following governments partially study information on the percentage of the ICT sector in gross added value: Denmark, Spain, Italy, Netherlands, Portugal, Finland, Sweden, Iceland, Norway, Switzerland, United Kingdom, Bosnia and Herzegovina, North Macedonia, Albania, and Serbia. The following governments do not study or record information on the percentage of the ICT sector in gross added value: Ireland, Cyprus, Luxembourg,

As shown in Figure 1, the largest group of countries is the one with the average ICT sector percentage to the gross added value, which is 17 countries (53.1%). Unfortunately, 12 countries have a low ICT sector percentage (37.5%), and only 3 (9.4%) countries have a high ICT sector percentage to the gross added value.

When studying the correlation coefficient between the percentage of the ICT sector to gross added value and gross domestic product per capita for each group of countries at the end of 2021 for all the countries studied, a coefficient of

Montenegro, and Turkey. For countries where governments have consistently or in some years recorded the percentage of the ICT sector in gross added value, an average percentage was determined, and a grouping of countries was performed. Figure 1 shows a diagram illustrating the results of the grouping.

Figure 1. Number of countries in groups with a certain percentage of the ICT sector Source: compiled by authors.



0.148 was obtained, which means that there is a positive weak relationship. To clarify the nature of the relationship, calculations were made of the correlation coefficients between the percentage of the ICT sector to gross added value and gross domestic product per capita for each group of countries separately. Table 1 shows the results of the study.

Table 1. Correlation coefficients for each group of countries

Percent Interval	Countries	Correlation coefficient
2.24-4.2	Albania, Greece, Italy, Spain, Lithuania, Poland, Norway, Austria, North Macedonia, Slovenia, Romania, Belgium	0.244
4.2-6.16	Iceland, Portugal, France, Slovakia, Germany, Denmark, Croatia, Serbia, Czechia, Bosnia and Herzegovina, Latvia, Finland, Netherlands, Switzerland, Estonia, Hungary, United Kingdom	0.159
6.16-8.12	Bulgaria, Sweden, Malta	0.006

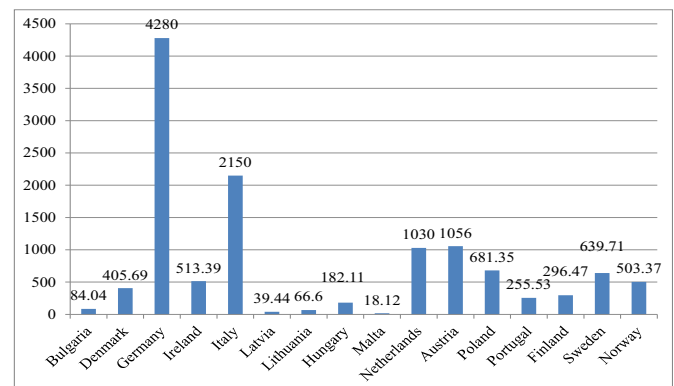
Source: compiled by authors.

As shown in Table 1, with an increase in the percentage of the ICT sector to the gross added value, the relationship between the percentage and the gross domestic product per capita weakens, which means that an increase in the percentage of the ICT sector will lead to a complete lack of connection, which significantly reduces the risks from the expansion of the ICT sector, that is, it is demonstrated that there are no risks for countries when increasing the percentage of the ICT sector in the gross added value (Sanakuiev, 2022).

However, the degree of readiness for the transition to information integration for the national economies of European countries is not the only factor that allows us to discuss how national economies respond to the new paradigms of globalization development. It is also necessary to analyze the readiness of enterprises in European countries to export and import services in general, and services in the fields of information and communication technologies, engineering and technical services, research, and scientific development (Sayed, 2023).

Since the main indicator of the efficiency of the national economy is the gross domestic product, we will consider it as a resulting factor in the study of the specified dependencies. To determine the dependence of the gross domestic product on the balance of the percentage of enterprises engaged in export-import activities, the countries that monitored the number of enterprises engaged in the export and import of services in various fields in 2021 were selected, namely Ireland, Italy, Latvia, Lithuania, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Finland, Sweden, Bulgaria, Denmark, Germany, and Norway. Figure 2 presents data on the gross domestic product for 2021.

Figure 2. Gross domestic product for 2021, billion euros



Source: compiled by authors.

As we can see from Figure 2, the countries selected have different levels of gross domestic product, with the highest indicator (for Germany) being 236 times higher than the lowest indicator (for Malta). Such different levels of GDP allow us to take into account its dependence on such factors as the size of the information and communication technology sector, engineering and technical services, research and development for countries with different levels of GDP, i.e. without taking into account the size of national economies, determining the trends of the desired dependencies, which makes them more unified for obtaining information on the course of globalization processes in the post-industrial spectrum.

A number of regression equations were obtained by applying linear regression, which are presented by formulas (1)-(3). Formula (1) shows the dependence of the gross domestic product for the selected group of countries on the level of the balance of operations on the export and import of services in the field of information and communication technologies. As shown in equation (1), this process is increasing, which indicates the need to expand cooperation between countries in this industry. According to the results presented in Figure 1, it is clear that this process is being restrained due to the lack of a large level of service supply in this area, which does not allow for effective expansion of integration in the field of information and communication technologies.

$$y = 22.1x + 1167.8 \quad (1)$$

Equation (2) contains the result of obtaining the dependence of the gross domestic product on the number of services in the engineering and technical services field. Compared with (1), the obtained function has a higher slope (68.3 compared to 22.1), which indicates a higher rate of increase of this function. This is because integration links have a broader communication base and history of development. The obtained result indicates the need to use the skills of cooperation between national economies in the field of engineering in the field of information and communication technologies.

$$y = 68.3x + 934.3 \quad (2)$$

Equation (3) is a linear model of the dependence of gross domestic product on the balance of operations on the exchange of services in the field of research and scientific development. Of the three areas studied, this process has the highest rate of increase. This became possible as a result of the fact that the scientific community effectively uses communication tools, which allows for improving the exchange of services in the field of scientific development between national economies.

$$y = 85.9x + 909.7 \quad (3)$$

The considered equations of dependence of gross domestic product on various factors of inter-economic interaction of national economies in Europe indicate the presence and constant growth of integration processes.

Discussion

Some limitations dictate the conduct of this study. Firstly, the study was conducted based on information provided by European governments, for the period up to and including 2021, and does not reflect the trends of the last two years. This is because European governments do not provide the statistics required to conduct such studies to the central European statistical authority on time.

Secondly, the study covered only those European countries that voluntarily submitted information on the number of enterprises engaged in the export and import of services in various areas, that is, 16 countries that considered it necessary to record the relevant information and make it available to a wide range of readers.

Thirdly, the study covered only three areas of types of

services for which exchange transactions are carried out between national economies since the objectives of this study include establishing the quality of interaction between national economies during the transition from an industrial to a digital economy. The study can be expanded to study other areas of interaction between national economies.

The study revealed that the formation of integration links between national economies is studied at the level of governments of European countries sporadically; there is no clear system for studying the activities of enterprises that supply abroad and purchase services by type, including various areas of interaction, both industrial and post-industrial. The study showed that in several European countries, such as Ireland, Cyprus, Luxembourg, Liechtenstein, and Montenegro, no study was conducted on the percentage of the information and communication technology sector from the gross surplus value, which means a complete lack of attention to the post-industrial development of the national economy.

Based on the results of the study of the percentage of the information and communication technology sector from the gross surplus value, the minimum (2.24) and maximum (8.12) average percentage were determined for the period from 2016 to 2021, since these studies were not subsequently conducted by the centralized statistical bodies of the European Union. As a result of the grouping, three groups of countries were formed: a low level (2.24-4.2), an average level (4.2-6.16), and a high level (6.16-8.12) of the percentage of ICT in the gross added value. For each group, the correlation coefficient between the percentage of ICT in the gross added value and the gross domestic product per capita was determined. It was found that with an increase in the percentage of ICT in the gross added value, the relationship between it and the gross domestic product per capita decreases, which means that governments can motivate entrepreneurs to increase the percentage of the ICT sector through additional investments without damaging the gross domestic product per capita.

When studying the structure of services purchased abroad by European enterprises in 2021, special attention was paid

to such groups of services as information and communication technologies, engineering and technical services, and research and development. The choice of these groups of services was made to study the impact on the gross domestic product of the countries participating in the study of these types of services. Since traditionally the relationship between national economies was carried out in the field of industrialization, it is necessary to obtain a regression equation demonstrating the dependence of the gross domestic product on the balance of transactions between enterprises of these countries for the provision of engineering and technical services from the total number of services. As a result of constructing this regression equation, it was found that for every 1% increase in the balance of services, there is a 68.3 million euro increase in the gross domestic product.

Since the scientific and political environment is actively declaring the transition from an industrial to a post-industrial economy, a regression study was conducted showing the dependence of the gross domestic product on the balance of transactions for the provision or purchase of information and communication services. For this area, the lowest level of increase in gross domestic product with an increase in the balance of services was obtained, which is 22.1 billion euros per 1%. Such a low level of influence of exchange between national economies of services in the field of information and communication technologies is explained, as was shown in the correlation analysis of the first part of this study, by the low percentage of the information and communication technology sector in the gross surplus value. Consequently, there is no basis for the implementation of exchange between the national economies of different countries, due to the small number of services in this sector.

The rather low level of interaction between national economies in the field of information and communication technologies may be because a large amount of scientific research is carried out in this industry, and interaction between national economies occurs to a greater extent in the field of scientific research and scientific development. When studying the impact of the balance of services in the field of scientific research and scientific development for

2021 in 16 European countries, it was found that with an increase in the balance of the percentage of services in the scientific sphere by 1%, an increase in the level of gross domestic product by 85.9 billion euros is expected, which is the highest indicator among the three types of services studied. Such high indicators obtained for cooperation between national economies in the field of scientific development are a consequence of previously carried out measures at the level of national economies to integrate scientific communities and research and production firms at a practical level.

The presented study revealed some facts that restrain the integration of national economies in the context of the transition from the industrial type to the post-industrial type. As the results showed, restraint occurs at the intra-national level, and it was proven that an increase in the percentage of the information and communication technology sector will not hurt the main macroeconomic indicators, which is the main motivating factor for increasing the investment attractiveness of this sector of the economy.

Conclusions

In the context of new paradigms for the development of integration and interaction of national economies in Europe, the methods of interaction in the field of information and communication technologies, engineering and technical services, and scientific research and development were considered. Despite the transition from an industrial economy to an information economy, the study found that most European countries (53.1%) have an average percentage, that is, from 4.2% to 6.16%, of the ICT sphere from gross surplus value, which indicates insufficient attention from European governments to the formation of surplus value in the field of information and communication technologies, since for the period under study from 2016 to 2021, the percentage of the ICT sphere in gross surplus value ranged from 4.19 to 4.97, respectively.

The low level of development of the information and communication technologies sphere, despite the desire to move from an industrial economy to an information economy at the global level, explains the lowest growth rate

of the gross domestic product dependence in national economies on the balance of services in the sphere of these technologies. According to the study, national economies interact most effectively in the sphere of scientific research and development, and the efficiency in the sphere of engineering and technical services is much higher than in the sphere of information and communication technologies (Baank, 2022b). The study shows that despite the declaration of the transition from an industrial economy to an information economy at the global level, the main factors of interaction between national economies remain interactions in the sphere of engineering, technical services, scientific research, and development, which is more effectively reflected in the gross domestic product produced in the national economies of European countries.

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