

ECONOMIC PROSPECTS FOR COOPERATION THE EUROPEAN UNION AND UKRAINE IN THE USE OF BLOCKCHAIN TECHNOLOGIES¹

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The article is devoted to the research of the possibilities of cooperation between the European Union (EU) and Ukraine in the use of blockchain technologies. The transition to the blockchain allows to minimise costs and maximise the results of economic activity. The experience of using blockchain technologies by world corporations is analysed. *The subject of the research* in the article is the potential of economic cooperation between the EU and Ukraine in the field of implementation and use of blockchain technologies. *The purpose* of the article is to find out the economic prospects of cooperation between the EU and Ukraine in the use of blockchain technologies. *Tasks*: researching of tendencies of development of blockchain technologies and possible variants of their implantation in activity of the Ukraine's enterprises, searching for benefits from cooperation between Ukraine and the EU in the field of use of blockchain technologies. General scientific used *research methods*: analysis – to determine the peculiarities of the use of blockchain technologies in the EU, synthesis – to find opportunities for cooperation between Ukraine and the EU in the use of blockchain technologies. The obtained *results*: based on the analysis of the dynamics of changes in the field of enterprise technology, problematic aspects are identified and the main advantages of the transition from the traditional management model to blockchain platforms are identified, and the economic benefits of locating mining farms in Ukraine compared to some EU countries are calculated. *Conclusions*: using of blockchain technologies by modern enterprises gives them a number of competitive advantages, including

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saving on labor costs, increased information security, reduced costs for quality control of products/services, etc. Blockchain allows to promote more sustainable cooperation between EU and Ukrainian companies not only in trade, but also in industry, finance and energy. By implementing joint blockchain systems with the EU, Ukraine can provide mining with low costs for electricity and wages.

Key words: blockchain, trade, cryptocurrency, technologies, mining, economy, cooperation, European Union (EU).

Formulation of the problem. The terms "blockchain" and "cryptocurrency" are firmly entrenched in the economic lexicon and are widely used by business analysts [1, 14], and the field of blockchain is attracting considerable attention from scientists [8-10]. Recently, interest to blockchain technologies has been increased by rising cryptocurrency rates. Thus, the price of one bitcoin was equal to the value of the Tesla electric car, and the digital currency itself is considered by investors as an alternative to gold.

But the use of blockchain technology can be useful not only in the financial sphere. The task is to optimize the activities of business structures, trade processes between countries, ensuring sustainable development, where the blockchain can provide a number of significant advantages. The economic effect of the use of blockchain technologies can be synergistic if the implementation of blockchain technologies is considered at the international level.

Analysis of recent research and publications. Although blockchain is the modern technology, there has been a lot of scientific work in this area, based on which, it is possible provide answers for problematic questions that arise. Prause G. in his work [10] notes that Industry 4.0 is based on the merging of the virtual and physical worlds, which requires new concepts for information management and indicates the possibility of using blockchain technologies. Monti M. and Rasmussen S. [8] propose an electronic architecture, created on the biological principle, as the basis of the Internet of Things, which will integrate many infrastructures and can be based on the blockchain. Esmailian B., Sarkis J., Lewis K. and Behdad S. in their work [5] explore the role that blockchain technologies can play in advancing supply chains in the direction of sustainable development. In parallel, Paliwal V., Chandra S., Sharma S. [9] reviewed the role of blockchain technology in the sustainable management of supply chains and showed the great strength and role of information systems that based on blockchain technologies. Among Ukrainian scientists, Davydova I. [15] dealt with similar issues and analysed the positive features of the blockchain and the problems that may arise while using it.

Today, many issues are related to the possibility of more global use of blockchain technology. This is especially true for minimising costs and maximising the benefits of doing economic activity. This article is devoted to finding

answers to such questions based on the analysis of existing experience of global corporations.

The purpose of the article is to research the economic prospects of cooperation between the EU and Ukraine in the use of blockchain technologies.

Research results. An important point for Ukrainian society is to assess the prospects for the introduction of innovative technologies in the country's economy, individual sectors of the economy, as well as the technologizing of society. However, the priority issue at the stage of considering possible options for economic modernization is the problem of legal regulation.

In the EU, USA, China, Singapore, South Korea and other countries, the foundations of legal regulation of the cryptocurrency market and blockchain industry were laid much earlier than in Ukraine, where only on December 2, 2020 the Verkhovna Rada of Ukraine voted in the first reading for Bill 3637 "On Virtual assets", which marked the beginning of the legalisation of the cryptocurrency market in Ukraine [18]. The absence of relevant laws means that payments with a cryptocurrency that has no legal status may be outside the law, which causes significant economic losses by the country in the form of uncollected taxes on cryptocurrency savings and transactions, as well as lost profits due to failure to provide possible services and guarantees to cryptocurrency owners [7]. Moreover, ignoring the development of blockchain technology at the national level can lead to the growth of the shadow sector of the economy [16, 17].

According to the information reference of the European Information and Research Center, October 26, 2017, the legal regulation of blockchain and cryptocurrency in some EU countries is carried out according to the principles listed in Table 1 [19].

In addition to legal regulation, an important problem in the introduction of blockchain in the Ukrainian economic system is the lack of understanding by most managers, civil servants and small, medium and large businesses of the principle of blockchain technology and the use of their potential benefits for the economy [2]. Therefore, it is worth paying attention to this problem.

I. Davydova defines the concept of a blockchain system [15] as a distributed public register based on modern cryptographic algorithms, which contains a database of all previously performed operations, which is decentralised and contained in public sources of the Network. On the other hand, decentralisation and publicity are discussed

in the context of large blockchain platforms, but the use of these same platforms on a smaller scale (e.g. in a single enterprise system) affects both decentralisation and publicity. Blockchain is a structured system with certain rules for building transaction chains and access to information.

Pros of using blockchain by business structures in the field trade field contain:

1. Minimal risk of losing any databases, virtual money and any information that must be protected by its owner. However, it should be noted that the loss of a private key (i.e. a special set of characters that is unique to each member of the system) can mean the final loss of your account, and thus permanently lose access to your data. On the other hand, if the private key becomes known to someone else, for example, an attacker, this person as a member of the system can make a fake transaction on someone else's behalf. Therefore, data protection depends only on the proper attitude to their own security.

2. Low transaction costs.

3. Ease of tracking transactions, i.e. the ability of each participant in the system to view transactions and events that took place in a certain period of time between two counterparties in the case of smart contracts or public blockchain platforms.

4. Innovative technology that, with proper use and support, provides unlimited opportunities, etc.

Transferring (or creating) a business from a traditional system to an innovative system based on blockchain technology can be done in four main steps [1]:

1. Identification of ways of blockchain use.

2. Analysis of the reality of blockchain implementation using the Proof of Concept tool.

3. Trial run.

4. Full functioning of the system.

Table 1

Aspects of legal regulation of blockchain and use of cryptocurrencies in EU countries

Country	Legal status	Government regulation
Germany	Virtual currency is a financial instrument. It is considered as a unit of account in comparison with foreign currency, but does not belong to the legal tender.	According to the law, cryptocurrency is a form of "private money" that can be taxed as capital. The creation of virtual money, as well as their use as a means of payment does not require any permits. If virtual money is sold, it is considered a financial instrument and requires licensing under the German Banking Act.
Austria	Cryptocurrency is considered by the tax authorities as an immaterial asset.	Cryptocurrency mining is considered as an operating activity. Income received as a result of its implementation is subject to income tax.
Finland	Virtual currency is not considered as currency or even as an electronic form of payment. The Central Bank classifies virtual currency as software that is a commodity.	The Finnish Tax Administration has issued instructions on the taxation of virtual currencies: - when transferring virtual currency to any other, the rule of taxation of capital gains is applied; - when virtual currency is used as a form of payment for goods and services, it is considered as an instrument of trade, and the increase in the value that the currency could receive after trading is taxed.
United Kingdom	The digital currency under the UK Law on Money Laundering is a combination of numbers obtained by complex mathematical calculations.	The UK Financial Services Authority does not recognize that bitcoin is a currency, digital currency or money, so cryptocurrency cannot be regulated in any way by UK financial law. New types of cryptocurrency in the UK are still beyond the financial regulation

Consider each step in more detail.

1. First, it is important to understand, is it necessary for businesses to switch to blockchain technology. The blockchain are most often used in trade, when it is necessary to simplify the transfer of data between counterparties, eliminate intermediaries, or in cases where it is necessary to secure large money transfer transactions using a more secure platform than existing ones. In other cases, blockchain technology can complicate the

company's work if the technical department is unfamiliar with the system, or there are other reasons for the inexpediency of using the technology, which are manifested in the second stage.

2. The POS tool (Proof of Concept) helps to document the first step – to prove or disprove the feasibility of implementing the blockchain in the enterprise. In the Ukrainian market there are several companies engaged in consulting and

development of individual blockchain platforms for business: Bitfury, AtticLab, BLOQLY and others.

3. If the feasibility of switching to the blockchain has been confirmed logically and documented, it is possible to proceed to the test phase. For example, if it is a large corporation, it is possible to try implementation the blockchain system in one of the structural units. If it is a small or medium business, it is possible to make an experimental launch over some period of time in order to assess the effect of the transition to this technology.

4. In the case of practical confirmation of the effectiveness of the transition to the blockchain in

the trial period, it is possible to change fully the structure of doing business to a new system.

It is worth noting that the transition to blockchain technology has recently become more common. Quite a few well-known companies in the field of goods or services trade are already making significant progress in this direction. In the Table 2 ten world-famous corporations that have partially or completely switched to blockchain technology are presented, as well as platforms they use (ranking is based on the size of the company's capitalization in descending order).

Table 2

Companies with the largest capitalization that use blockchain platforms [6]

No	Company	Country	Sector	Capitalization, billion \$	Blockchain platform
1	Microsoft	USA	Software	1622,92	Ethereum, Parity, Quorum, Corda, Hyperledger Fabric
2	Amazon	USA	Online retail	1590,55	Hyperledger Fabric, Ethereum
3	Google	USA	IT	1234,28	Bitcoin, Ethereum, Bitcoin cash, Ethereum classic, Litecoin, Zcash, Dogecoin, Dash
4	Facebook	USA	IT	801,311	No data available
5	Visa	USA	Finances	447,269	Hyperledger Fabric
6	Walmart	USA	Retail	419,877	Hyperledger Fabric
7	JPMorgan Chase	USA	Banks	374,197	Quorum
8	Mastercard	USA	Finances	338	Use a platform of own development
9	Comcast	USA	Telecommunications	236,316	Bitcoin, Ethereum, Hyperledger Fabric, Quorum
10	Intel	USA	Microprocessors, Computer Engineering	213,178	Corda, Ethereum, Hyperledger Fabric, Hyperledger Sawtooth

All the companies listed in Table 2 are registered in the United States, because this country is one of the first, where legal regulation of blockchain and cryptocurrency was introduced. Thus, government organizations involved in tax control of all activities of the companies were able to create certain tools that became levers of influence on the collection of the necessary data on the activities of companies, which greatly reduced the risk of firms to be in the shadow market. At the same time, the EU also has examples of the introduction of blockchain in enterprises in various fields. Among that fields are:

1. Logistics. With the use of blockchain, IT technologies and autopilot trucks, it is possible to create a decentralized supply chain both in the country and in international deliveries with the EU. This approach is actively studied [10] and

used in Europe. For example, the process of fuel delivery has always been and remains important for the country's economy, as the working of many enterprises, gas stations, etc. depends on the availability and timely delivery, but this process in the traditional sense has many shortcomings. The process of loading fuel into trucks, obtaining the appropriate invoices, permits, maintenance and navigation, scheduling – at each of these stages there may be complications that are associated with the mechanical action of certain forces. Automation of these processes will not only speed up their implementation, but also significantly reduce costs (autopilot – no driver costs; automatic refuelling and unloading of tanks – no staff costs; automatic navigation and maintenance – no costs for dispatchers; it means that more than half of the work and administrative personnel becomes

unnecessary) and increase the productivity of their implementation. This is just one of many examples of the use of blockchain in the delivery process, which Maersk has been doing successfully around the world. With blockchain help, the processes of delivery by ship, air and motor transport have been significantly simplified. The introduction of such technologies could improve the environmental, economic and social relations between Ukraine and the EU.

2. Finances. The concept of physical banks in the world is gradually becoming obsolete, as innovative technologies (cloud storage, the availability of a smartphone [13], etc.) are displacing uncompetitive physical departments. In Ukraine, for example, the largest bank Privatbank, has partially switched to blockchain technology. In its work, the technology of transaction encryption is used, as well as electronic access key, and the bank gives every Ukrainian the opportunity to open his crypto wallet. As for the EU experience, We.trade is the largest company that allows European banks to move from traditional customer request processing technologies to innovative blockchain technologies. The company is developing blockchain platforms that reduce the process of processing loan requests from 7 days under the old scheme of work to an hour on blockchain platforms [11]. This became possible due to the automation of most processes of considering the attractiveness of the client for the bank, the complete absence of paperwork and decentralisation of banks.

3. Production and delivery of products. It is important in the work of any food establishments, from grocery stores to catering establishments, to control every process related to food. From the moment of growing grain to the moment of selling bread it is necessary to control the quality of the product, storage and processing conditions. This, in turn, requires large expenditures of both monetary resources and human capital. Since blockchain technology allows each participant to monitor each other, and, accordingly, their actions and transactions, the trust to the product increases several times. Automatic control over the harvest in greenhouses, automatic collection, automatic transportation, control over the quality of cooking – all that are possible due to the introduction of blockchain technologies.

If we consider the prospects for the use of blockchain technologies in trade, we can identify the following advantages of using blockchain:

1. Confirmation of the correctness and transparency of contracts. In order to reach the trust relationship between the seller and the buyer about the quality of the product, its proper storage, in insurance cases the blockchain helps to store information that is accurate, it means that its changing to intentionally false will be reflected in the system and can be easily checked.

2. Technologizing of service processes. When the buyers buy goods, they receive a warranty card, a receipt of purchase, the serial number indicated on the package. If buyers for warranty reasons will need to return the goods, hand over for repair, or replace with a new one, they have to save all the documents confirming ownership of the goods (check, warranty card, packaging). This is an inconvenient procedure for customers, so while using the blockchain all information about the purchase process (time, place of purchase, warranty card, serial number of the product) can be recorded in blocks, which will significantly speed up and facilitate storage information about the product for both buyer and seller.

3. Online ordering. When buyers buy goods through the website, they often choose the option of placing an order in one of the branches of the chain store. However, the number of sales consultants serving online orders is often limited and insufficient. They check the order number, confirm the identity of the buyer through the passport number or phone. All procedures can be shortened if the buyer has a public and private electronic key used to verify identity in the blockchain system. Goods can be issued automatically at order points even without human assistance.

4. Discount system. Many networks of large companies use a system of personal discounts for customers, which can also be successfully implemented through a blockchain system: customer data, personal account number in a store, personal discount – all this data can be written in blocks.

5. Reducing the level of bureaucracy and corruption. The transition to a system in which there are no intermediaries, and there is only a buyer and seller, greatly simplifies the work of all organisations in the field of trade. We can get rid of queues at checkpoints at customs, unscheduled inspections by tax authorities, etc. All information can be stored in a single system and be available to all users. Anybody cannot change or hide the information without changing all the previous blocks.

Blockchain technologies can become one of the main areas where Ukraine and the EU can actively cooperate. On the path to European integration, it is important to find the benefits that Ukraine can give to the EU. One such benefit may be Ukrainian experience and advantages in cryptocurrency and mining. At the same time, the issue of Ukraine's transition to Industry 4.0 is important. Blockchain and cryptocurrency can be one of the drivers of such transition.

Cryptocurrency mining is the creation of new blocks of information that become part of a chain – a blockchain. In order to be the first, who create such a blockchain unit, a particular person or company has to have large capacity. The main

factors that increase the efficiency of mining in Ukraine are:

1. Low electricity price. In comparison with the leading EU countries, Ukraine occupies a leading position in low electricity tariffs. Thus, in 2019, the price per 1 kW*h for the needs of industry in Ukraine was 0,08 €. For comparison, in Germany – 0,2 €, in Spain – 0,14 €, in France – 0,12 € [4]. Consider this advantage on the example of a mining farm (a system of several video cards), which uses 10 graphics cards GeForce GTX 1650 (a powerful option on the market) operates with a minimum power of 300 W*h each. Thus, the power of the entire mining farm is 3 kW*h. As mining farms operate continuously, the daily consumption of electricity is 72 kW*h, and per month – 2160 kW*h.

Electricity costs in Ukraine and, for example, in Germany are:

In Ukraine: $2160 \cdot 0,08 = 172,8$ (€).

In Germany: $2160 \cdot 0,2 = 432$ (€).

The difference is 259,2 € per month of operation of the mining farm (the data do not consider the electricity cost for CPU, RAM, hard disk and power block, the difference for these types electricity costs is proportional).

2. Another factor that increases the efficiency of mining in Ukraine is the cheap labour required for farm maintenance, process control, etc. In Ukraine, the minimum wage at the beginning of 2020 was 157 \$ or 141,44 € per month at the current exchange rate [12]. And the minimum wage in the most developed and influential countries of Europe: Germany – 1223,42 €, Spain – 1047,75 €, France – 1216,22 €. Thus, in case we have at least two employees, the minimum monthly wages for Ukraine and Germany are:

In Ukraine: $141,44 \cdot 2 = 282,88$ (€).

In Germany: $1223,42 \cdot 2 = 2446,84$ (€).

The difference is 2163,96 € (subject to the payment of the minimum wage to employees).

3. Another factor is the lower average annual temperature in Ukraine than in the EU, that

provides a positive effect on the cooling of mining farms.

The monthly benefit from the operation of a mining farm in Ukraine compared to Germany is 2423,16 €. Based on this result, investment by EU public and private enterprises in Ukraine's economy, particularly in cryptocurrency mining and blockchain technologies, is a promising area of Ukraine's cooperation with the EU.

Consider what additional benefits can be obtained from the introduction of blockchain platforms in the work of a single business (Table 3).

As can be seen from table 3, the introduction of a blockchain platform can significantly reduce the cost of the company, and the size of the cost depends on the size of business (small, medium or large). Cost reduction is one of the main motivating mechanisms for companies to switch to blockchain technology.

Despite the fact that the technology is actively developing, at the moment we can identify the main threats, benefits and the real (current) state of the blockchain platforms (Table 4) [5].

The results of the research can affect not only theoretically but also practically the Ukraine's future and its integration into the EU through the introduction of blockchain platforms in the economic system.

Conclusions. In the article the possibilities of blockchain technologies in enterprise management and options for possible close cooperation between Ukraine and the EU in this area were analysed. Due to the fact that the sphere of innovative technologies is actively developing in Ukraine, more progressive EU countries can cooperate with Ukrainian companies on favourable terms, investing significant funds in the Ukrainian economy.

Higher economic effect of the location of mining farms on the territory of Ukraine in comparison with the EU countries was also calculated and proved.

Table 3

Comparison of two management systems by cost indicators

	Simple management system	Blockchain platform
Transaction calculation costs	+	-
Document storage costs (archive)	+	-
Audit costs (verification of the correctness of document management)	+	-
Staff costs	The more extra work – the more staff	Reduction of staff (and therefore staff costs)
Intermediary costs	+	-
Transaction fee	Commission to banks	Commission to miners (percentage for creation of new blocks)

Comparison of concerns, benefits and the current situation of blockchain platforms

Threats	Benefits	Reality
<ul style="list-style-type: none"> • The scale of technology • Consumption of large amounts of energy by blockchain technology • Regulatory and legality challenges • Potential loss of funds by losing a personal electronic key 	<ul style="list-style-type: none"> • Reducing the number of intermediaries • Transparency of transactions • Smart contracts 	<ul style="list-style-type: none"> • Blockchain technology is under development • Companies are actively investing in the development of this technology

ЕКОНОМІЧНІ ПЕРСПЕКТИВИ СПІВРОБІТНИЦТВА ЄВРОПЕЙСЬКОГО СОЮЗУ ТА УКРАЇНИ У СФЕРІ ВИКОРИСТАННЯ БЛОКЧЕЙН-ТЕХНОЛОГІЙ

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Стаття присвячена дослідженню можливостей співробітництва Європейського Союзу (ЄС) та України у сфері використання блокчейн-технологій. Перехід на блокчейн дозволяє мінімізувати витрати та максимізувати результати при веденні економічної діяльності. Проаналізовано досвід використання блокчейн-технологій світовими корпораціями. *Предметом дослідження* в статті є потенціал економічного співробітництва між країнами ЄС та Україною у сфері впровадження і використання блокчейн-технологій. *Мета* статті полягає в дослідженні економічних перспектив співробітництва ЄС та України у сфері використання блокчейн-технологій. *Завдання*: дослідження тенденцій розвитку блокчейн-технологій та можливі варіанти їх впровадження в діяльність підприємств України, пошук вигод від співпраці України та ЄС у сфері використання блокчейн-технологій. Використовуються загальнонаукові *методи дослідження*: аналізу - для визначення особливостей використання блокчейн-технологій у ЄС, синтезу - для пошуку можливостей співпраці України з ЄС у сфері використання блокчейн-технологій. Отримано такі *результати*: на основі проведеного аналізу динаміки змін в сфері технологізації підприємств виявлено проблемні аспекти та визначено основні переваги переходу від традиційної моделі управління на блокчейн-платформи, а також обчислено економічну вигоду від розміщення майнінгових ферм на території України порівняно з деякими країнами ЄС. *Висновки*: Застосування блокчейн-технології сучасними підприємствами надає їм ряд конкурентних переваг, серед яких економія на трудових витратах, підвищення інформаційної безпеки, зниження витрат на контроль якості продукції/послуг та ін. Блокчейн може сприяти більш стійкій співпраці компаній ЄС та України не лише у сфері торгівлі, а й у промисловості, фінансовій, енергетичній сферах. При реалізації спільних блокчейн-систем з ЄС Україна може забезпечити майнінг з невисокими витратами на електроенергію та оплату праці.

Ключові слова: блокчейн, торгівля, криптовалюта, технології, майнінг, економіка, співробітництво, Європейський Союз.

ЕКОНОМИЧЕСКИЕ ПЕРСПЕКТИВЫ СОТРУДНИЧЕСТВА ЕВРОПЕЙСКОГО СОЮЗА И УКРАИНЫ В СФЕРЕ ИСПОЛЬЗОВАНИЯ БЛОКЧЕЙН-ТЕХНОЛОГИЙ

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Статья посвящена исследованию возможностей сотрудничества Европейского Союза (ЕС) и Украины в сфере использования блокчейн-технологий. Переход на блокчейн позволяет минимизировать затраты и максимизировать результаты при ведении экономической деятельности. Проанализирован опыт использования блокчейн-технологий мировыми корпорациями. *Предметом исследования* в статье есть потенциал экономического сотрудничества между странами ЕС и Украиной в сфере внедрения и использования блокчейн-технологий. *Цель* статьи заключается в исследовании экономических перспектив сотрудничества ЕС и Украины в сфере использования блокчейн-технологий. *Задача*: исследование тенденций развития блокчейн-технологий и возможные варианты их внедрения в деятельность предприятий Украины, поиск выгод от сотрудничества Украины и ЕС в сфере использования блокчейн-технологий. Используются общенаучные *методы исследования*: анализа - для определения особенностей использования блокчейн-технологий в ЕС, синтеза - для поиска возможностей сотрудничества Украины с ЕС в сфере использования блокчейн-технологий. Получены следующие *результаты*: на основе проведенного анализа динамики изменений в сфере технологизации предприятий выявлены проблемные аспекты и определены основные преимущества перехода от традиционной модели управления на блокчейн-платформы, а также вычислено экономическую выгоду от размещения майнинговых ферм на территории Украины по сравнению с некоторыми странами ЕС. *Выводы*: Применение блокчейн-технологии современными предприятиями придает им ряд преимуществ конкурентных преимуществ, среди которых экономия на трудовых затратах, повышение информационной безопасности, снижение затрат на контроль качества продукции/услуг и др. Блокчейн может способствовать более устойчивой сотрудничеству компаний ЕС и Украиной не только в сфере торговли, но и в промышленности, финансовой, энергетической сферах. При реализации совместных блокчейн систем с ЕС Украина может обеспечить майнинг с невысокими затратами на электроэнергию и оплату труда.

Ключевые слова: блокчейн, торговля, криптовалюта, технологии, майнинг, экономика, сотрудничество, Европейский Союз.

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