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Strategic leadership of Information Systems in The Development of The Digital Economy

Kepemimpinan Strategis Sistem Informasi dalam Pengembangan Ekonomi Digital

Moamin Mazin Salim , Moamin.m.salim@uotechnology.edu.iq, (1)
Lecturer at Department of production engineering and metallurgy University of Technology-Iraq, Iraq

Yasir Jihad Saeed , yasserjihad@uokirkuk.edu.iq, (0)
Assistance Lecture, Department of Economics , College of Administration & Economics, Kirkuk University, Iraq, Iraq

Dahlia Abdulhussein Ahmed , Dahlia.a.Ahmed@uotechnology.edu.iq, (0)
Lecturer at Department of production engineering and metallurgy University of Technology-Iraq, Iraq

Mustafa Ali Ibrahim, Mustafa.a.ibrahim@uotechnology.edu.iq, (0)
ASS PROF. at Department of production engineering and metallurgy University of Technology-Iraq, Iraq

(1) Corresponding author

Abstract

The essay explores contemporary trends in the economic transformation of nations driven by digital technology. It provides an overview of key technology paradigms shaping economic growth and outlines the primary characteristics of the digital economy, such as shifts in production resources, evolving IT cycles, and the importance of networked models emphasizing connectivity, self-sufficiency, and autonomy. The economic landscape of the digital era is analyzed, with a focus on institutional frameworks, relational norms, and the prerequisites for adapting education systems to meet digital economy demands. The role of knowledge in societal evolution and its interaction with institutional environments and information domains is highlighted, alongside tools for information processing and protection. The essay presents the results of the Digital Economy Index (DEI) and its components, providing insights into the status of digital transformation. Based on these findings, proposals are formulated to advance the digital economy in the Republic of Iraq, addressing challenges and leveraging opportunities identified through statistical analysis and provided data.

Highlights:

1. Digital technology reshapes economies and drives development trends.
2. Focus on connectivity, autonomy, and knowledge transformation in digital era.
3. Proposals enhance Iraq's digital economy based on DEI analysis.

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Keywords: information age, digital economy, knowledge economy, technological order, institutional environment, digital economy index

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Introduction

Currently, the foundation of the technological order is established by the information accessible to all actors in socio-economic interactions, with the whole collection of unstructured information serving as a source for the creation of the information space. The information space comprises banks and databases, technologies for their management and utilization, and information telecommunication systems that operate on fundamental principles, facilitating information exchange between organizations and citizens while addressing their informational requirements (Withrow and Diagrams, 2004:87).

The digital economy is defined primarily as an economy where a significant portion of GDP is generated by activities related to the production, processing, storage, and dissemination of information and knowledge, with over half of the workforce engaged in these activities. Additionally, it embodies the concept associated with predictions of the forthcoming information society, highlighting the pivotal role of electronic information and communication technologies in the advancement of all major economic sectors.

The foundation of the digital economy comprises sectors involved in the manufacturing and distribution of electronic components and equipment (hardware), software (software), networking, and data transmission services (communication), along with integration and consulting services (services). The digital economy encompasses sectors involved in the synthesis, processing, storage, transfer, and display of information. The term encompasses education, science, and culture within the realm of the digital economy. It may be said that individual components of the digital economy are present in nearly every sector of the national economy.

The primary aim of the essay is to examine the characteristics of modern technology's impact on the digital economy, where strategic leadership is influenced by information systems that facilitate the establishment of a knowledge-based society.

Methods

The issue of the emergence of the information society and the digital economy in economic theory gained prominence solely in the latter part of the 20th century. The significance of information in transforming management methods and structures was highlighted in the writings of economists from heterodox schools, particularly in institutional economic theory, as exemplified by J. Galbraith (Galbraith, 1975:321), and in the theories of post-industrial society, notably in the works of D. Bell (Bell, 1973:7) and E. Toffler (Toffler, 1984:567). The characteristics of the creation, diffusion, and utilization of information were also examined by several neoclassicists, including F. Machlup, K. Arrow, J. Stiglitz, M. Spence, and J. Stigler. K. Arrow linked the reorientation of economic theory to two essential truths:

1) Information or signals have economic value, and therefore their receipt and transmission cost certain costs;

2) Different individuals have different information.

This leads to fundamental findings, notably that the unregulated information market fails to ensure the efficient allocation of resources, highlighting the significance of coordination and ethical guidelines in decision-making (Arrow, 1970:56).

The examination of practical and theoretical issues within the digital economy is partially grounded in research pertaining to information theory. N. Wiener, A.N. Kolmogorov, A.Ya. Khinchin, and K. Shannon established the information-theoretical framework, which catalyzed the comprehension of information-related issues across several fields and significantly broadened the scope of applications. It is acknowledged that, alongside the mathematical theory of information, several iterations of information theory—specifically topological, algorithmic, combinatorial, pragmatic, semantic, and teleological—emerge, coexist, and mutually enhance one another.

In the digital economy, the productivity and competitiveness of entities—whether individuals, firms, or national economies—primarily hinge on their capacity to generate new information, process, systematize, and effectively utilize existing information grounded in current knowledge (Castells, 1996:58).

The primary impetus of the digital economy is the generation and utilization of information, rather than the production and consumption of tangible goods. This encompasses both materialized forms, such as high-tech products, and intangible forms, ultimately serving as a crucial element in the advancement of the economy and society at large (Digital Economy Report 2021). The evolution of the economy entails a systematic and incremental transformation of technological paradigms, wherein the nascent technological paradigm first utilizes existing energy sources and transportation infrastructure. The establishment of new infrastructure transpires when an emerging lifestyle dominates the fundamental sectors of the economy, supplanting the former one (Yoshihiro, 1998:536). Table 1 provides a broad overview of technical modalities.

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Way of life	Development period	Prevailing infrastructure	Leading sectors of the national economy
1st	Late 18th – early 19th centuries	Roads, irrigation canals	Agriculture, Textile industry
2nd	Second half of the 19th century	Railways, shipping lines	Light industry, metallurgy, chemistry, shipbuilding, general engineering
3rd	Late 19th – Mid 20th centuries	Energy systems, post office, telegraph, radio communications, telephone, railways	Chemistry, metallurgy, mechanical engineering, fuel and energy complex (FEC), electrical engineering
4th	30-80s of the XX century	Expressways, power systems, pipelines, radio and television communications, shipping and airlines	Power industry, precision engineering, production of new synthetic materials, instrumentation, radio electronics
5th	80-90s of the 20th century – beginning of the 21st century	Telecommunication facilities, computer networks, satellite communications. Internet, global energy systems, ecological systems, airlines	Microelectronics, computer science, biotechnology, aerospace industry. Computer science, genetic engineering, education, healthcare, electronics, commerce

Table 1. *Brief description of the prevailing technological modes*

Source: Infrastructure for Supporting Inclusive Growth and Poverty Reduction in Asia // URL:https://www.adb.org/sites/default/files/publication/29823/infrastructure-supporting inclusivegrowth.pdf.

Result and Discussion

The present phase of the digital economy's evolution might be described as a time of establishment. This unusual developmental phase is marked by a juxtaposition of significant ambiguity regarding future conditions and rapid developmental dynamics. The second defining characteristic of the formative stage is the interplay between the inclination to refresh or dismantle existing structures (institutions, relationships, agents) and the concurrent emergence of new ones. The digital economy can be characterized by the following attributes:

1) Altering the fundamental characteristics of the primary producing resource. Within the framework of the digital economy's development, the significance of information as a production element is escalating. The industrial economy is defined by the growth of capital and energy-intensive industries, whereas the digital economy emphasizes the production of knowledge-intensive products, characterized by substantial investments in research, development, new technologies, materials, and equipment. (Aligica, and Tarko, 2012:254)

The rise in information intensity within the national economy and industry signifies the advancement of the digital economy. In the USA, Japan, and Germany, this value was established at 2.5-2.8%; in France and the UK, it was 2.2-2.4%; while in Italy and Canada, it was from 1.3-1.5%. Over the last decades, the Southeast Asian nations of South Korea, Taiwan, Singapore, and Hong Kong have augmented their knowledge intensity by 1.5 to 2 times, nearing the metrics of European countries, with South Korea having attained the American standard. The knowledge intensity in Iraq is between 0.7% and 1% (Iraq Country Report 2022). In 2021, the highest expenditures on research and development were recorded in Sweden (4.27%), Finland (3.51%), and Denmark (2.60%) (Gercek, 2018:398).

The incremental significance of information as a production element constitutes the foundation of the structural transformations within the national economies of the aforementioned nations. A complex mechanism of cause-and-effect relationships is initiated, resulting in the contradictions of social, technological, infrastructural, financial, energy, and other domains, which were previously harmonious during the industrial stage of development, transforming into a state of disharmony or conflict.

2) Altering the parameters of information technology cycles. In the economy, several cyclical processes coexist, with some being short-term and others long-term; yet, the majority of economic cycles exhibit rather consistent features, particularly the duration. For instance, demographic factors (the lifespan of an individual is around 70 years, the educational phase spans 10-15 years, and the working capacity lasts 40-50 years), as well as production and investment cycles, are structured for investments in capital goods and fixed assets (such as buildings, equipment, and fundamental technologies). The advancement of information technology has led to certain

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inconsistencies between economic cycles, particularly in production and investment, and the cycles of information technology due to a misalignment of their characteristics.

The primary observation is that the duration of information technology cycles within the framework of the digital economy has significantly decreased compared to previous economic cycles and continues to diminish. While the fundamental technologies of the preceding technological era evolved at a sluggish pace, the current situation is markedly different. The cycles of information technology are highly dynamic, attributed to the fundamental characteristics of information: its intangible nature, ease of replication and distribution, extreme cost subjectivity, and the potential for swift cost reduction; consequently, predicting the parameters of the information technology cycle proves challenging. The parameters of alternative economic cycles exhibit more stability.

3) A network model of development and interaction emphasizes the necessity of networking to provide functionality. The network serves as the fundamental backbone for information transfer, rendering the advancement of the digital economy nearly unattainable without its utilization. In the digital economy, novel economic structures are emerging from global networks of capital, government, and information, with access to technology skills and knowledge through these networks serving as the foundation of productivity and competitiveness. Companies, firms, and increasingly, other organizations and institutions are forming networks of diverse configurations, which signify a break from the conventional differences between major corporations and small enterprises (Castells, 1996:59).

The digital economy requires for its development the use of adequate network interaction models that are closest to the definition of complex networks. Under these conditions, the following contradictions appear – between the existing linear, hierarchical, matrix and emerging perfect network models of interaction (B2B, B2C, B2G) and their basic characteristics (global – local, a large number of connections – a small number of connections, static – dynamic).

4) Focus on self-sufficiency, autonomy, predominantly within the network nature of interaction. The digital economy is being created in the context of a reduction in the reserves of natural resources in the world, an increase in the energy intensity of economies, a deterioration in the environmental situation and a simultaneous increase in the desire to achieve stability and predictability of business processes, a change in the ratio of basic values (free time, standard of living, well-being, work and leisure). The globalization of the world economy, which gives firms and countries the freedom to choose a business partner and, consequently, less dependence on their dictate, the power of transnational corporations (TNCs), financial globalization, the development of a single type of economic practice – these are the new rules for the development of the modern world economy. The formation of a single economic, social and cultural space under the influence of information technologies is taking place in the world.

First: the digital economy features.

The advancement of the digital economy results in a shift in the ratio between the quantity of material and energy utilized and the volume of information embedded in the goods and services generated during the manufacturing process. There is a reduction, ceteris paribus, in the bulk of the substance utilized and in the energy expended. The substantial reduction in GDP energy intensity in industrialized nations is mostly attributable to advancements in the information and communication technology (ICT) sector.

Consequently, the digital economy – the economics of the information society – encompasses a broad spectrum of enterprises that produce and distribute products and services using information and communication technology. The digital economy is a system of interactions among economic entities characterized by several distinctive traits that set it apart from previous economic systems. It is prudent to emphasize the principal characteristics of the digital economy:

1) Knowledge and information, manifested in products and services, constitute an expanding portion of value creation, evidenced by the rising knowledge intensity of manufactured goods, escalating research and development expenditures, increasing contributions of "high technologies" to GDP, and the surpassing total costs of purely information sectors—such as electronics and communications—over the associated costs of energy generation, transmission, and consumption;

2) Activities pertaining to the production and processing of information and knowledge are gaining significance, evidenced by the rising proportion of workers engaged in these processes, reaching half or more of the nation's entire amateur workforce;

3) The progressive shift of economic activity from a collection of production processes to a series of functions: design, supply, transportation, and sales of products;

4) The swift transformation of previously unique products into commonplace items, coupled with the rapid obsolescence of technologies, marketing concepts, and professions, necessitating the prompt generation of replacement information;

5) The escalating importance of management in overseeing the development and dissemination of information and

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communication technologies as a means to mitigate strategic errors associated with their utilization.

In all fundamental decisions on the development of information systems in the digital economy, a balance of interests of the participants in relations should be achieved, which increases their importance and significance. To this end, the main stakeholders of the digital economy, as a rule, develop and approve the following indicative list of documents that regulate the rules of relationships and establish a structure within the institutional environment:

a. Code of Conduct;

b. Recommendations on wages and remuneration, ensuring equal rights, non-interference in their private life, freedom of expression;

c. Rules and regulations relating to environmental protection, health and safety in the workplace;

d. norms and rules prescribing constant concern for improving the quality of goods and services produced, conducting an acceptable pricing policy, as well as observing the ethical aspects of advertising;

e. Norms and rules that determine the priorities of the corporation's charitable activities;

f. Programs to inform, train and educate managers on issues of corporate relations.

Second: National education police.

National education must adequately reflect and meet the needs of society. However, the forms of organizing the acquisition and updating of knowledge in Iraq have practically remained unchanged. One form of resolving contradictions between the interests of society, group interests (for example, corporations, educational institutions) and the interests of the individual can be the development of education on the principles of openness. The principles of openness in education are expressed, as a rule, in the possibility of the subject to manifest his will, in the recognized need, in independence, in the absence of any restrictions and constraints. In higher professional education, for example, this is primarily an “accessibility policy”:

1) Freedom in admission, for example, to a university (renunciation of any conditions and requirements for enrollment in studies; “open door policy”);

2) Freedom in planning training (relative freedom in drawing up an individual training program by combining courses; "individual educational trajectory of personality development");

3) Freedom in choosing the time and pace of training (admission throughout the year and the absence of training periods);

4) Freedom in choosing the place of study (the organization of the educational process is such that there is a choice of where, how and with whom to study; "points of open access");

5) Freedom of choice of a teacher (determination of the teacher who most potentially meets the needs of the individual, especially in the future, when training can develop into “educational consulting” for the student and teacher).

Often, when implementing distance learning technology, problems arise that are difficult to solve with this form of education. In particular, a serious problem when using distance learning in engineering education is the conduct of laboratory work. In essence, it is difficult to imagine a full-fledged training of a specialist in most engineering specialties without him getting acquainted with real physical devices and installations and gaining skills in working with them. We can only talk about a significant reduction in the amount of hours devoted to the traditional type of education, due to the student's in-depth study of the relevant physical processes on the basis of a virtual laboratory workshop based on models that fully reflect the studied real processes and phenomena.

Promising directions for creating such workshops are based on the use of network technologies. In this case, there are two options when the workshop functions as a network application, or as a local application, the executable code of which is downloaded by the client from the cloud service of the corresponding distance education center . Creating applications as downloadable applets eliminates the need to purchase and install the corresponding applications on each client machine, provides a platform-independent mode, and makes it easy to keep the application up to date.

At the same time, in a number of cases, it becomes necessary to use such complex mathematical models of real processes that the creation of an appropriate applet turns out to be impractical. Under these conditions, only the interface part of the application can be designed in the form of an applet, thus allowing the remote user to create a task for modeling. The latter is transmitted over the network to the application server, executed there, and the simulation results are returned to the user through the applet.

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A separate direction in solving the problem of laboratory workshops is the creation of systems with network remote access to real laboratory facilities. In this case, in essence, we are talking not about a virtual, but about a real practice of a distributed type with multiple two-way remote access to the management of real physical objects, providing real-time receipt of the results of the impact on the object on the client computer. Of course, it is advisable to use such a rather complicated technology only in case of access to unique installations within the framework of cooperation between several universities, in particular, when implementing the concept of a virtual university. Research in the field of creating laboratory workshops should be concentrated in the following areas (Heradio, de la Torre, Jose & Dormido, & Vargas, 2011:138)

a. Development of a tool environment for the implementation of virtual laboratory work based on remote access to model libraries;

b. Provision of client-server interaction in the Internet environment to support laboratory workshops that provide remote access to real objects.

One of the most important trends in the modern system of Iraqi education is the development of on-line education. Advances in science and technology have turned the computer network into an effective tool offering dissemination of learning materials based on interactive multimedia, open discussion of opportunities for exchange between learners and tutors/teachers and among learners themselves, and course management at the tutor/teacher level.

At present, new forms of education are becoming more widespread in educational institutions, while the old forms are preserved. In this regard, it can be said that educational institutions with a dual and mixed model of education are currently operating within the framework of the Iraqi education system. Many dual and blended educational institutions have endorsed well-prepared learning material designed to support distance self-learning and are using it for face-to-face teaching of students at universities, following standard lectures and face-to-face seminars. It is very rare to find the opposite.

Since access to the university server for on-line work is provided for students studying part-time in ODL, students studying full-time at the university require the same opportunity, allowing them, as an integral part of their education, to work at home.

In selected educational institutions that currently claim leadership in the open education sector, the learning process is based on high quality interactive multimedia material located in educational databases available on-line. Above this, institutions should offer various types of support functions for different groups of students, using lectures and face-to-face seminars, video lectures and video conferences, online virtual seminars, and computer conferences.

The aforementioned examples suggest that, within the context of the issue at hand, particular emphasis should be placed on the domain of education in the digital economy. Education is a crucial element in the advancement of a knowledge-based society. The subject of education is crucial in addressing the issue of human growth. Highly educated and proficient individuals are essential for the generation, distribution, and efficient use of information.

Third: Features of a knowledge economy.

A knowledge-based society need comprehensive educational systems that extend to increasingly broader segments of the population. Education systems must ensure an increasing percentage of highly qualified professionals in the workforce, establish conducive conditions for the ongoing education of citizens, with particular emphasis on creativity and adaptability, to enhance their capacity to consistently adjust to the evolving demands of social progress and the knowledge-based economy. The global acknowledgment of credentials and degrees conferred by educational institutions in various nations should aid in the development of contemporary education systems.

A knowledge-based society imposes greater requirements on the skill proficiency of the workforce. Consequently, among the nations of the Organization for Economic Co-operation and Development (OECD), the percentage of employees possessing higher education has increased in recent years, along with the economic benefits derived from such education. In these nations, the proportion of the adult population possessing postsecondary education rose from 22% to 48% between 1975 and 2006, nearly doubling. Despite a substantial growth, the percentage of workers possessing higher education remains insufficient to satisfy the growing need for competent professionals.

The essential characteristics of a knowledge-based society and economy are predominantly shaped by the extensive utilization of information resources, which possess distinct attributes that differentiate them from conventional resources (machinery, equipment, natural resources, etc.) (Figure 1). A comparison of traditional resources with information resources shows that the former are characterized, as a rule, by material flows and stocks, while knowledge and information are characterized by intangible flows and stocks. In addition, knowledge increases if it is transferred, replicated and used, and vice versa, if knowledge is not used, it decreases and is destroyed. In this they differ from machinery and equipment, which the more they are used, the more they wear out, reducing their cost.

A traditional resource is often a private good, meaning its usage by one individual precludes consumption by

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another individual. An information resource typically functions as a public good, whereby the utilization by one consumer does not exclude its use by others. Conventional resources are predominantly finite. The reproduction of information resources by individuals is boundless. The Internet serves as a prominent illustration of an infinite information resource.

Traditional resources can be replicated at great cost: it takes almost as much labor and capital to make another car as it did to make the previous car. At the same time, the cost of producing the first copy, distributed over the total output of the entire series, per car is relatively small. When replicating an information resource, the situation is reversed: the cost of the process of copying information, as a rule, is negligible. In this regard, the issue of storage, systematization and effective use of already accumulated information is of particular importance in the new economy in order to get the maximum of newly created value and useful effect from each element of knowledge.

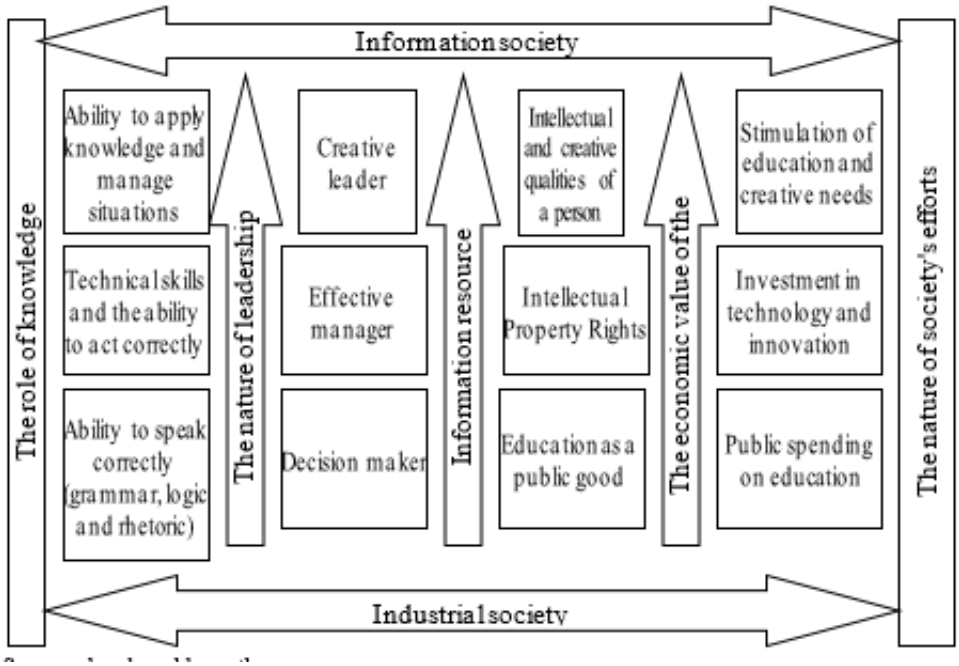

Figure 1. *Changing the role of knowledge in the development of society*

The use of information resources is defined by the phenomenon of network interaction. The integration of several contemporary technological devices (computers, fax machines, telephones) inside a vast network is the underlying reason. Under typical circumstances, the value of any gadget is dictated by its specific attributes and is largely unaffected by the prevalence of comparable devices. This does not apply to the network. An increase in the number of components inside the network enhances the usefulness and the associated economic impact of each individual device. This is evident in the case of the telephone network. The value of each telephone set increases with the number of subscribers in the network, encompassing both individuals and institutions that may be contacted. A form of positive feedback transpires when all proprietors of current gadgets are motivated to enhance this network and experience a magnification of the benefits from such an expansion. A broader network is more appealing to join. A similar phenomenon is observed in computer networks. Specifically, an increased number of nodes on the Internet enhances performance, which is applicable to many software kinds.

Special attention within the institutional environment of the digital economy should be given to the concept of an information resource. Within the framework of the main interaction of the institutional environment of the digital economy and the information field, an information resource arises. In our opinion, an information resource is information that is useful within the institutional environment from the information field. The main element of this interaction is the information filter, which, according to the author, is the main information processor that filters out useless information (Figure 2).

The main tools within the information resource are the tools for processing and protecting information:

1 Computing power;

2. Intellectual resource of the user;

3. Data networks;

4. Information storage devices;

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5. Legal support of information security processes.

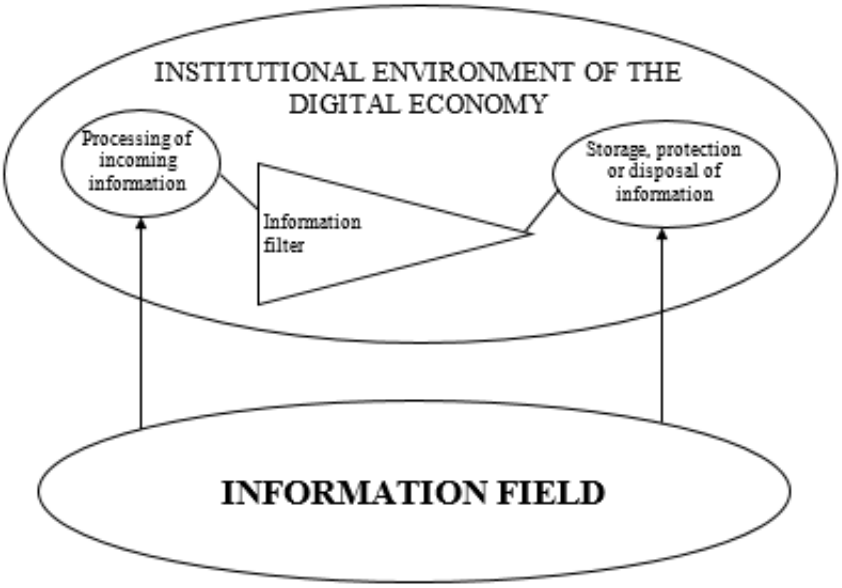

Figure 2. *Scheme of interaction between the institutional environment of the digital economy and the information field*

In a society based on knowledge, the importance of the so-called external effects (externalities) is increasing. This applies not only to network products, but also to education. Quality education of individual members and groups of society contributes to the cohesion of the entire nation, helping to strengthen social unity and trust in social institutions, the activation of the population and open discussions, as well as the correct understanding of issues of gender, ethnic, religious and social diversity. In addition, a pluralistic democratic society is based on the results of scientific and analytical research, the development of which is promoted by programs in the social sciences and humanities. Higher education is indispensable in the preparation of the necessary health professionals, which provides significant social and economic benefits for the whole society, promotes the transition to a healthy lifestyle and improves health outcomes.

When comparing the levels of scientific and technological development of different countries, indicators of science intensity and science output are used. Without dwelling on their methods for determining values, let's try to outline the place of the Republic of Iraq in the global scientific and technological space, based on the knowledge of key indicators.

The share of R&D spending in Iraq in 2021 was 1.52% of GDP. At the same time, R&D spending by the 27 member countries of the European Union exceeded 480 million euros. As a percentage of GDP, the level of spending on R&D amounted to 1.84%. However, the intensity of R&D in Iraq is significantly lower than in other major countries of the world: in the US, R&D spending is 2.68% of GDP, in Japan – 3.18%. In China, this figure in 2021 reached a level of 1.34%.

In terms of GDP per employed person, which characterizes the productivity of the national economy, Iraq ($9.2 thousand, in prices and purchasing power parity (PPP) 2021) is 3.5 times inferior to the United States ($36 thousand) and 2.7 times to the countries of the European Union (24 thousand dollars). According to the World Economic Forum Competitiveness Index, Iraq ranks 59th, behind China (33rd) and India (46th), which have significantly lower GDP per capita. In terms of the share of high-tech exports in total merchandise exports, Iraq (3.1%) is at the level of India (3.1%), yielding more than five times to China and 2.5 times to Italy (7.9%).

The World Bank proposes one of the most comprehensive and constructive methodologies for assessing the digital economy through its Knowledge for Development initiative (2004, Knowledge for Development – K4D) (Wah, 2018:654). The suggested technique evaluates a country's preparedness to shift to a knowledge-based development paradigm. A collection of 76 indicators is offered to facilitate the comparison of individual indicators across several nations, as well as the average indicators representing a group of countries. Comparison may be conducted using both individual indicators and aggregated indicators that characterize the following essential attributes:

An institutional regime that provides incentives for the effective use of existing and new knowledge and the development of entrepreneurship. The degree of education of the population and the availability of its skills regarding the creation, dissemination and use of knowledge. An information and communication infrastructure that facilitates the efficient dissemination and processing of information. A national innovation system that includes firms, research centers, universities, consulting and other organizations that perceive and adapt global knowledge

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for local needs and create new knowledge and new technologies based on it.

Economic institutional framework. This directive outlines the circumstances under which the economy and society together evolve. This approach takes into account both the formal and informal "rules of the game." In the digital economy, the primary inquiry is to the extent to which the economic and legal framework influences the generation, dissemination, and utilization of information in its many forms. Specifically, the accessibility of money for creative projects, the extent to which education and training are promoted, and the degree of respect for intellectual property rights, among other factors.

This area encompasses indicators of tariff and non-tariff barriers, the quality of economic regulation (evaluated through price control, banking regulation, foreign trade regulation, and business development), the extent of legal implementation (assessed via the criminal situation, among other factors), and additional metrics.

The digital economy requires a flexible educational system, as well as education that takes place throughout the working life of workers. The system of continuous education implies both formal and non-formal types of this training, as well as a competitive environment of educational institutions. To assess education, indicators of adult literacy are used, as well as the ratio of registered schoolchildren and students in relation to the number of persons of the corresponding age, as well as a number of others.

To realize the existing significant potential for the formation of a new economy in the country, it is necessary to develop the institutional foundations of the modern economy and accelerate the growth of the material and technical base of the digital economy, including the massive development of modern means of communication and communication. Information technologies and communications, which are assessed using the number of telephones, personal computers, Internet users in the population, as well as other similar indicators.

Innovations that demonstrate the efficacy of commercial collaborations with universities, libraries, research institutions, labs, innovation hubs, and diverse professional associations. Innovation is assessed by the quantity of scientists engaged in R&D, the count of registered patents, the volume of published papers in scientific and technical publications, along with additional metrics.

The K4D program provides two composite indices: the Digital Economy Index and the Knowledge Index. The Digital Economy Index represents the mean of four indices: the institutional regime index, the education index, the innovation index, and the information technology and communications index. The knowledge index is the mean of three components: the education index, the innovation index, and the information technology and communications index. These indexes are computed for individual nations, groupings of countries, and the entire globe. Table 1 compares the Digital Economy Index (DEI) and its components across several nations. The nations are organized based on the magnitude of the decline in the DEI, and their geography is rather expansive.

An analysis of the data in the table allows us to conclude that, in terms of innovation, the Iraqi index takes values close to the corresponding values of this index for countries that are ahead of Iraq both in terms of the digital economy index and in terms of the overall level of economic development. The same can be said about the education index. At the same time, the index of the institutional regime of the economy is disproportionately low in the country (in general, for the countries of Europe and Central Asia, this index is almost twice as high, it is also higher in countries that significantly lag behind Iraq in terms of the aggregate digital economy index, in particular, in Brazil and Ukraine). All of the countries at the top of the table have an institutional regime index that is significantly higher than that of Iraq. A similar conclusion can be drawn about the information infrastructure index.

Country	DEI	Institutional regime of the economy	Innovation	Education	Information infrastructure
Sweden	9,25	8,36	9,67	9,20	9,78
US	8,69	7,81	9,47	8,43	9,03
Germany	8,38	7,95	8,88	7,87	8,82
Ireland	8,04	8,01	7,86	8,23	8,07
South Korea	7,70	6,10	7,88	7,80	9,03
Estonia	7,70	8,18	7,03	7,74	7,84
Czech Republic	6,80	6,10	6,76	7,07	7,28
Russia	5,69	2,43	7,57	7,52	5,25
Argentina	5,23	1,74	6,06	7,13	5,99
Brazil	5,03	3,92	4,84	5,55	5,82
Ukraine	4,92	2,49	6,03	7,82	3,33
Kazakhstan	3,62	1,55	4,08	6,30	2,56
China	3,50	2,42	4,18	3,04	4,35

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Iraq	3,18	1,12	3,47	3,09	2,18

Table 2. *Digital Economy Index (DEI) and its components*

Thus, analyzing in general the readiness of Iraq to embark on a path of development based on knowledge, it can be noted that the country's economy has significant opportunities to adapt to new conditions. These opportunities are primarily due to high intellectual potential, significant opportunities for the innovation process and a sufficiently developed material and technical base of the national innovation system. At the same time, unresolved problems in the development of the institutional environment remain a kind of brake that hinders Iraq's progress towards a digital economy.

Specifically, these include the inefficiency of governmental administration and economic regulation, the underdevelopment of venture capital, and significant administrative hurdles. To harness the considerable potential for establishing a new economy in the country, it is essential to enhance the institutional frameworks of the contemporary economy and expedite the advancement of the material and technical infrastructure of the digital economy, particularly through the extensive development of modern communication technologies. Consequently, the digital economy is a fundamental component of the information society.

The information society represents a phase in the evolution of contemporary civilization, marked by the heightened significance of information and knowledge in societal functioning, a growing proportion of information and communication technologies, products, and services within the gross domestic product (GDP), and the establishment of a global information framework that facilitates efficient information exchange among individuals, grants access to global information resources, and fulfills their social and personal requirements for information products and services (Kurzweil, 2016: 76).

Information or post-industrial society (IS) is a philosophical term denoting the stage of development of society that has been achieved so far, the main and defining value of which is; information. The definitions of informational and post-industrial are often used in the scientific literature as identical, meanwhile, each of them carries its own semantic load: the first indicates a meaningful feature of a new type of society, the second indicates a chronological sequence in the development of society. We will try to reveal these features from the standpoint of economic theory.

The main work on the study of the information society was initiated by a number of Japanese research organizations: the Agency for Economic Planning ("Japanese Information Society: Topics and Approaches", 1969), the Institute for the Development of the Use of Computers ("Information Society Plan", 1971), the Council for the Structures industry ("Contours of the policy of promoting informatization of Japanese society", 1969).

These studies characterize the information society as one in which advancements in computerization provide individuals access to accurate information sources and alleviate them from mundane tasks, ensuring a high degree of production automation. Simultaneously, substantial alterations will immediately impact manufacturing, resulting in a more information-intensive product, therefore significantly augmenting the proportion of innovation, design, and marketing in its value. The authors assert that the creation of an information product, rather than a tangible object, will be the catalyst for societal education and growth.

In 1973, the American sociologist D. Bell published a book titled "The Coming Post-Industrial Society" (Bell, 1973: 17). The phenomenon of social forecasting popularized the phrase "post-industrial society" (Riesman, 1958 & Coomaraswamy, 1914). D. Bell categorizes the entirety of human civilization into three distinct eras: agricultural, industrial, and post-industrial (Table 2). D. Bell posits that a significant characteristic of the coming post-industrial society is the expansion of the service sector, the heightened importance of theoretical knowledge, an emphasis on futurism, and the advancement of novel intellectual technologies. D. Bell is the originator of the prominent classification of civilizations based on specific characteristics: the primary production resource, the type of production activity, and the nature of fundamental technology.

	Main production resource	Type of production activity	Nature of underlying technologies
Post-industrial	Information	Sequential processing	Science-intensive
Industrial	Energy	Manufacturing	Capital intensive
Pre-Industrial	Raw Materials	Mining	Labor Intensive

Table 3. *Categorization of societies proposed by D. Bell*

In the 1970s, a groundbreaking technical development occurred - the introduction of the microprocessor (Intel 4004, 1971), the fundamental technology of contemporary computers, followed by the widespread adoption of the personal computer (IBM PC, 1981). The remarkable increase in the productivity and accessibility of personal computer technology facilitated the emergence of the information society. The Japanese scientist I. Masuda subscribes to this perspective. The fundamental concepts and characteristics of the forthcoming society are delineated in his book The Information Society as a Post-Industrial Society (Masuda, 1983: 171).

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The author posits that the cornerstone of the future society will be computer technology, which he perceives primarily as a means to replace or substantially augment human cognitive labor. I. Masuda delineates the novel attributes of information, due to which it will replace traditional utilitarian material values: universality of information; ability to self-growth, he notes that information does not wear out, may not be spatially separated from subjects, it accumulates to be reused. An important distinguishing property of information is the simultaneity of its production and consumption (Reizema, 1991: 132). The result was the recognition of information as a specific resource, very different from traditional factors of production.

T. Stonier contended that information, akin to money, may be amassed and preserved for further utilization. He felt that in an information society, national information resources will emerge as the most significant potential source of income. In this context, it is essential to cultivate, primarily, a new sector of the economy – information. In the emerging society, the industrial sector, regarding total employment and its contribution to the national product, will be supplanted by the service sector, primarily focused on the collection, processing, and diverse provision of necessary information (Stonier, 1983: 224).

Another theorist of the information society, E. Toffler, attributed the following to the signs of a new society: deconcentration of production and population; significant growth of information exchange; the development of small firms replacing giant corporations; the predominance of self-governing and self-organizing systems. In his opinion, "information plays a role as important, if not greater, than land, labor, capital and raw materials" (Penty, 1917: 213). He predicted the emergence of new elites based on inequality in the possibility of obtaining knowledge, a decrease in the role of "material wealth as the main personal incentive value", considered the consequences of the emergence of multinational corporations and the need for a fundamental change in the structure of many large corporations, in connection with the transition from industrial to "super industrial" epoch.

Conclusion

According to the current ideas, a developed information society is characterized by a certain set of features, among which, first of all, such as an increase in the role of information and knowledge in the life of society, the creation of a global information space, the emergence in the economy of fundamentally new approaches to the use of modern information and communication technologies, raising the level of professional and cultural development on the basis of modern education systems, etc. Any developed information society should be based on certain basic components: the digital (new) economy, e-business and e-commerce, which make up its economic base; knowledge-oriented technologies, which are its intellectual base, through the involvement of highly qualified specialists and the creation of a developed system of education and training; the growth of the welfare of citizens; technologies of e-government and e-democracy, which form the political basis of the information society.

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