The Internet and Information and Communication Technologies in Today's Society

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Edited by
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PREFACE

An important feature of the modern world is the active introduction of the internet and information technology into various spheres of public life.

In that regard, it is important to discuss the results of new scientific and practical research in the field of the Internet and information technology and share the opinions and experiences of scientists working in this field.

The recognition of the opportunities and challenges of the Internet and information technology and understanding their role and importance in the socio-economic development of the country is a relevant task at the present stage.

The IX international scientific and practical conference "Internet and Society" was held on October 6-7, 2023, at Akaki Tsereteli State University.

The conference proceedings brought together review articles and research papers from the registered participants of the conference. The papers included in this book reflect a diverse array of research and theoretical reflections on information and communication technologies.

We have organized the papers into four chapters reflecting the primary topics: the internet, electronic government, and electronic business. Modeling and programming. Management Information Systems. Information and communication technologies in education.

We hope that this book of proceedings will help students, teachers, researchers, and scientists gain knowledge as well as make new research plans in the field of the Internet and information technology. We are extremely grateful to the contributing authors for their support in bringing out these proceedings. We are also thankful to Cambridge Scholars Publishing for offering to publish the proceedings.

Akaki Girgvliani
David Zautashvili
Avtandil Bardavelidze
Akaki Dzneladze

Editors
October 2023

PART 1:

INTERNET, ELECTRONIC GOVERNMENT, ELECTRONIC BUSINESS

CHAPTER ONE

INFORMATION SOCIETY AND THE DIDACTICS OF INFORMATICS

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Abstract: The role of didactics of informatics in the process of forming the information society is discussed. Basic principles and methodology of teaching academic courses at public schools and universities with informatics educational programs, with special focus on computer science, software engineering, and information technology. As a result, pupils and students (according to the level of education) will be able to master the essence of new digital technologies and the specifics of their use: databases, OO-modeling, programming, design of management-supporting information systems and integrated software application development, CASE technology and programming automation. Illustrative examples of the projects realized by us at GTU together with respective scientific and pedagogical literature are presented.
Keywords: information society, didactics of Informatics, MIS, CASE, DBS, ORM/ERM, Web-portal.

Introduction

One of the important challenges of the 21st century is the formation of the information society in the world and the intensification of the didactics of information and communication technology (ICT) disciplines in the continuous education system on the basis of digital technologies (Chogovadze, Prangishvili, Djagodnishvili, and Surguladze, 2018; Chogovadze, Surguladze, Topuria, and Kharitonashvili, 2021). The introduction and development of integrated lessons and interdisciplinary lectures in public schools and universities is particularly noteworthy.

May 17 is the International Day of the "Information Society," which was announced in 2006 by the initiative of UNESCO and the resolution of the UN General Assembly. The forums of the World Summit on the Information Society (WSIS) are held annually in Geneva, Switzerland, where current issues of sustainable development of the information society in ICT are discussed (World Summit on the Information Society Forum 2023).

In 2003, the UNESCO Chair "Information Society" was established at the Georgian Technical University (Tbilisi) with the support of UNESCO (Paris) Director General K. Matsuura. This year, the department celebrates its 20th anniversary (Surguladze, 2023).

Didactics of informatics is the science of the computing teaching process (Chogovadze, Surguladze, Topuria, and Kharitonashvili, 2021; Surguladze,2022). Our goal is to further develop and perfect this process on the basis of ICT. “Didactics develops models of the content of education, which provide an answer to the composition and structure of its content, to the algorithm of their selection, and to the presentation of the training courses.” Didactics develops a model of learning, for example, for an interdisciplinary lesson or lecture, etc. (Surguladze, Papavadze, and Machaladze, 2023).

Methodology

Our approach to didactics in informatics provides for the study of computer science methods and CASEtools that help users of the applied field create their own information systems.Based on international experience and the use ofbest practices, methodologies accepted today include unified processes (UML), agile development (AgileD), software life cycle models (e.g., Spiral), ITIL, BSI, and COBIT security standards, etc. (Surguladze and Urushadze, 2014). In addition, the hybrid methodology for designing and building integrated systems presented in the article uses the principles of an object-oriented approach, building desktop, web, and mobile applications using SQL Server or Azure-SQL databases. We have implemented such projects for the problem areas of education, Black Sea ecomonitoring, and multimodal shipping logistics management (Surguladze, Topuria, Gavardashvili, and Namchevadze, 2018; Surguladze, Gia, Petriashvili, Topuria, and Surguladze Giorgi, 2015; Surguladze, Petriashvili, and Topuria, 2022). Figure 1-1 shows the stages of theUMLmethodology and a spiralmodel.

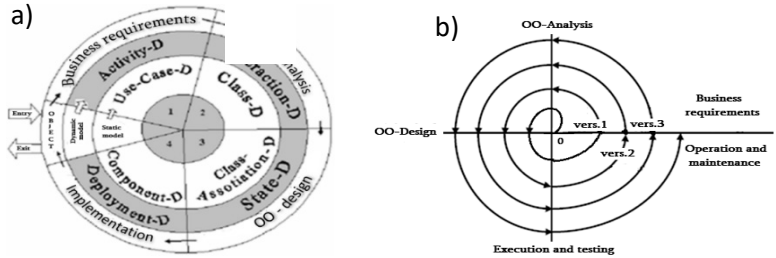


Fig. 1-1. a) 4 stages of UML-methodology; b) Spiral model of Lifecycle

Consider a general example for building an integrated hybrid system (in the form of a web portal), with an illustration of its subject composition and structure (Fig. 6-1-2).

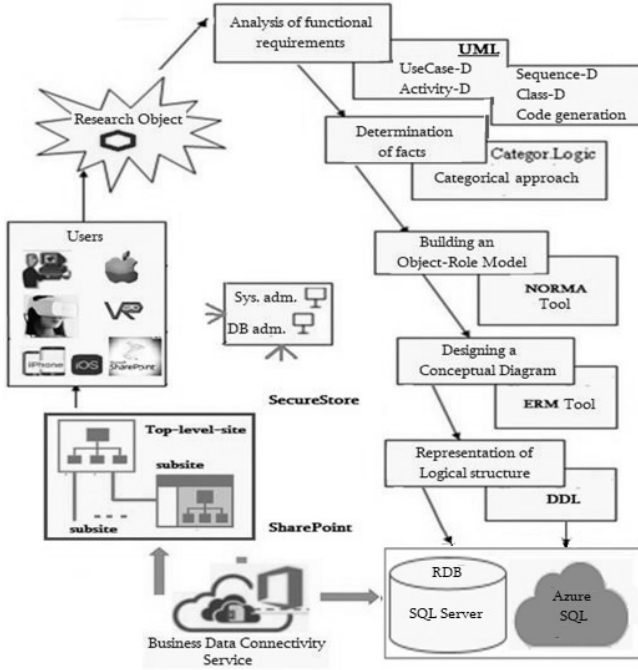


Fig. 6-1-2. Scheme of the methodology for the construction of web-portal of the information system

The applied field has no principle meaning (it is a virtual object). In our case, from the point of view of didactics in informatics, it is the field of education.

This file presents a scheme of the general methodology for designing and building a web portal (using a UML/Agile compromise approach). Taking into account our concept, in which the determination of the business requirementsofusers, OO-analysis and design, creation of their interfaces, and construction of databases (or storage) using cloud architecture are carried out.

In the automated design process related to the conceptual models of database ORM/ERM, using the VisualStudio.NET platform, the constructed schemes were adjusted for their further optimization using the NORMA tool, with the help of the user (educator) (Halpin, 1997).

System users (teacher, pupil, student, etc.) have developed their interfaces for different types of information or materials to receive and access computer monitors, mobile devices, or virtual reality glasses. The web portal linking the softwareapplication database and user interface is implemented using the Microsoft SharePoint package, based on a service-oriented architecture.

The MS SharePoint package was used to design the web portal, which offers users a flexible opportunity to collaborate and use group services. The SharePoint portal can be accessed through any browser. Connecting SharePoint to SQLServer is done with the help of SharePoint Designer (Fig. 6-1-3) (Chogovadze, Surguladze, Topuria, and Kharitonashvili, 2021).

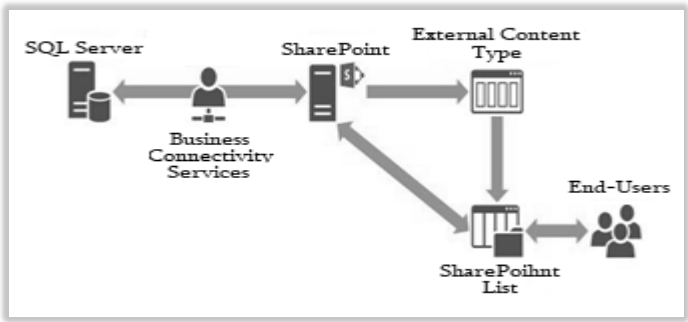


Fig. 6-1-3. SharePoint Designer

Business Connectivity Services is a centralized infrastructure that provides integrated solutions for working with data and accessingdatathat is located outside of SharePoint content (e.g., on a SQL Server). In addition, it is necessary to configure the Secure Store service (Fig. 6-2).

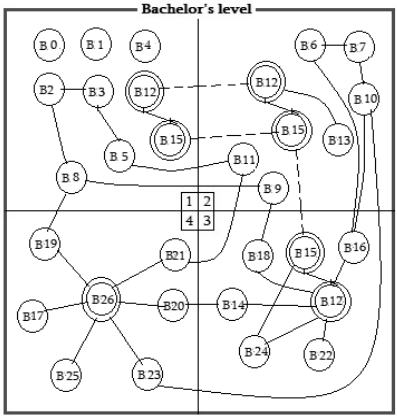
Secure Store includes a database where user records and passwords are stored to identify applications that are used for authorized access to shared resources.

For example, SharePoint Server's secure storage database can be used to store or retrieve accounting records when accessing external data. Thus, the Secure Store service stores confidential data, so it needs to be encrypted. First, it is necessary to generate the key with which the content will be encrypted. It is also necessary to archive the encryption key. To perform the above steps, you need to enable Sharepoint Central Administration and configure these services. Teachers can use the built-in web portal from their mobile phones. For example, data input from Windows Phone, iOS, and Android operating systems is quickly reflected on the portal website and SQL Server database (Meier, 2012).

Didactics of informatics: basis of an interdisciplinary approach

The main problem of didactics in informatics, according to the level of education (school, college, university), is reflected in the goals and results of their educational programs and syllabi of academic courses in the form of basic and optional subjects. Particular importance - their sequence and interrelationship in semesters.

Consider how the process of didactics in informatics at GTU is conducted, taking into account the relevant academic courses (for example, a concentration in software engineering). In this case, UML methodology (OO-analysis of systems, OO-design, OO-realization, and implementation) is consideredthemain subject of interdisciplinary connections. In our case, we will see the bachelor's and master's levels of university education (Fig. 6-1-4).Table 1-1 shows the list of academic courses in the Bachelor of Informatics program (for software engineering) corresponding to the subject identifiers in Fig. 6-1-4. The third column shows the number of stagesin the UML methodology.



Bachelor **Tab.1**

N	Course Name	UML/Sem
B0	Introduction to Informatics (Comp. Science)	1/1
B1	Computer skills	1/1
B2	Basics of programming	1/1
B3	Data structures and algorithms	1/2
B4	Computer architecture & Organization	1/2
B5	Introduction to Databases	1/3
B6	OO-programming (C++/C#, Java, Python)	2/4
B7	OO-Programming & Applications	3/5
B8	Basics of Web-technologies (Html,Css,JavSc)	1/4
B9	Web-programming (XML, Angular, jQuery)	2/5
B10	Multiparadigm programming (Java, Python)	2,3/5
B11	Database design (SQL, NoSQL)	3/2,4
B12	Fundamentals of Software Engineering	1,2,3/5
B13	Fundamentals of information Security	2/5
B14	Software applications & data management	3/6
B15	OO-Analysis & Design of Systems (UML)	1,2,3/6
B16	Mobile programming (Android, iOS)	2,3/6
B17	Computer Networks Fundamentals	4/3,6
B18	Content management systems	3/7
B19	Web-programming (PHP/MySQL)	4/7
B20	Development of software products	4/7
B21	Big Data storage and processing systems	3/7
B22	Industrial practice	3/7
B23	Artificial Intelligence programming	4/8
B24	Agile testing and Quality management	3/8
B25	Applications tasks of Operations Research	4/8
B26	Bachelor project	3,4/8

Fig. 6-1-4. Distribution of academic courses according to stages

Virtual reality in school

With the help of the system built according to our methodology, an interdisciplinary lesson is conducted at the school with the help of virtual reality glasses. The topic includes geography, computer science, English, history of science and other subjects (Fig. 6-1-5) (Chogovadze, Surguladze, Topuria and Kharitonashvili, 2021)

Fig. 6-1-5. The lesson is taught by the geography teacher of Tbilisi Public School,Ph.D. candidate M.Kharitonashvili (2022)

Conclusion

The reform of education requires the transition of the learning processes of educational institutions to new digital technologies, which essentially depends on the implementation of certain investments in this sphere. The formation of an information society and the activation of didactic informatics are two of the main criteria for the sustainable development of the country and the formation of a national mentality. That is why special attention should be paid to the introduction of interdisciplinary studies and the further development of the scientific direction of the didactics of informatics.

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CHAPTER TWO

GEORGIAN ELECTRONIC COMMERCE PROBLEMS AND DEVELOPMENT PROSPECTS

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Abstract: The article analyzes the concept and types of e-commerce and the advantages and problems of the development of the e-commerce sector. The article also describes the current state of electronic commerce development in Georgia and provides necessary recommendations for the rapid development of the e-commerce sector in Georgia.
Keywords: e-commerce, types of e-commerce, development of e-commerce, Georgia.

Introduction

Trade has always played a huge part in the development of mankind. Great civilizations have developed along the trade routes. At present, e-commerce, just like the great trade routes in the past, strongly influences the evolution of world civilization. Over the past three decades, e-commerce has changed the appearance of the planet.

There are many spheres that have developed rapidly with the advent of the Internet, such as e-government, health informatics, and bioinformatics, but e-commerce stands out for its great impact on the development of the economy and the prosperity of countries.

E-commerce offers plenty of business benefits: cheap connectivity, the opportunity to conduct a quick information search, a reduction in the internal costs of the business, a low cost of advertising, and worldwide dissemination of information about the company. All these factors led to the rapid development of the e-commerce sector.

It is obvious that the ability of business and government structures to use the opportunities of e-commerce is one of the key factors in the competitiveness of enterprises, companies, and countries in the global economy of the 21st century.

A key requirement for the effective development of commercial activity in the world is the assessment of changes in the main development trends of e-commerce and the market prospects. The problems and prospects of e-commerce development in developing countries represent an urgent task. (Lawrence and Tar, 2010; Kshetri, 2007).

E-commerce definition

Electronic commerce is a powerful concept and process that has fundamentally changed the current cycle of human life. Electronic commerce is among the main criteria of the revolution in information technology and communication in the field of the economy. (Nanehkaran, 2013)

The variety of products provided by e-commerce to consumers, detailed information about products, and the ability to compare product features and prices have contributed to the rapid development of e-commerce worldwide.

Let us explore some definitions of e-commerce.

E-commerce, a new way of doing business in the global economy, is the process of buying, selling, exchanging, or transferring goods, services, and information through computer networks (Turban, E. et al., 2012).

The OECD (Organization for Economic Co-operation and Development) defines an e-commerce transaction as “the sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placingorders.” (OECD**,** 2011**)**

According to the World Trade Organization (WTO), this is a process of “production, distribution, marketing, sale, or delivery of goods and services by electronic means." (WTO, 2023)

According to Jamsheer, e-commerce is the use of telecommunication networks to automate business relations and workflow. (Jamsheer, 2019)

E-commerce is the trade of products or services using computer networks such as the Internet. E-commerce relies on technologies such as mobile commerce, electronic funds transfer, supply chain management, Internet marketing, online transaction processing, electronic data interchange (EDI), and inventory management systems.

Summarizing all the studied definitions and existing concepts, we can define e-commerce as follows: E-commerce is the process of purchasing and selling goods and services using Internet technologies.

Type e-commerce

There are seven main types of e-commerce:

1. Business-to-Business (B2B) E-commerce encompasses all electronic transactions of goods or services between companies. Manufacturers and traditional wholesalers typically work with this type of e-commerce.

2. Business-to-Consumer (B2C) This type of e-commerce is characterized by the establishment of electronic business relationships between businesses and their final consumers.

Contrary to the belief that online commerce is often sold to the final consumer (B2C sector), the bulk of e-commerce falls into the B2B sector.

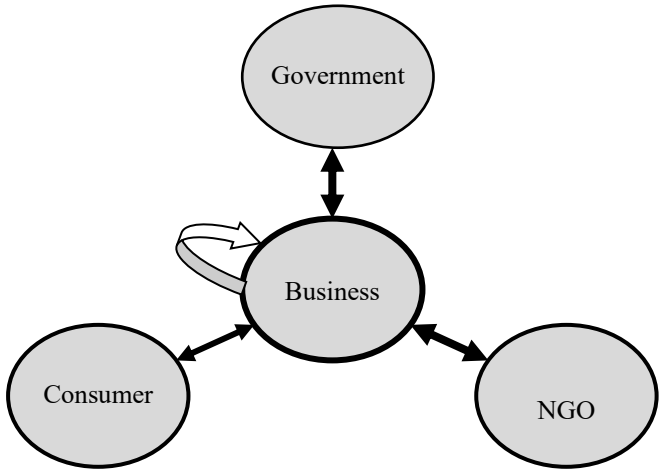

Fig. 6-2-1 Type e-commerce

The B2B segment, which dominates global online commerce, is increasingly adopting tools from the B2C segment, with a focus on behavioral data from business partners, modern technology, and social

media. These processes will lead to simpler and faster transactions between companies, reducing the differences between the business models of the B2B and B2C segments.

At this stage, B2C and B2B are the main areas of e-commerce.

3. Consumer-to-Consumer (C2C). This type of e-commerce encompasses all electronic transactions of goods or services between consumers. Typically, these transactions are conducted through a third party that provides the online platform on which the transactions they are actually executed.

4. Consumer-to-Business (C2B). This type of e-commerce is quite common in crowdsourcing-based projects. A large number of people provide their services or products for purchase to companies.

5. Business-to-Government (B2G). This part of e-commerce includes all transactions conducted via the Internet between business companies and government administrations. This is an area that includes a large variety of services, especially in areas such as taxation, social security, employment, legal documents, and registers.

6. Consumer-to-Government (C2G). The consumer-to-government model covers all electronic transactions conducted between individuals and government administrations. Examples of applications include: education (disseminating information, distance learning, etc.); social security (disseminating information, making payments, etc.); taxes – the filing of tax returns, payments, etc.); and health (records, information about diseases, payment for medical services, etc.).

7. Business-to-Nongovernmental Organizations (B2N). This type of e-commerce is the least developed at present. Although some projects in this area already exist, it can be noted that the future of this area directly depends on the role and importance of non-governmental organizations.

Research Methods

The purpose of this study is to get a clear picture of the current situation with e-commerce in Georgia. Particular attention is paid to the current state, the development of infrastructure, and public policy. Our study is primarily based on secondary data. Data and information were received from government reports, websites, journals, and scientific research.

E-commerce development in Georgia

In 2021, retail e-commerce sales amounted to approximately 5.2 trillion U.S. dollars worldwide. This figure is forecast to grow by 56 percent over the next few years, reaching about 8.1 trillion dollars by 2026, and the sector's share in total market sales will increase to 24.5%. The ten global leaders in the e-commerce market account for 88.6% of the market, while only three countries—China, the USA, and the UK—account for about 76%. (Statista, 2022)

According to data provided by the Galt & Taggart company, the size of the local e-commerce market in Georgia increased 3.2 times annually in 2020. Despite rapid growth, the share of e-commerce in retail sales in Georgia is still significantly below the level of developed markets (1.1% in Georgia vs. 12% European average). The size of the local e-commerce market in Georgia will increase to 500 million dollars in the period 2021-2025, and its share will reach 4.7% of retail sales in the same period. (Galt & Taggart, 2021)

According to NASDAQ data, it is estimated that by 2040, 95% of purchases will be facilitated by e-commerce. (UK, 2017)

Figure 2 illustrates e-commerce as a percentage of retail sales by country. China's leadership in this data is noteworthy (47%).

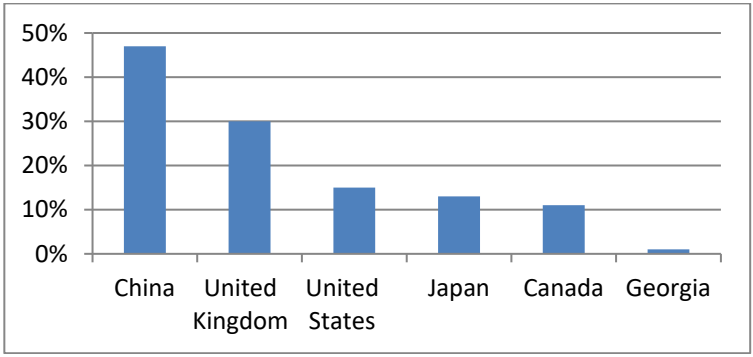

Fig. 6-2-2. E-commerce as a percentage of retail sales by country

Access to the Internet is a prerequisite for the development of the economy based on knowledge and innovation in the country. As of 2022, 91.2% of the population of Georgia had access to Internet resources

(Internet World Stats, 2023), and this had a positive effect on the development of electronic commerce.

Georgian consumers mostly use the four largest online platforms: Amazon, eBay, Taobao, and AliExpress. The marketplace Etsy is also popular among consumers.

The platform Mymarket.ge (mainly the C2C model) is the largest online trading platform in Georgia, visited by more than 750 thousand unique users monthly. The vendoo.ge is the largest B2C platform (with about 350 thousand unique users per month) (top.ge, 2023)

In general, the rate of development of electronic commerce is determined by the country's economic development, digital infrastructure, the availability ofbanking services, and demographic trends. In this regard, Georgia should use the existing advantages, such as the developed banking sector, high access to the Internet, an increased number of online merchants, and the relatively young population of the nation.

The main hindrances to electronic commerce in Georgia

The following main factors hindering the growth of e-commerce in Georgia should be noted:

1. Most Georgian business companies are not interested in the development of e-commerce. Only 18.4% of business entities had a website as of January 2020. It should be noted that the catalog of goods and services was available on only 23.1% of websites. In addition, only 17.9% of them had an online purchase function on the website, which is only 3.3% of the total business entities in Georgia. (Galt & Taggart, 2021)

2. In recent years, one of the main factors hindering the development of e-commerce in Georgia has been the absence of a law on e-commerce.

After almost 10 years of “discussion”, in June 2023, the Parliament of Georgia passed the Law on Electronic Commerce. By adopting the law, the European regulations of electronic commerce are established, which will contribute to the protection of the rights of consumers in the process of electronic commerce in the Internet space and determine the rules and conditions of signing an electronic contract in the process of electronic commerce and the responsibilities of intermediate service providers during information transfer and storage. (E-commerce law, 2023) However, in the near future, it will be necessary to adopt several more laws that will contribute to the development of e-commerce in Georgia. The development of e-commerce is significantly hindered by the imperfection of the legal framework.

3. Major barriers to delivering products to consumers include inefficiencies in shipping and logistics services, infrastructural limitations, and legal issues. In addition, online stores require large warehouses because of the wide variety of products and large amount of inventory.

Georgia ranks 79th out of 160 countries in the 2023 Logistics Index, scoring relatively well in customs and border management efficiency but low in logistics efficiency and international shipping. It should be noted that the USA, the European Union, and some other developed countries (China, Japan, and Singapore) have the highest scores on this index, while the logistics environment of low- and middle-income countries is still underdeveloped. (The Logistics Performance Index, 2023)

Shipping cargo from Georgia to different countries around the world is expensive. Both Georgian Post and foreign carriers operating in Georgia have very high prices. This significantly limits the development of e-commerce.

4.Marketplaces play an important role in the development of e-commerce, both in individual countries and throughout the world.

According to statistics provided by the analytical agency Digital Commerce 360, in 2021, the volume of purchases on the world's 100 largest online platforms (49 of which are located in the United States) amounted to about $3.23 trillion, which is equal to 65% of the global e-commerce market. *(*Digital Commerce 360, 2023)

The goods of Georgian Internet users are the most represented on the Etsy marketplace. For the development of e-commerce in Georgia, it is important to place exclusive goods onworld marketplaces.

5. Today, all projects in the e-commerce sector are usually being implemented by IT specialists who do not have the necessary economic knowledge. Effective implementation of e-commerce requires specialists who possess in-depth knowledge and practical skills in the fields of both business and information technology.

The lack of qualified personnel in the e-commerce sector is clearly visible from the following data: out of 62 accredited higher education institutions in Georgia, only 22universities train specialists in the fields of information technology, and the disciplines of electronic commerce and electronic business are taught at only 7 universities *(*Ministry of Education and Science of Georgia, 2023) It is necessary to increase the number of IT specialists in Georgian universities.

Conclusion

Despite noticeable improvements over the past few years, the level of e-commerce development in Georgia is still far from the average for developed countries. Most Georgian commercial companies still use traditional business methods. There are many more problems and questions in the Georgian e-commerce sector than answers and solutions.

Government support in e-commerce policy and law development, as well as infrastructure development, is important for the development of the e–commerce sector. The government of Georgia should work on a good adaptive policy that will be attractive and motivating for business.

The development of e-commerce involves the introduction of the latest innovative approaches in the fields of information technology and business. In the economies of the world's developed countries, electronic commerce is a powerful stimulus for social and economic development. For the developing economy of Georgia, this would be the most direct route to the formation of an innovative and strong economy.

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CHAPTER THREE

THE DIGITAL TRANSFORMATION OF AGRICULTURE

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Abstract: The article discusses the main aspects of the digital transformation of agriculture, goals, challenges, and prospective directions for Georgia. The article highlights a systematic approach to digital agriculture development that will help create an efficient agricultural sector. The article discusses the risks, barriers, challenges, and disincentives of digitizing agriculture, as well as the strategic priorities and drivers of change.
Keywords: digital technologies; digital transformation; precision farming; the Internet of Things (IoT).

Introduction

Agriculture, as a producer of agricultural products, faces the challenge of an ever-growing population. On the other hand, as the largest user of land, it has a responsibility to conserve natural resources such as land and water. The digital transformation and revitalization of agriculture have the potential to revolutionize the industry, contribute to the efficiency, sustainability, and competitiveness of the sector, and address pressing issues such as food security and climate change.

Digital Agriculture

Digital agriculture is the application of new and advanced technologies, data, and artificial intelligence to all aspects of agriculture. Agriculture has come a long way toward increasing productivity. The

digital age has touched every industry, and agriculture is no exception. (Wigmore, 2022)

Today, feeding the world's population is the world's greatest challenge. The Food and Agriculture Organization of the United Nations (FAO) predicts that by 2050, the world's population will exceed nine billion, therefore governments have to ensure that food production increases by 70 percent. (FAO, 2023)

Digital technologies have the potential to transform traditional farming practices. The FAO has called this change a revolution. Other sources refer to the change as Agriculture 4.0.

CEMA, the European Agricultural Engineering Association, is offering agriculture after iodization in Europe (Agricultural Machinery Industry Association, 2021)

Table 3-1. Periodization of agriculture

The stage of development	period	Characteristics
Agriculture 1.0.	Beginning of the 20th Century	➢ It's based on the use of physical labor; ➢ It's characterized by low productivity**.**
Agriculture 2.0.	End of the 1950s	**"The new revolution"** ➢ Intensive mechanization and the replacement of manual labor by engineered machines. ➢ The active use of fertilizers, pesticides, and herbicides.
Agriculture 3.0.	"From the 1990s to the 2000s	**precision farming** It uses modern technologies such as various sensors, control and management systems, robots for autonomous transport, and automated equipment.
Agriculture 4.0.	Since the beginning of the 2010s	**Digitalfarming.** It'sthesame**"smartfarming".** ➢ The use of digital technologies and technical tools in agricultural production; ➢ The implementation of operations in digital form, automated data transmission, processing and analysis.
Agriculture 5.0.	Future	It can be seen as the last stage of agricultural development. ➢ It's going to be based on robotics and artificial intelligence ➢ Operations will be performed without human intervention

It should be noted that according to the table agriculture 2.0. is the beginning of digital agriculture, and it's an intermediate stage. The progress of agriculture depends on the successful functioning of all three levels of the Agriculture 2.0, Agriculture 3.0, and Agriculture 4.0 systems.

The Technologies of "Smart" Agriculture

The development of agriculture is unimaginative without the use of digital technology. Precise GPS navigation systems for agricultural machinery, robots, drones, satellites, the Internet of Things, and other innovations are making farming and agriculture smart. It reduces the share of manual labor and financial costs, increases production capacity, and increases the profitability of agribusiness.

Let's look at some of the technologies that can be used on Georgia's modern farms.

The Internet of Things (IoT) is a concept of data transfer between physical objects (things) or groups of objects as a new direction in the development of modern smart agriculture. In the context of farming, it's the use of sensors, cameras, and other devices to make all the elements involved in the farming of the land—weather, humidity, plant health, mineral status, presence of pests, and many more—into one big database and enable farmers to collect, exchange, and analyze the information they receive, connect with each other and with consumers, share integrated experiences, and make quick decisions. (Cropin, 2023)

Precision farming is considered to be a system that makes the practice of working the land controllable and highly precise. It's a strategy that involves collecting permanent, temporal, spatial, and local data, combining it, and linking it to other data. Precision technologies aim to increase yields with fewer resources and reduce production costs; seeds, agrochemicals, fertilizers, and water are used with strict requirements.

Smart greenhouses can use fertilizers, chemicals and water efficiently. The number of staff is minimized, and there is no manual intervention in the growth and development of the plant. As a result, more crops can be harvested from a smaller area, and manual labor can be replaced by a robot. Although the global market for smart heaters is less than 3% of the total, the number of smart heaters is growing by 9% per year.

Smart farms are farmers' services systems based on modern principles that create a benign epidemiological environment. Scientists believe that traditional methods of animal husbandry are ineffective today. The use of automated monitoring systems on smart farms can increase

milk yields by 30% to 40%, helping to use existing food supplies more efficiently.

Equally important are the pilot programs of the modern principles-based Farmer Services System (NAITS), which provide the ability to study an animal or group of animals at any stage of their lives, from the place of origin to the place of sale or use. Food safety is guaranteed by controlling the entire food chain at every stage of production, processing and distribution. (SciForce, 2023)

Monitoring the usage of agricultural machinery through satellite navigation systems (such as GPS) and sensors allows us to adjust the movement, trajectory and speed of tractors and agricultural machinery to the centimeter, as well as reduce fuel consumption and the burden on personnel. It is worth noting that in the EU countries 80% of agricultural machinery is sold with navigation equipment, but only 30% of them are actually connected to the grid, as such navigation systems are not economically feasible for small family farms dominated by agriculture.

Automated irrigation is an intelligent plant irrigation system that performs regular plant watering without human intervention using a humidity sensor. This system allows the humidity to be determined at each section and prevents excessive water consumption. The irrigation process is done with the help of IoT technology, and it's available even to economically underdeveloped countries.

Electronic trading platforms for farmers are used for quick communication between agricultural producers (farmers) buyers and trade organizations. This reduces the time it takes to get the product from the field to the slaughterhouse and the need of intermediate storage. Unmanned aerial vehicles (UAVs) in agriculture involve the use of drones to assess the condition of crops in a large field and for other purposes. The main advantage of using drones in agriculture is their wide range of capabilities, namely:

- Visualizing the condition of plants in fields, and monitoring their condition
- A fast and accurate map
- Measuring the height of crops
- Measurement of chlorophyll and nitrogen levels in wheat
- Automated detection and counting of litter.

Despite the benefits of "smart" agriculture, this concept comes with some risks and challenges:

1. The lack of Internet. Smart farming technology requires a stable Internet connection. Unfortunately, it's not available in all regions of the world