

DIGITAL INFRASTRUCTURE IN GEORGIA AS A CONDITION FOR SUCCESSFUL APPLICATION INDUSTRY 4.0

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Abstract: *New generation of digitized factories in Industry 4.0 is based on a combination of cyber-physical systems (CPS) and digital technologies, to provide an integrated and intelligent synergy in production process, linking the physical, digital and virtual world. Industry 4.0 uses production systems, CPS, CPPS, SCPS and robots in combination with digital technologies IoS, IoP, IoT, IIoT, IoE, CC and etc. The digital infrastructure of a country can be evaluated using different development indices, such as: IDI, EGDI, TII, OSI and etc. The paper is given of trend analyzes of development indices (DI) for using ICT and the Internet., EGDI and TII in Georgia for the period 2003 to 2018.*

Key words: *Industry 4.0, digital infrastructure, Internet infrastructure, ICT Development Index (IDI), e-Government Development Index (EGDI), Telecommunications Infrastructure Index (TII).*

1. Introduction

Republic of Georgia is a Eurasia country in the Caucasus region, which is divided into 9 regions, 1 city and 2 autonomous republics. These in turn are subdivided into 67 districts and 12 self-governing cities. It borders with Russia in the north and northeast, Turkey and Armenia in the south and Azerbaijan in the southeast. In the west, it reaches the Black Sea shores of about 310 km. Georgia occupies an area of 69700 km² with 3904204 population (according to estimates for 2019). The country's main and largest city is Tbilisi, with over a million people. Major cities in Georgia are: Kutaisi, Batumi, Rusztavi, with over a 100 thousand people and etc.

Georgia is a member of the following international organizations: Council of Europe, Organization for Security and Co-operation in Europe (OSCE), EUROCONTROL, World Trade Organization (WTO), GUAM (Georgia, Ukraine, Azerbaijan and Moldova) Organization for Democracy and Economic Development, and is also a signatory to the NATO Partnership for Peace program and etc.

Gross national income (GNI) of Georgia is 14.3 billion US\$ and GNI per capita is 3.760 US\$ in 2017 according to The World Bank (WB). Georgia's exports are over 2.7 billion US\$, and imports are more than 7.9 billion US\$ in 2017 according to The World Bank (WB).

2. Industry 4.0

Industry 4.0 (fourth industrial revolution) is a new generation of digitized factories that are based on a combination of cyber-physical systems (CPS) and digital technologies, to ensure the integrated and intelligent synergy of the manufacturing process, in which the physical, digital and virtual worlds are connected.

Industry 4.0 is dominated by new intangible software and management technologies, compared to the material ones.

Industry 4.0 uses manufacturing systems (FMS, RMS, IMS, AMS, CMS, RMS, SMS, CBMS, etc.), Cyber-Physical Systems (CPS), Social-Cyber-Physical Systems

(SCPS), Cyber-Physical Production Systems (CPPS), robots, control units (NC, CNC and DNC), controllers (PLC, PIDC, DMC, IMC, MFC, MPC, MRC, etc.) in combination with digital technologies: Internet of Services (IoS), Internet of People (IoP), Internet of Things (IoT), Industrial Internet of Things (IIoT), Internet of Everything (IoE), Cloud Computing (CC) and etc. [1-4, 8-12, 19-21].

It also utilizes all standard technologies applied in Industry 3.0: software technologies (CAA, CAD, CAE, CAM, CIMA, CAP, CAPP, CAQ, CAR, CAS, CASE, CIM, PLM, etc.) and industrial software (SCADA, etc.), communication infrastructure, security system, digital industrial services, etc.), Big Data (BD), etc. Industry 4.0 involves the complete digitization of all production processes and the implementation of the aforementioned digital technologies when creating an idea of a product, product engineering, manufacturing organization, manufacturing realization, process control and the provision of industrial services. Everything becomes digital and smart in it: digital cities, smart factories, smart homes, smart cars, smartphones, etc.

Figure 1 shows an industry 4.0 workspace in which the research areas are categorized as smart: smart projecting and design, smart machines, smart monitoring, smart control, smart time scheduling, smart planning, etc. [21].

The authors of this paper analyze and research the application of the new industrial strategy Industry 4.0 in Georgia [7, 14-15].

3. Digital infrastructure in Georgia

For the successful implementation of the Industry 4.0 concept of a country or region, its digital infrastructure is important.

The digital infrastructure of a country can be evaluated using different development indices (DI), such as: IDI (ICT Development Index), EGDI (e-Government Development Index), TII (Telecommunications Infrastructure Index), OSI (Online Service Index) and etc. Accordnig to development indices (DI) can identify successful implementation of Information and

Communication Technologies (ICT) and digital infrastructure of a country or region, as one of the prerequisites for successful implementation of Industry 4.0.

In papers [5-6, 13, 16] analyze some of the development indices (DI) in Serbia and Georgia.

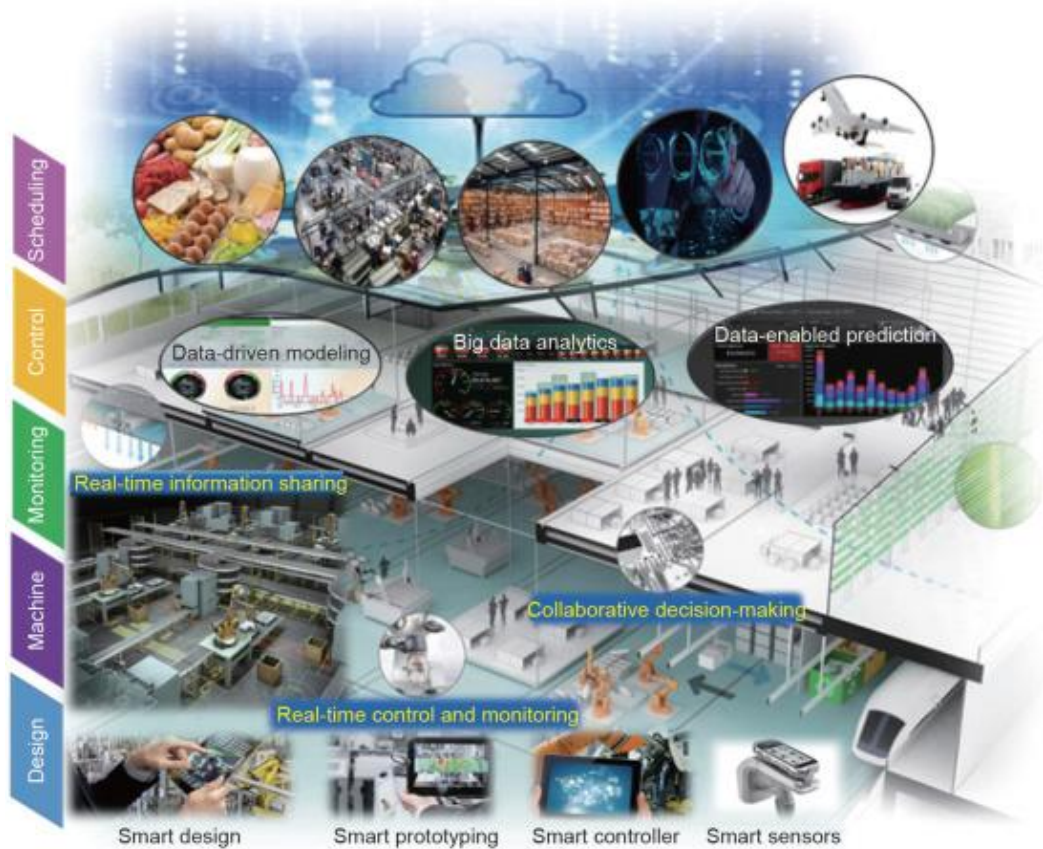


Figure 1: Industry 4.0 framework [21]

3.1. ICT and Internet infrastructure in Georgia

In 2000 Georgia had only 20000 Internet users, while in December 2018 it had 2658311 Internet users, with penetration from 68.1 % population according to IWS (Internet World Stats) (URL: <https://www.internetworldstats.com/>).

In December 2017 Georgia had 2100000 Facebook subscribers, with penetration from 53.8 % population according to IWS (Internet World Stats).

Tables 1 and 2 are shown of ICT and Internet infrastructure indices in Georgia in 2008 and 2018.

Table 1: Tabular view of ICT and Internet infrastructure indices in Georgia in 2008 [17]

No	ICT and Internet infrastructure indices	2008
1.	Internet per 100 users	7.49
2.	PC per 100 users	4.70
3.	Cellular Subscribers per 100 users	38.43
4.	Main Telephone Lines per 100 users	12.47
5.	Broadband per 100 users	0.61

Table 2: Tabular view of ICT and Internet infrastructure indices in Georgia in 2018 [18]

No	ICT and Internet infrastructure indices	2018
1.	Fixed telephone subscriptions per 100	21.24
2.	Mobile cellular telephone subscriptions per 100	140.95
3.	Percentage of Individuals using the Internet	58.01
4.	Fixed (wired) broadband subscriptions per 100	17.57
5.	Active mobilebroadband subscriptions per 100 inhabitants	64.03

3.2. E-Government Development Index (EGDI)

The EGDI (e-Government Development Index) is a composite index based on the weighted average of following three indices: Telecommunications Infrastructure Index (TII), Human Capital Index (HCI) and Online Service Index (OSI). The EGDI which assesses e-government development at the national level [17-18]. The EGDI index is based on data collected and publication of United Nations E-Government Survey (UN-EGS) and analyzes the ranking of the 193 United Nations (UN) member states, from 2003.

The value of the EGDI index ranges from 0 to 1, and is divided into four quartiles: Low with a abbreviation LEGDI (EGDI values in the range of 0.00 to 0.25), Middle with a abbreviation MEGDI (EGDI values in the range of 0.25 to 0.50), High with a abbreviation HEGDI (EGDI values in the range of 0.50 to 0.75) and Very-High with a abbreviation VHEGDI (EGDI values in the range of 0.75 to 1.00).

According to the 2018 data, there were 40 countries in the first VHEGDI category, 71 countries in the second HEGDI category, 66 countries in the third MEGDI category and 16 countries in the fourth LEGDI category.

Figure 2 shows the trend of the EGDI index in Georgia from 2003 to 2018. According to data from 2003 to 2018, according to the EGDI index, Georgia was largely in the HEGDI category.

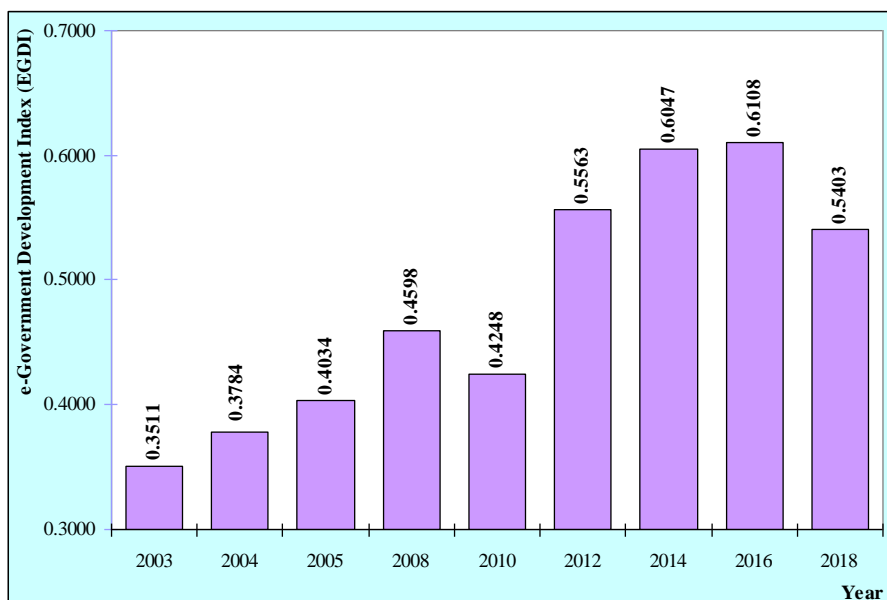


Figure 2: Trend of the EGDI index in Georgia from 2003-2018

3.3. Telecommunications Infrastructure Index (TII)

The TII (Telecommunication Infrastructure Index) is a composite index based on the weighted average index of five primary indices based on basic infrastructural indicators, which define a country's ICT infrastructure capacity [18-19].

The TII index is based on data collected and publication of International Telecommunications Union (ITU) and analyzes the ranking of the 193 United Nations (UN) member states.

The TII index is an arithmetic average of five indicators [18-19]:

- Internet users per 100 inhabitants;
- number of main fixed telephone lines per 100 inhabitants;
- number of mobile subscribers per 100 inhabitants;
- number of wireless broadband subscriptions per 100 inhabitants and
- number of fixed broadband subscriptions per 100 inhabitants.

Figure 3 shows the trend of the EGDI index in Georgia from 2003 to 2018. According to data from 2003 to 2018, according to the EGDI index, Georgia was largely in the HEGDI category.

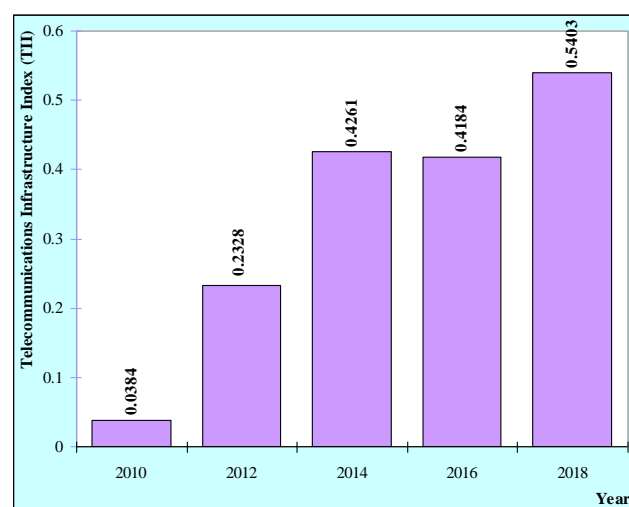


Figure 3: Trend of the TII index in Georgia from 2010-2018

4. Conclusion

Development indices (DI) for Information and Communication Technologies (ICT) and Internet infrastructure in Georgia are on the constant growth.

The EGDI index had an increase of 196.33 % in 2018 compared to 2003.

The TII index had an increase of 1407.00 % in 2018 compared to 2010. This means that the implementation of

ICT and Internet infrastructure has increased many times over this period (from 2010 to 2018).

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