DIGITAL ATLAS OF HT GROUP

Analysis of HT Group's contribution to the digital transformation of the Republic of Croatia

LIFE IS FOR SHARING

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ABOUT AUTHORS – INSTITUTE OF ECONOMICS, ZAGREB

The Institute of Economics, Zagreb (EIZ) is a public scientific institute with 80 years of experience in scientific and development research in the field of economics. It was founded in 1939 and today has the reputation of being the leading institute for economic research in Croatia. EIZ conducts research in four broad areas: macroeconomics and international economics, business economics and economic sectors, regional development, social policy, and the labor market. Within the research area of business economy and economic sectors, EIZ also covers topics related to digital transformation and digital infrastructure, in which it has participated in several research projects for the Croatian Employers Association, Deutsche Telekom, A1, Tele 2 Norway, SAP, Ernst & Young, Hrvatski Telekom, and the European Commission.

More information on the Institute of Economics, Zagreb available at **www.eizg.hr.**

The Digital Atlas of HT Group was prepared by Maruška Vizek, PhD as head of research, also the director of the Institute of Economics, Zagreb, and Tajana Barbić, PhD, Davor Mikulić, PhD, and Assoc. prof. Nebojša Stojčić, PhD from the University of Dubrovnik as research team members.

OBJECTIVE OF DIGITAL ATLAS

In Hrvatski Telekom, they believe that a better future is possible today. To make this happen, they are working on providing everyone in Croatia with access to digital services, regardless of where they are.

The Digital Atlas of the HT group aims to systematically, credibly, and consistently describe and evaluate the impact that HT Group companies are already making on the digital transformation of Croatian society and the economy. To achieve this goal, the Atlas presents the findings of a series of analytical methods and procedures that assess the impact of the HT Group in multiple dimensions. These dimensions, also a topic of one of the chapters in the Atlas, are Digital Company, Digital Infrastructure, Digital Business, Digital Society, and Smart Life solutions.

We start the Digital Atlas by presenting basic information about the HT Group. Then, in the chapter Digital Company, special attention is paid to the overall impact of the HT Group on the Croatian economy, whereby under the overall influence we mean the sum of direct, indirect and induced effects estimated using the input-output model. The total economic impact of the HT Group as a digitally intensive group of companies on the overall Croatian economy is, among other things, a consequence of the Group's intense digital transformation, which aims to transform jobs within the company in line with the requirements of the digital era and enable new working models and digital competencies so that the Group can continue to attract the best talent and provide a comfortable and productive work environment
Since the HT Group, and especially HT d.d., is the largest telecommunications company in the country, they have an obligation to build faster, more secure and reliable networks so that all citizens and all companies have the opportunity to be connected with other people, companies, and experiences that make their life and business more comfortable and productive, the chapter Digital Infrastructure will evaluate economic effects of the HT Group's investment in four types of digital infrastructure: copper and fiber-optic fixed access network, mobile network, and data centers. Using the input-output model, the effects of investing in these four types of digital infrastructure on gross value added, the number of employed people, and tax revenues will be assessed.

The chapter Digital Business gives a brief overview of the HT Group's smart technologies that facilitate digital transformation and increase the productivity and efficiency of other companies and the public sector. This chapter also assesses the effect of increasing available speeds in fixed and mobile networks and increasing the volume of data traffic on the operations of companies in the Republic of Croatia. Business operations here imply those indicators that are of strategic importance for the overall economic development of the Republic of Croatia, such as the rate of establishment of new companies, especially startups, productivity, number of employees, export revenues, and average net salaries in companies.

The Digital Society chapter presents donation programs through Which the HT Group encourages the increase in digital inclusion and literacy, while the Smart Life chapter presents smart and digital services that the HT Group develops and offers, which make everyday life easier, more secure, and more comfortable. The last chapter presents the main findings of the analyses in the previous chapters. The models used to evaluate the effects described in more detail in the addendum to the Atlas.

ABOUT HT GROUP

The HT Group is the leading provider of telecommunication services in Croatia and provides fixed and mobile telephony services as well as wholesale, internet, and data services.
The main activities of Hrvatski Telekom d.d. (HT d.d. or the Company) and members of the HT Group are the provision of electronic communications services, designing, and building electronic communications networks in the Republic of Croatia.

In addition to the fixed telephony service (access to and traffic of fixed telephony services and additional fixed network services), the HT Group also provides internet, IPTV, and ICT services, data transfer services (lease of cables, Metro-Ethernet, IP/MPLS, ATM), and GSM, UMTS, and LTE mobile network services.

INCORPORATION AND HISTORY

Since the separation of Croatian Post and HT-Croatian Telecommunications in 1998, a long journey towards a modern company was taken.

Hrvatski Telekom d.d. is a joint-stock company, majority-owned by Deutsche Telekom Europe B.V. It was incorporated on December 28, 1998 in the Republic of Croatia, pursuant to the provisions of the Act on the Separation of Croatian Post and Telecommunications into Croatian Post and Croatian Telecommunications, by which the business operation of the former HPT – Hrvatska pošta i telekomunikacije (HPT s.p.o.) was separated and transferred into two new joint-stock companies, HT – Hrvatske telekomunikacije d.d. (HT d.d.) and HP – Hrvatska pošta d.d. (HP d.d.). The Company commenced operations on January 1, 1999.

Pursuant to the terms of the Act on Privatization of Hrvatske telekomunikacije d.d., on October 5, 1999, the Republic of Croatia sold 35% of shares in HT d.d. to Deutsche Telekom AG (DTAG), and on October 25, 2001, DT AG purchased further 16% of shares in HT d.d. and thus became the majority shareholder with a 51% stake. Pursuant to the Share Transfer Agreement, in December 2013, DTAG transferred 51% of its shares in the Company to T-Mobile Global Holding № 2 GmbH. Pursuant to the Deed of issuance of a share against non-cash contribution, in February 2014, T-Mobile Global Holding № 2 GmbH transferred 51% of the shares in the Company to CMobil B.V. In April 2015, CMobil B.V. changed its registered name into Deutsche Telekom Europe B.V.

In 2002, HT mobilne komunikacije d.o.o. (HTmobile) was established as a separate legal entity and subsidiary wholly owned by HT d.d. for the provision of mobile telecommunications services. HTmobile commenced commercial activities on January 1, 2003 and in October 2004, the company's registered name was officially changed to T-Mobile Croatia d.o.o. (T-Mobile).

On October 1, 2004, the Company was re-branded in T-HT, thus becoming a part of the global T- family of Deutsche Telekom. This evolution of corporate identity was followed by the creation of trademarks for the two separate business units of the Group: the fixed network operations business unit, T-Com – which provides wholesale, Internet and data services; and the mobile operations business unit, T-Mobile.

On February 17, 2005, the Government of the Republic of Croatia transferred 7% of its shares in HT d.d. to the Fund for Croatian Homeland War Veterans and Their Families, pursuant to the AoP.

In May 2006, the Company acquired 100% of shares of Iskon Internet d.d., one of the leading alternative telecom providers in Croatia.

Since 2006, the HT Group holds a stake in HT d.d. Mostar based in the Federation of Bosnia and Herzegovina. The main activity of this company is the provision of telecommunication services, and the HT Group's stake is 39.1%.

As part of the continued privatization of HT d.d., on October 5, 2007, the Republic of Croatia sold 32.5% of T-HT ordinary shares through an Initial Public Offering (IPO). Of the total shares included in the IPO, 25% were sold to Croatian citizens, while 7.5% were acquired by Croatian and international institutional investors.

In October 2009, T-Mobile Croatia was merged into HT d.d., effective as of January 1, 2010. On May 21, 2010, the Company's registered name was changed from HT – Hrvatske telekomunikacije d.d. to Hrvatski Telekom d.d.

On May 17, 2010, HT d.d. completed the acquisition of COMBIS d.o.o., the company providing IT services, extending its reach into the provision of IT software and services for a client base that ranges from small businesses to government institutions.

In June 2014, HT took over management of OT-Optima Telekom d.d., following the completion of the pre-bankruptcy settlement procedure. Zagrebačka banka, as the largest creditor of Optima Telekom, transferred controlling rights acquired in the pre-bankruptcy settlement procedure to HT. Croatian competition agency (AZTN) has determined a set of measures defining the rules of conduct for HT with regard to management over Optima. The duration of the concentration of HT and Optima shall be limited to a period of four years, starting from HT's acquisition of control over Optima Telekom. In June 2017, AZTN extended the duration of temporary management rights of OT_Optima Telekom d.d. for HT until July 10, 2021, when the right is automatically revoked, without the possibility of extension. With the approval of the Croatian Competition Agency, Optima Telekom merged H1 Telekom on August 1, 2017.

In January 2017, HT acquired a majority stake in Crnogorski Telekom. Hrvatski Telekom concluded a Share Purchase Agreement with Magyar Telekom, Nyrt, based in Budapest, Hungary acquiring 76.53% stake in Crnogorski Telekom A.D., based in Podgorica.

In 2018, HT d.d. transferred its shares in Iskon Internet d.d., COMBIS d.o.o., E-tours d.o.o., KDS d.o.o., and Optima Telekom d.d. to HT Holding d.o.o. HT Holding d.o.o. acts as a special purpose entity owning the following companies:

COMPONENTS OF HT GROUP

HT Group consists of a total of seven companies, the most significant of which is HT d.d.

Company	Ownership stakes of HT Holding as of December 31, 2018
Combis d.o.o.	100%
Iskon Internet d.d.	100%
KDS d.o.o.	100%
e-Tours d.o.o.	100%
Optima Telekom d.d.	17,41%
Crnogorski Telekom AD	76,53%

As the Digital Atlas of the HT Group focuses on assessing the digital impact of the HT Group on Croatian society and the economy, it will not analyze the effects of Crnogorski Telekom AD.

COMBIS D.O.O.

COMBIS, a regional system integrator, has been a member of the HT Group since 2010 and is wholly owned by Hrvatski Telekom. The company focuses on the development of application, communication, security, and system solutions, as well as providing services for the development and integration of ICT solutions, ICT infrastructure management and support. By integrating advanced technologies, it delivers complete business solutions, tailored to customer specific requirements, on a turnkey basis. In Croatia, it is present with eight service locations, and for several years it has been active in the region, more specifically with three service locations in Bosnia and Herzegovina and Serbia. By adopting the trends of modern European and world business and constantly improving the quality of work and work environment, COMBIS is today among the leading ICT companies in the region in the segment of service provision and the leading provider of IT services in Croatia.

ISKON INTERNET D.D.

Iskon is a modern telecommunication company recognized for its dynamic and entrepreneurial business culture and quality of services, as well as its developed rapport with residential and business customers it provides broadband internet access services to. In addition to the internet, it offers telephony and digital television (IPTV) services and TV content viewing on mobile devices.
Iskon operates as an independent company, and since 2006 year it is a member of the HT Group and is wholly owned by Hrvatski Telekom. Through its infrastructure, Iskon provides services in Zagreb, Split, Dubrovnik, Rijeka, Pula, Osijek, Velika Gorica, Samobor, Opatija, and Solin, while its affiliation to the HT Group enables its availability across Croatia.

HT PRODUKCIJA D.O.O.

HT Produkcija is a limited liability company providing a pay TV service - evotv, which for the distribution of content uses DVB-T2 signal – second generation digital terrestrial television. Company focuses on development and positioning of evotv service, preparation and implementing projects to develop new communications and IT services that follow the latest global communication trends. It was the first in Croatia to launch the HbbTV technology it uses for development and suppl of interactive services as part of its evotv offering. HT Produkcija has been operating since 2011, under the name HP Produkcija, and since 2019 year it is a member of the HT Group, changes its name to HT Produkcija and is wholly owned by Hrvatski Telekom. Considering that HT Produkcija has been a part of the HT Group since 2019, and the Digital Atlas of the HT Group is for 2018, this company is not included in the assessment of the HT Group's digital impact on Croatian society and economy.

KDS D.O.O.

KDS – Kabelsko distributivni sustav – is a limited liability company for telecommunication services.

E-TOURS D.O.O.

E-tours d.o.o. travel agency has been a member of the HT Group since 2013 and is wholly owned by Hrvatski Telekom.

The company provides airline ticket sales, accommodation, packaged travel, car and boat rental services.

OT — OPTIMA TELEKOM D.D.

Optima Telekom (OT) is a fixed telecommunications operator whose IP technology-based network which ensures greater networking through the dominance of broadband, is present in more than 100 Croatian cities. Using the latest technologies and global telecommunication solutions, Optima creates added value on the fixed telephony market in Croatia. Citizens can choose with the upgrade of voice services, data transmission, internet, and video content.

TABLE 1 BASIC INDICATORS OF THE HT GROUP COMPANIES

	Combis d.o.o.	E-tours d.o.o.	HT d.d.	Iskon Internet d.d.	KDS d.o.o.	OT- Optima Telekom d.d.
Sector	Wholesale and Retail trade	Administrative and support service activities	Information and communications	Information and communications	nformation and communications	nformation and communications
Activity	Non-specialized wholesale trade	Activities travel agencies	Activities of wired telecommunications	Activities of wired telecommunications	Activities of wired telecommunications	Activities of wired telecommunications
Number of employees (Average number based on man-hour)	353	15	3,960	155	5	406
Average net wage (in HRK)	11,257	13,784	9,484	11,350	9,499	6,530
Total assets (in HRK 000)	331,387	18,633	14,797,550	311,365	6,007	641,630
Total revenue (in HRK 000)	663,678	26,941	6,195,092	388,518	3,141	549,381
Total expenditure (in HRK 000)	635,206	23,341	4,984,176	395,749	2,992	541,285
EBITDA (in HRK 000)	36,032	3,792	2,621,355	75,684	342	125,490
Profit tax (in HRK 000)	6,338	651	220,255	-1,4	203	3,174
Net profit (in HRK 000)	22,135	2,949	990,661	-5,871	-55	4,923
Newly created value (in HRK 000)	112,604	7,794	2,072,242	50,093	1,320	77,924

DIGITAL COMPANY

This chapter of the Digital Atlas of HT Group describes the HT Group's contribution to the Croatian economy in terms of gross domestic product (GDP), gross value added (GVA), employment, and tax revenues. The total economic impact of the HT Group as a digitally intensive group of companies on the Croatian economy is partially a consequence of its intensive digital transformation which aims to transform jobs within the Group in line with the requirements of the digital era, define and apply new business models and empower digital competencies so that the Group could continue to attract the best talent and provide a comfortable and productive work environment The results of the analysis presented in this chapter build on an earlier research published in 2016 in the publication Economic Atlas of HT Group, which covered the economic effects of the HT Group in the period up to 2015. The Digital Atlas of HT Group assesses these effects until 2018. These effects were assessed only for the Group members operating in Croatia (i.e., without Crnogorski Telekom AD) and without the members that became part of the Group in 2019 (HT Produkcija d.o.o.).

TYPES OF HT GROUP CONTRIBUTION TO CROATIAN ECONOMY

The HT Group contributes significantly to the domestic economy through its operations. The total contribution is calculated by summing the gross value added through the Group's direct, indirect and induced contributions.

The total contribution of the HT Group to the Croatian economy was assessed using the input-output model. A more detailed description of the methodology is presented in the Addendum to Atlas. The input-output analysis distinguishes **three types of company contribution to the overall economy**: direct, indirect and induced contribution. The sum of these three types of contributions represents the total contribution of the HT Group to the economy.

The direct contribution of the HT Group includes the economic results of the Group itself, i.e., the total amount of GVA, tax revenues, and the number of employees created through the company's operations alone.

The indirect contribution of the HT Group to the entire national economy refers to the GVA realized by all the entrepreneurs involved in the production (supply) chain of the companies making the HT Group. The indirect effect is spread through two channels:

- channels of suppliers of intermediary goods for the needs of HT Group members,
- channels of suppliers of investment goods procured by the HT Group.

To deliver the required amount of services to its customers, the HT Group procures intermediary products such as raw materials, materials, energy and various services from other companies. In this way, the suppliers of the HT Group's intermediary products generate revenue and GVA. At the same time, for the production and delivery of goods and services commissioned by the HT Group, they also procure intermediary goods and services on the market, thus stimulating the production of other entrepreneurs in the Croatian economy. In the next rounds of multiplier effects, indirect effects are spread throughout the economy, i.e., all units directly or indirectly involved in the HT Group's production chain.

In addition to the intermediary consumption channels, the indirect effects of the HT Group's operations also spread through the channels of the investment goods suppliers, with the HT Group's procurement contributing most to the activities of manufacturers of telecommunications equipment and software, but also of other entrepreneurs involved in the production chain of manufacturers of investment goods.

In addition to the indirect effects, the operations of the HT Group contribute to the national economy through an induced contribution, i.e., through a contribution of induced personal consumption. Specifically, GVA, which is directly and indirectly related to the activities of the HT Group, is allocated to compensation of employees, taxes, and net operating surplus. Revenue from employees' household income is spent on the purchase of goods and services. Therefore, with the increase of the HT Group's activities, the total personal consumption of HT Group employees and employees of the HT Group's suppliers also increases, which then induces an increase in the production of entrepreneurs producing goods and services intended for the personal consumption of these employees. At the same time, the output of all those entrepreneurs included in the chain of producers of goods and services intended for personal consumption of employees is growing.

TOTAL HT GROUP CONTRIBUTION TO CROATIAN ECONOMY

In 2018, the HT Group contributed directly and indirectly to the Croatian economy with HRK 11.3 billion in induced GDP, 30.2 thousand jobs, and HRK 3.26 billion in taxes and contributions. At the same time, the GVA induced by the Group's activity increased from HRK 8.95 to HRK 9.77 billion in the observed period.

The overall contribution of the HT Group to the Croatian economy in absolute terms shows an upward trend in the period from 2015 to 2018. (table 2). **In 2018, the HT Group contributed directly and indirectly to the Croatian economy with HRK 11.3 billion in induced GDP, 30.2 thousand jobs, and HRK 3.26 billion in taxes and contributions**. At the same time, the GVA induced by the Group's activity increased from HRK 8.95 to HRK 9.77 billion in the observed period with a cumulative growth rate of 9.2%. The absolute contribution to GDP in 2018 compared to 2015 increased by 7.8%, the contribution to the total number of employees in the economy by as much as 11.1%, while the contribution to the general state budget revenue in the observed period increased by 2. 5%. With respect to the annual dynamics of the contribution, the contribution of the HT Group in absolute terms in 2016 declined slightly compared to 2015, to continue increasing in 2017 and 2018.

TABLE 2: TOTAL HT GROUP CONTRIBUTION TO CROATIAN ECONOMY - ABSOLUTE TERMS

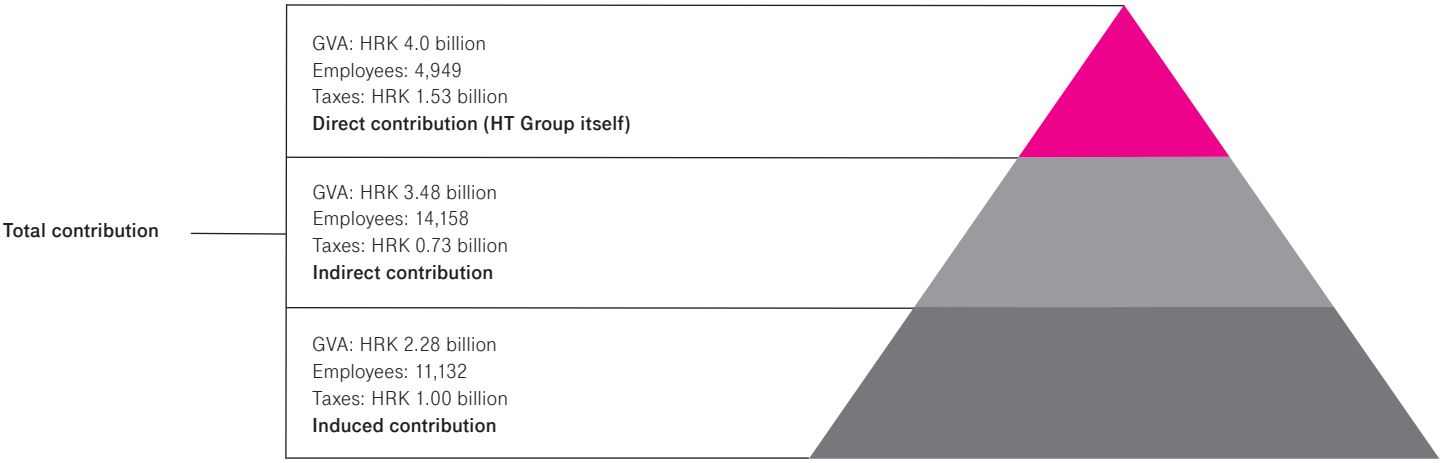
	BDP (in million HRK)	BDV (in million HRK)	Employment	Porezi i doprinosi (in million HRK)
2015	10,497	8,951	27,230	3,185
2016	10,387	8,881	27,050	3,138
2017	10,962	9,433	28,558	3,155
2018	**11,313**	**9,772**	**30,239**	**3,264**

Source: EIZ calculation.

Taxes and contributions induced by HT Group members provide relatively stable general budget revenue of the state and have been maintained at around HRK 3.2 billion over the last few years at the level of the total economy. Taxes and contributions related to indirect activities of producers of investment goods, but also induced personal consumption in 2018 have seen a significant increase over the last three years, which is a consequence of intensified investment activity in the HT Group and an increase in the number of employees. Based on HT Group's investment activity in 2018 alone, the Group's suppliers of investment equipment paid taxes and contributions into the state budget the amount of HRK 284 million.

When it comes to newly created GVA and tax and contribution revenues, the largest contribution in 2018 is made directly by the HT Group itself (figure 1). The Group thus directly generates 41% (HRK 4 billion) of the Group's total GVA-induced activity and 47% (HRK 1.53 billion) of the Group's total induced state budget revenues from taxes and contributions. On the other hand, the Group's largest contribution to inducing employment is realized indirectly, i.e., through the Group's channel of suppliers of intermediary and investment goods. The Group's indirect contribution to the employment, through its suppliers, is over 14 thousand jobs, which is 47% of the total induced jobs in the HT Group's economy.

FIGURE 1 STRUCTURE OF THE TOTAL HT GROUP'S CONTRIBUTION TO THE ECONOMY IN 2018

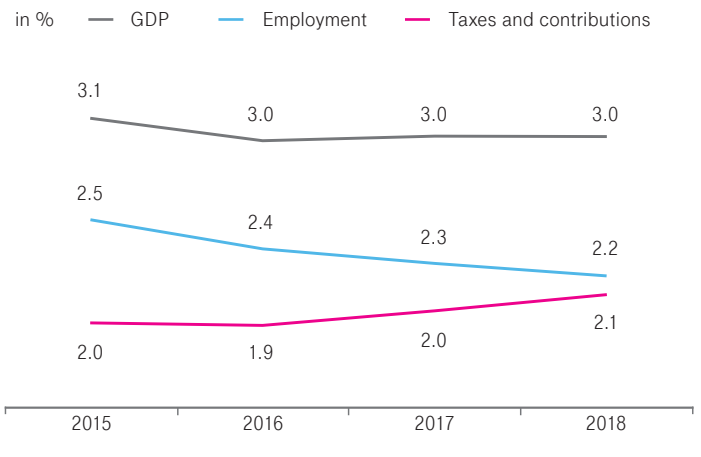


Source: EIZ calculation.

In addition to an absolute contribution to the economy, the relative contribution of the HT Group is important as well as it indicates the economic importance of the Group. In economy, by relative contribution we mean the share of HT Group's contribution to the total GDP, number of employees, and taxes. In 2018, the HT Group directly and indirectly generated 3% of Croatia's GDP, 2.2% of tax and contribution revenues and 2.1% of total employment (figure 2). The relative contribution of the HT Group in terms of GDP declined slightly in 2018 compared to 2015. Namely, in 2015 it amounted to 3.1%, while in all subsequent years it amounted to 3%. **Given that at the same time the HT Group's absolute contribution to GDP was increasing, the stagnation of the relative contribution to GDP can be attributed to the continued decline in the prices of HT d.d. telecommunications services and a simultaneous rise in the average price level of other goods and services in the economy over the analyzed period.** In other words, this means that the HT Group's relative contribution to Croatia's GDP, thanks to the reduction of telecommunication services prices first in 2016, slightly reduced, to stagnate over the next two years.

The relative contribution of the HT Group to tax and contribution revenues decreased by 0.1 percentage point each year. However, with a share of 2.2% in total revenues from taxes and contributions from the general government sector, the HT Group ranks among the most significant Croatian business entities contributing to the sustainability of the public finance system through their activities. The trend of decreasing share of tax revenue induced by HT Group's activities in the analyzed period, with the presence of growth in absolute contribution to tax revenues, is also a consequence of the decrease in the prices of telecommunication services with the simultaneous rise in prices other goods and services. At the same time, the contribution of the HT Group in the observed period to the employment increased slightly, and in relatives terms in 2018 it was 0.1 percentage points higher than in 2015.

FIGURE 2 TOTAL HT GROUP CONTRIBUTION TO CROATIAN ECONOMY – RELATIVE TERMS



Source: EIZ calculation.

HT GROUP'S DIRECT CONTRIBUTION TO CROATIAN ECONOMY

GVA directly generated in the HT Group in 2018 reached HRK 4 billion, the Group employed almost 5 thousand employees and paid HRK 1.53 billion directly to the State Budget for taxes and contributions.

GVA directly generated in the HT Group in 2018 amounted to HRK 4 billion. In spite of the continuous decrease in the prices of telecommunication services (which form the basis of the Group's operations) while improving the quality of service, it can be observed that after the decrease in the level of direct GVA in 2016, there was a turnaround and in 2017 and 2018 the Group recorded an increase in directly realized GVA (table 3).
HT Group's total revenue in 2018 amounted to approximately HRK 7.2 billion (figure 3).

The total revenue from the sale of goods and services of the HT Group at market prices, increased by the non-deductible VAT on deliveries to residential customers, was estimated at HRK 8.1 billion in 2018, while the gross output of the HT Group was, by definition from national accounts, HRK 5.7 billion. In the production process, HT Group members spent approximately HRK 1.7 billion in intermediary goods and services procured from other manufacturers, which ultimately yields HRK 4 billion in direct GVA from the Group.

In 2018, the HT Group directly employed almost 5,000 employees in Croatia. The fact that the HT Group's share of GVA on average is more than three times higher than the share in employment indicates a significantly higher level of productivity of HT Group employees than the national average. The Group's share of total employment varies from year to year, ranging from 0.33% to 0.36%.
In 2018, the HT Group paid HRK 1.53 billion directly into the state budget for taxes and contributions.

FIGURE 3 STRUCTURE OF THE HT GROUP'S REVENUE IN 2018 AND RELATIONS WITH CATEGORIES FROM NATIONAL ACCOUNTS, IN MIL. HRK

Source: EIZ calculation.

In spite of the continuous decrease in the prices of telecommunication services (which form the basis of the Group's operations) while improving the quality of service, it can be observed that after the decrease in the level of direct GVA in 2016, there was a turnaround and in 2017 and 2018 the Group recorded an increase in directly realized GVA

TABLE 3 GROSS OUTPUT, GVA, AND HT GROUP'S EMPLOYMENT 2015 TO 2018

Year	BDV (in million HRK)	Number employees	Direct share in GVA RH (in %)	Direct share in employment RH (in %)
2015	3,930	5,013	1.39	0.36
2016	3,765	4,682	1.29	0.34
2017	3,900	4,713	1.29	0.33
2018	4,004	4,949	1.28	0.35

Source: EIZ calculation.

INDIRECT AND INDUCED HT GROUP'S CONTRIBUTION TO CROATIAN ECONOMY

The indirect effect on suppliers in the HT Group's production chain is relatively higher than the direct contribution of the HT Group, generating more than HRK 4 billion in GVA through this channel and indirectly generating more than 17 thousand jobs (table 4). The multiplier effects of the Group are particularly evident in the case of indirect jobs, since the average national productivity is far below the productivity of the digitally intensive HT Group and more employees are required for the same output and GVA across the supplier channel than within the Group itself.

The indirect and induced effects through the channel of the investment goods suppliers are of somewhat lower intensity than in the case of intermediary goods suppliers. The gross production of domestic manufacturers in the entire supply chain of the HT Group's investment goods amounts to HRK 3.7 billion, generating around HRK 1.6 billion in GVA and employing almost eight thousand employees. Through both channels, suppliers of intermediary products and suppliers of investment goods, the HT Group induces nearly HRK 6 billion in GVA in the Croatian economy and over 25 thousand jobs.

TABLE 4: DIRECT, INDIRECT AND INDUCED CONTRIBUTION OF THE HT GROUP TO GVA AND EMPLOYMENT IN 2018

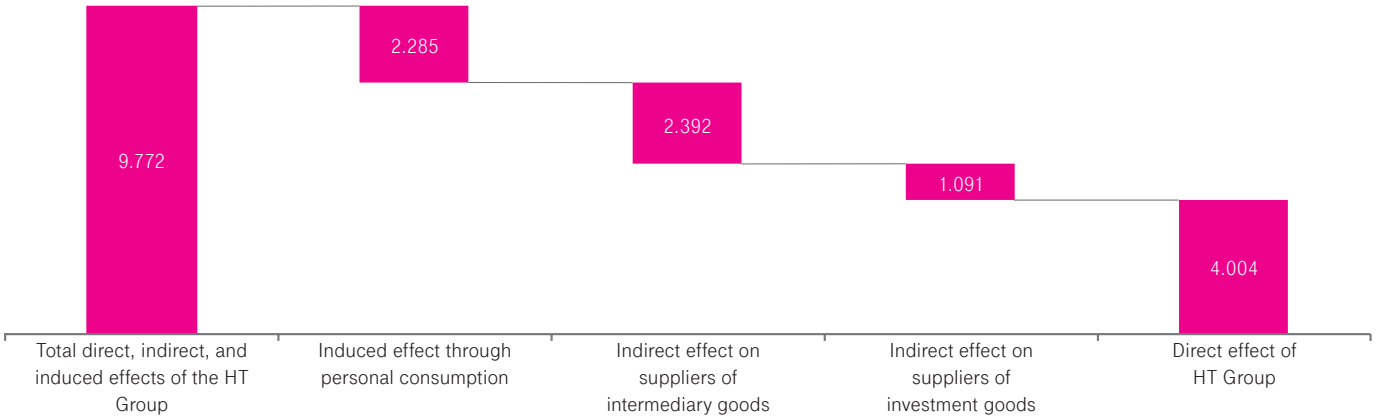
	Gross output (in million HRK)	Gross value added (in million HRK)	Employment	Compensation of employees (in million HRK)
Direct contribution of HT Group	**5,664**	**4,004**	**4,949**	**1,021**
Indirect and induced contribution of the HT Group through intermediary goods suppliers	**6,302**	**4,152**	**17,335**	**1,656**
- effect without induced personal consumption	3,688	2,392	8,680	1,006
- effect of induced personal consumption	2,614	1,760	8,655	650
Indirect and induced contribution of the HT Group through investment goods suppliers	**3,652**	**1,616**	**7,955**	**935**
- effect without induced personal consumption	2,648	1,091	5,478	708
- effect of induced personal consumption	1,003	525	2,477	227
Total direct, indirect, and induced contribution of the HT Group	**15,618**	**9,772**	**30,239**	**3,612**

Source: EIZ calculation.

In 2018, the HT Group contributed around HRK 3.2 billion in tax revenues through its activities in total. Almost half of the total taxes and contributions are directly related to the payments made by the units within the Group, while the remaining amount relates to payments made by the entities included in the HT Group's value chain, i.e., the induced VAT (figure 6).

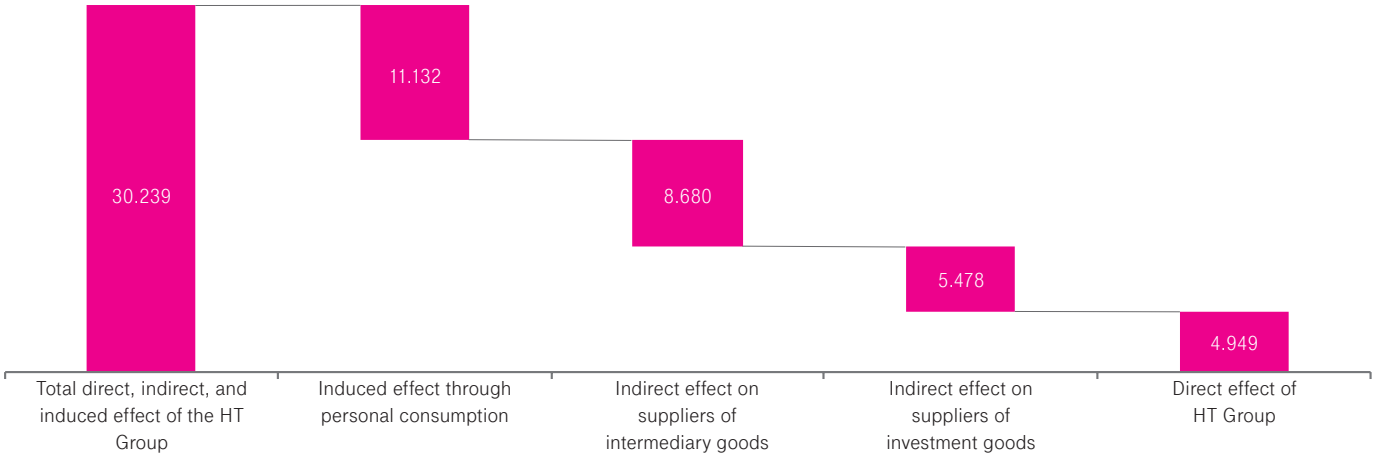
The multiplier effects in the contribution of the general state budget are lower than the multiplier effects of gross value added and employment. This is due to the higher level of salaries and profits earned in the Group members relative to the average of the Croatian economy. By tax revenue categories, almost 50% of the general state revenue induced by the activities of the HT Group is VAT, followed by taxes and contributions from and to salaries with a share of more than one-third. Profit tax above HRK 450 million is also a significant source of budget revenues, while other production taxes, which are not dependent on operating results, are less substantial.

FIGURE 4: TOTAL DIRECT, INDIRECT, AND INDUCED CONTRIBUTION OF THE HT GROUP TO GVA IN 2018, IN MIL. HRK



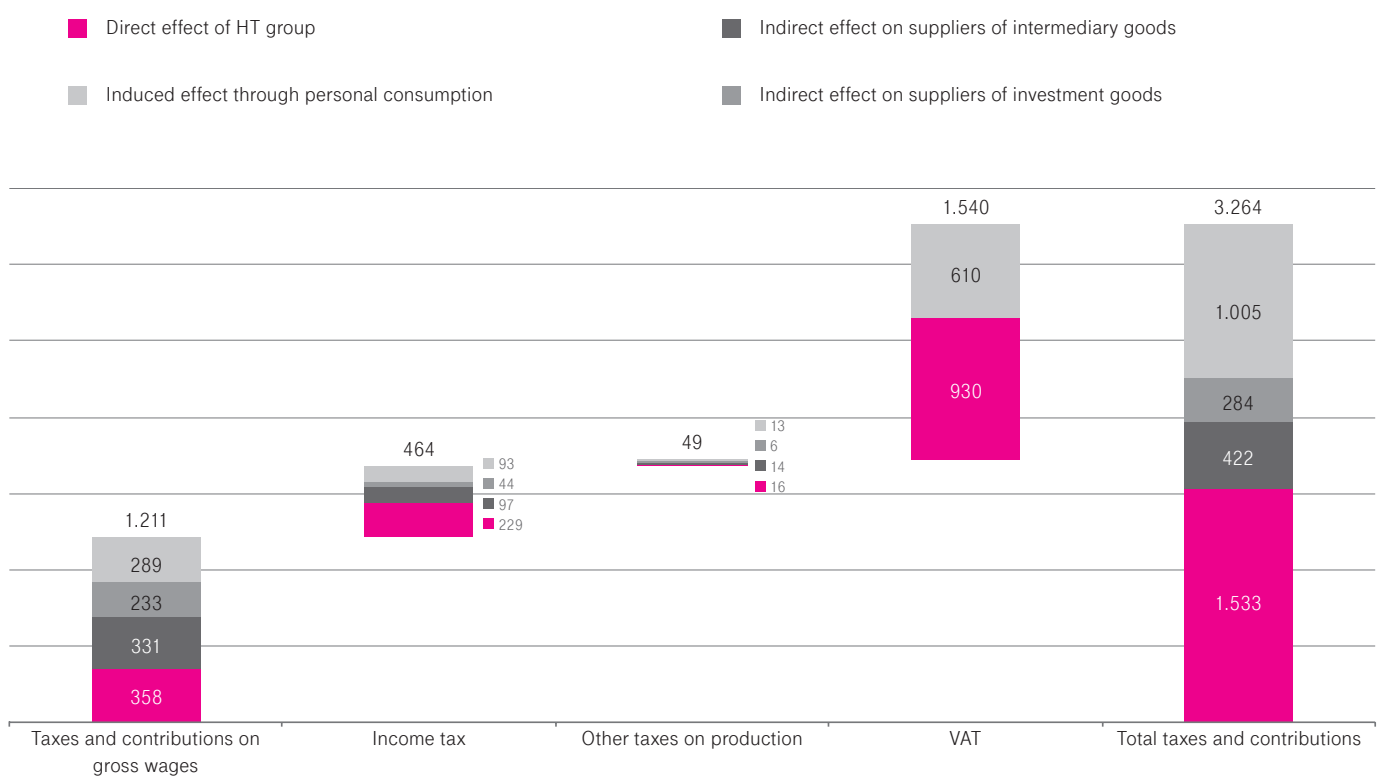
Source: EIZ calculation.

FIGURE 5: TOTAL DIRECT AND INDIRECT CONTRIBUTION OF THE HT GROUP TO THE GENERATION OF JOBS IN 2018



Source: EIZ calculation.

FIGURE 6: TOTAL TAXES AND CONTRIBUTIONS INDUCED BY THE ACTIVITIES OF THE HT GROUP IN 2018 IN MIL. HRK



Source: EIZ calculation.

CONTRIBUTION OF HT GROUP TO SECTORS AND ACTIVITIES OF CROATIAN ECONOMY

HT Group members use energy, maintenance, rental services, and promotion costs in their production processes. Therefore, through the channels of demand for intermediary goods and services, the most significant indirect effects are created by companies providing business services. On the other hand, with regard to investments in tangible and intangible assets, the most significant indirect effect of the HT Group is realized on telecommunication equipment manufacturers and suppliers of computer components and services. In addition to the GVA, which is broken down by industry, the total contribution to GDP also includes net taxes on products that, by the methodology of national accounts, are not joined to a particular activity but form part of the newly created income, which is the general state sector's income.

Total GDP, directly and indirectly induced by the activities of the HT Group, amounted to approximately HRK 11.3 billion in 2018. The most significant part is related to the direct GVA generated by HT Group members (35.4%), but also a significant contribution of the Group realized by enterprises classified in business services (27% of induced GDP; table 5). Strong positive effects of the HT Group's operations are also reflected in the operations of groups of activity such as construction, trade, transport, hotels and restaurants, and the industry. The effects on agriculture and public and personal services are not high and are primarily related to an increase in induced personal consumption, while their share is not significant in the intermediary costs and investments of the HT Group.

If GVA directly generated by HT Group members is added to value added tax charged to final consumers, then the total GDP directly related to the Group's operations in 2018 was HRK 4.9 billion. The indirect effect on suppliers of intermediary products amounted to approximately HRK 2.4 billion, while the indirect effect on suppliers of investment goods amounted to approximately HRK 1.1 billion. In absolute terms, the value of intermediary consumption is higher than the value of the investment, but compared to the previous period, a significant increase in induced effects can be observed through the investment channels resulting from the Group's investment in digital infrastructure and its digital transformation.

Induced personal consumption, which includes additional household consumption financed by the growth of income of employees in the HT Group, as well as the entire supply chain of intermediary and investment goods and services, contributed to additional GDP growth of approximately HRK 2.9 billion in 2018. In addition to indirect contribution to overall economic activity and the standard of households, HT Group's activities also contribute significantly to the sustainability of public finances in Croatia, with VAT directly and indirectly generated by the Group's activities amounting to more than HRK 1.5 billion.

In addition to value-added tax, the HT Group also directly contributes to other general state tax revenues. An integral part of the gross remuneration of employees is the contributions calculated from and to the wage and income tax. From the realized profit, HT Group pays corporate income tax, and other production taxes that are independent of the achieved operating result are an integral part of GVA. In addition to directly paid taxes and contributions by the HT Group, an indirect effect is manifested in the induced GVA of other domestic manufacturers, of which the central budget revenue, i.e., the budget revenue of local government units, is a part.

TABLE 4: DIRECT, INDIRECT AND INDUCED CONTRIBUTION OF THE HT GROUP TO GVA AND EMPLOYMENT IN 2018

	Activity	HT group (in million HRK)	Chain of suppliers of intermediary goods (in million HRK)	Chain of suppliers of investment goods (in million HRK)	Induced effect (in million HRK)	Total (in million HRK)	Structure of induced income (in %)
BVD	HT Group	4,004.4	-	-		4,004.4	35.4
	Agriculture, fishing, forestry	-	7.9	3.4	137.0	148.3	1.3
	Industry	-	297.2	448.3	402.4	1,147.9	10.1
	Construction, trade, transport, hotels, and restaurants	-	407.1	218.5	605.0	1,230.6	10.9
	Business services	-	1,629.1	410.9	1,016.2	3,056.2	27.0
	Public and personal services	-	50.9	9.5	124.3	184.8	1.6
PDV	PDV	930.0	-	-	610.4	1,540.4	13.6
BDP	BDP	4,934.4	2,392.3	1090.6	2,895.3	11,312.6	100.0

Source: EIZ calculation.

CONCLUSION ON CONTRIBUTION OF HT GROUP TO CROATIAN ECONOMY

The intensification of HT Group's investment activities in digital infrastructure enables an increase in the volume and quality of services, which compensates for the reduction of retail prices of telecommunication services, but in this way it has a positive effect on the digitalization of the entire economy.

The indicators this chapter describes, suggest that the HT Group is successfully keeping pace with the trends in the telecommunications services market. In the conditions of continuous reduction of the prices of these services, the process of own digital transformation, and intensive investment in digital infrastructure, it achieves a high level of GVA throughout the period and provides an adequate level of income for employees, profit to owners, but also sufficient funds to continue the investment cycle, which is a necessary condition for improvement of business and maintaining a leading position in the Croatian market.

- Over the past two years, there has been a trend of growth in nominal GVA directly created by HT Group members, despite the continuing trend of decreasing prices for telecommunications services. In real terms, the HT Group's activity continued to increase in terms of minutes of calls, SMS/MMS, and internet traffic. In addition to the increase in physical traffic of services, there is a noticeable increase in the quality of services provided while ensuring higher speed, traffic safety and providing new high-tech services. By increasing the quality and the real volume of services provided, the HT Group successfully compensates for the decrease in sales prices.
- The digital transformation and improvement of business processes in the analyzed period also influenced the structure of the intermediary demand of the HT Group, in which products and services of higher added value play an increasingly important role. Throughout the period, indirect effects can be observed through the channel of suppliers of intermediary goods and services. In this way, the HT Group's operations gave a strong impetus to the rest of the economy and contributed to the recovery of the Croatian economy from the recession.
- Intensification of HT Group's investment activities in digital infrastructure enables an increase in the volume and quality of services, but also has a positive impact on the entire value chain of suppliers of investment goods. Total GVA indirectly related to investments of HT d.d. increased significantly in the analyzed period and amounted to over HRK 1 billion in 2018. Investments of HT d.d. in digital infrastructure have a positive influence on sectors that are categorized as high technology such as manufacturers of telecommunication equipment and software support, thus further improving the technological base and productivity of the Croatian economy.
- The activity of the HT Group induces a significant number of employees who earn income directly in the Group members, that is, throughout the chain of suppliers of intermediary and investment products. The effect of induced personal consumption on the GVA of the Croatian economy amounted to approximately HRK 2.3 billion in 2018. The multiplier effects on employment trends in the national economy are even stronger than the multiplier effects on GVA movements.
- As in the case of GDP movements, over the last two years there has been an evident increase in the total number of jobs directly or indirectly related to HT Group activities. Thus, the HT Group's operations contributed to the employment of more than 30 thousand people in 2018 in total, the highest number in the analyzed period.

DIGITAL INFRASTRUCTURE

This chapter of the Digital Atlas of HT Group analyzes the economic effects of investments in digital infrastructure . To assess the economic effects of investing in infrastructure, an input-output analysis, described in more detail in the Addendum to the Atlas, has also been applied in this chapter. Digital infrastructure has been separated into a separate chapter because it represents an important strategic area of activity of the largest company within the HT Group - Hrvatski Telekom, which also owns fixed telecommunications infrastructure and a significant part of mobile infrastructure in the Republic of Croatia.

TYPES OF INVESTMENT OF HRVATSKI TELEKOM IN DIGITAL INFRASTRUCTURE

In terms of investment intensity, measured by the amount of investment on each kuna of generated revenue, HT is the first among large companies in Croatia. Between 2010 and 2018, the HT Group invested more than HRK 12 billion, or an average of HRK 1.35 billion annually.

Economic research on the effects of the telecommunications sector on the national economy often emphasizes the importance of investing in digital infrastructure. In addition to improving the quality of customer service, investments also indirectly affect the supply chain of investment goods, thus contributing to the growth and job creation in the overall economy. In the period from 2010 to 2018, the HT Group invested more than HRK 12 billion, or an average of HRK 1.35 billion annually, of which HT d.d. invests the majority. Because of this fact, an assessment of the economic effects of investing in infrastructure has been made for investment into infrastructure by HT d.d. Namely, according to the intensity of investment measured by the amount of investment on each kuna of realized income, HT d.d. is the first among the largest companies in the Republic of Croatia. In 2018 alone, HT d.d. allocated as much as a quarter of total revenue for investment purposes, and similar investment intensity was recorded throughout the period analyzed.
The company also ranks first among private service companies by total investment in 2018, and second among privately-owned companies (following INA d.d.). It should be emphasized that INA d.d. recorded three times higher revenues than HT d.d. with only slightly higher total investments, which means that investment intensity of HT d.d. is almost three times higher than INA d.d.

Four types of HT d.d. investments in infrastructure have been differentiated in creating the Digital Atlas of the HT Group:
- investments in the copper fixed access network,
- investments in the optical access network,
- investments in the mobile network,
- investments in data centers

When **investing in an access (fixed) network**, the emphasis is on investments in the optical access network, providing users with ultra-high speed internet access - greater than one hundred megabits per second, expandable up to one gigabit per second. Croatian cities whose population can use the internet through optical infrastructure and optically based access, already have more than 700,000 households with direct access to speeds exceeding thirty, and an additional 250,000 households with speeds from one hundred to five hundred megabits per second. Hrvatski Telekom's continued investment in optical infrastructure has resulted in the first quarter of 2019 in the modernized next-generation high-speed access network (NGA). Currently, this means coverage of 59% of households with speeds over thirty megabits per second and 22% of households with speeds exceeding 100 megabits per second). By further investing in the development of optical infrastructure, Hrvatski Telekom will enable as many as 1.2 million of Croatia's 1.5 million households to enjoy speeds higher than thirty megabits per second in the next two and a half years. Almost a third of the total number of households, more than 600,000, will have access to speeds of between one hundred and five hundred megabits per second in the coming period.
In addition to investments in optical infrastructure, in areas with the existing copper access network, the investments are aimed at shortening the length of the copper pair to provide users with speeds of at least thirty megabits per second, and to further implement advanced technological solutions such as the so-called supervectoring functionality that delivers user speeds over one hundred megabits per second to users connected via short length copper pairs.

Furthermore, HT was the first in the market to introduce a Hybrid Access fixed-mobile convergence service aiming to increase speeds for fixed users that have the technical capability to achieve lower speeds. Thanks to this innovative hybrid technology, Hrvatski Telekom has provided access to high speeds of up to thirty megabits per second in rural and less populated areas of Croatia. It is a combination of the most affordable fixed and the best mobile network in a single service that provides stable and fast internet access. More than 50 thousand users are already enjoying the benefits of this innovative technology on the Croatian market.

With regard to **mobile network investment**, in early 2018 HT d.d. started with over HRK 1 billion worth of radio access network modernization program, which includes modernization of infrastructure (antenna masts, poles, antennas), expansion of transport capacities and replacement of radio equipment by the Single RAN concept that ensures efficient use of radio equipment between different RAN technologies. Estimated duration of the

program is four years and will continue to be regularly upgraded to all RAN technologies according to customer needs. The goal of the modernization program is to ensure, in addition to applying state-of-the-art implementation concepts in the industry, the possibility of introducing innovative solutions to improve service quality and mobile network performance, all to improve customer perceptions of mobile network users.

During the modernization of the mobile network, in addition to replacing the existing equipment, the existing network of the access network will be expanded, which will enable:

- increase of coverage i.e., availability of UMTS (3G) and LTE (4G) mobile network services in the entire territory of the Republic of Croatia,
- the uniform quality of mobile network service in rural and urban areas as an important segment of creating the infrastructure preconditions for rural development,
- increase in available data rates (max up to 1 Gbps),
- increasing the quality of voice service,
- additional capacity for access of an increased number of users during the tourist season.

The modernization of the mobile network will enable support for NB IoT (M2M (machine-to-machine) communication technology used in health care, surveillance, traffic, etc.) throughout the territory of the Republic of Croatia and will also create preconditions for introduction of 5G technology. At the end of June 2019, 64% of the entire network was modernized. The network has been modernized in Istria, Zagreb County, the City of Zagreb and along the coastline as the whole, allowing for up to 30% faster speed in these areas. By the end of this year, the modernization of the network will be completed in other parts of Croatia as well, and the network will be fully ready for the implementation of 5G technology. Thanks to HT's investment in 2019, the 4G network covered 85% of the indoor population and 99% of the outdoor population.

Prestigious independent international researches also confirmed the correctness of the activities of Hrvatski Telekom in investing in infrastructure. These are the certificate for the best mobile network in Croatia (P3 certificate) won for measurement in 2018 and the Ookla Awards, which confirm the top quality of the mobile network. The awards awarded to Hrvatski Telekom were for the fastest mobile network in Croatia and the best coverage. According to Ookla, Hrvatski Telekom's network is among the top ten networks in the world, with only the Netherlands ahead of Croatia in Europe.

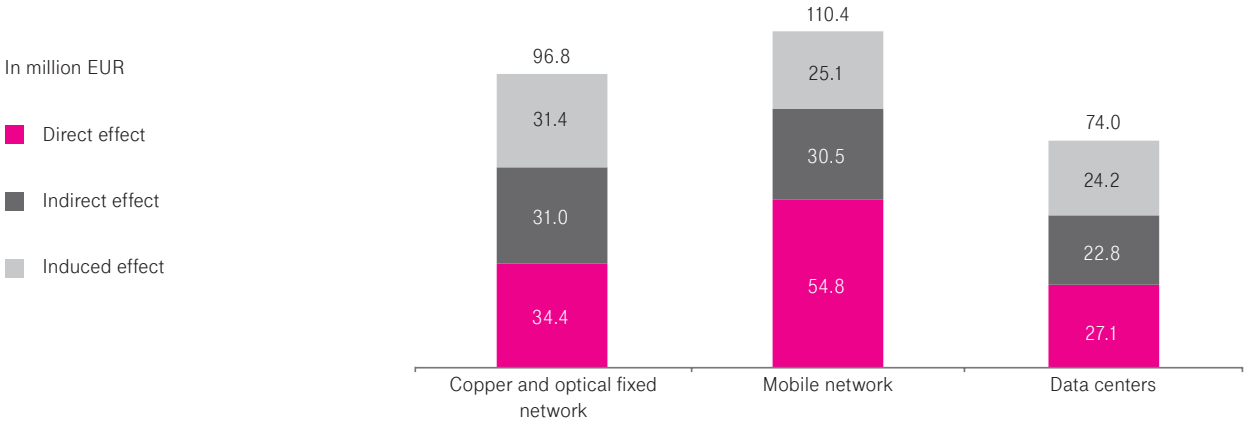
HT d.d. has been intensively testing 5G technology, and commercial work is planned to start in 2020. Pilot projects are currently underway to test the 5G network in the 3.5 GHz band at a dozen base stations in Croatia, to gain a better understanding of the state of technology and its behavior under real conditions. One of the results is a speed over one gigabit per second on a commercial 5G device measured on the streets of Krk by the Speed Test. 5G is not only a new telecommunications network but also encompasses an entire eco-system based on new advanced services. In the future, 5G will be widely used in industry, agriculture, education, health care, etc., and will drive many innovations and contribute to stronger economic growth and greater global competence. 5G will also play an important role for residential users and will enable broadband speeds to fixed internet users using mobile technology.
Over the last two years, HT d.d. Has also intensively invested in modernization of data centers. Data centers are the very heart of all telecommunications and ICT services offered by HT d.d. and therefore, significant resources are invested in maintaining and raising the level of data center security against outages (Tier3 standardization). This means that in the event of a power failure, data centers operate continuously, allowing users to use all the services offered. In addition to investing in the energy part, investments are also in IT infrastructure, especially in virtualization of equipment in data centers, enabling HT's services to operate at a high availability level with less power and other resources.

ECONOMIC EFFECTS OF INVESTMENT IN DIGITAL INFRASTRUCTURE

Investments in digital infrastructure show a significant multiplier effect. For example, a one hundred million euro investment in a mobile network induces as much as 110 new million euro of gross value added.

Figure 7 shows the effects on GVA investments of one hundred million euros in the four types of digital infrastructure. Because investments in copper and optical access network, mobile network, and data centers require different product and supplier structures, the overall multiplier effects of these investments vary. For example, **investments in the mobile network have the greatest multiplier effect on GVA**, since they involve the installation of high-tech telecommunication equipment domestically manufactured of high added value. Thus, **a hundred million euro worth of investment in the mobile network induces as much as 110 new million GVA, of which most of the newly created GVA** (55 million euros) is generated directly by the investment itself. Thirty million euros of new GVA is induced through the activity of suppliers of equipment and services necessary for the improvement of the mobile network, and 25 million euros of GVA is induced by employees of HT d.d. and its suppliers spending their income earned by working on investment in the mobile network. At the same time, investments in copper and optical access network of one hundred million euros induce 97 million euros of new GVA, while the same amount of investment in data centers generates 74 million euros of new GVA. The reason for the lower multiplier effect of investments in data centers should be sought in the fact that this investment requires a significant share of imported equipment, which makes the effect of these investments on the generation of domestic GVA slightly lower than other categories of investments in digital infrastructure.

FIGURE 7: GVA INDUCED BY INVESTMENTS OF HT D.D. IN THE VALUE OF 100 MILLION EUROS

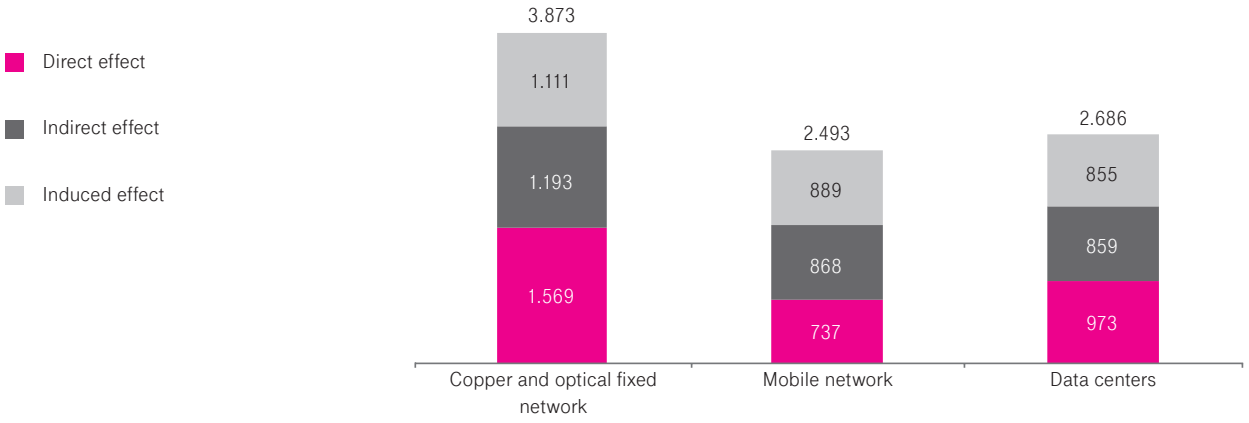


Source: EIZ calculation.

As investments in upgrading the copper access network and in the construction of the optical network require more construction work that is labor-intensive and less productive, **the largest multiplier effect on employment of investments in digital infrastructure will be in the investments in the fixed access network** (Figure 8). This investment in the fixed network thus induces 3,873 new jobs. Interestingly, the direct effect of HT's investments on employment is much smaller than the direct effect of that company's investments on GVA, while the effect on employment induced by HT's employees and its suppliers of investment equipment is much greater. At the same time, investing one hundred million euros in data centers induces 2,686 new jobs, while the investment in the mobile network has the lowest effect on employment - 2,493 new jobs.

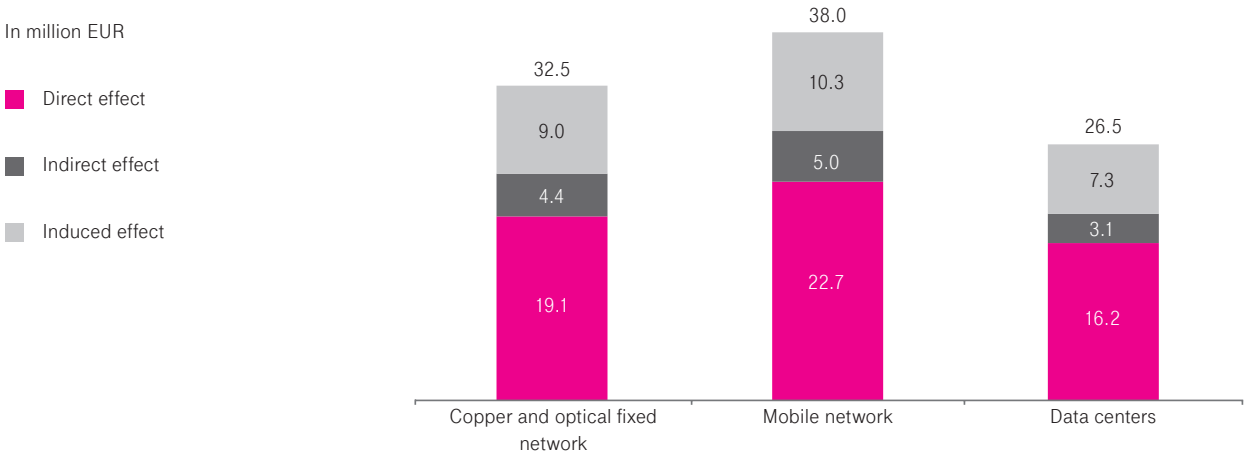
The amount of taxes and contributions induced by each type of investment in digital infrastructure roughly follows the structure of induced GVA, so the **positive effect on the state budget per unit of investment is greatest for the mobile network, where EUR 100 million of investment generates EUR 38 million in new taxes and contributions**. The same amount of investment in the fixed network generates EUR 32 million in taxes and contributions, while in data centers, such an investment induces EUR 26 million in taxes and contributions. Taxes and salaries paid in the case of investments in the mobile network amount to EUR 23 million, and in the case of the fixed network around EUR 19 million.

FIGURE 8: EMPLOYMENT INDUCED BY INVESTMENTS OF HT D.D. IN THE VALUE OF 100 MILLION EUROS



Source: EIZ calculation.

FIGURE 9: TAXES AND CONTRIBUTIONS INDUCED BY INVESTMENTS OF HT D.D. IN THE VALUE OF 100 MILLION EUROS



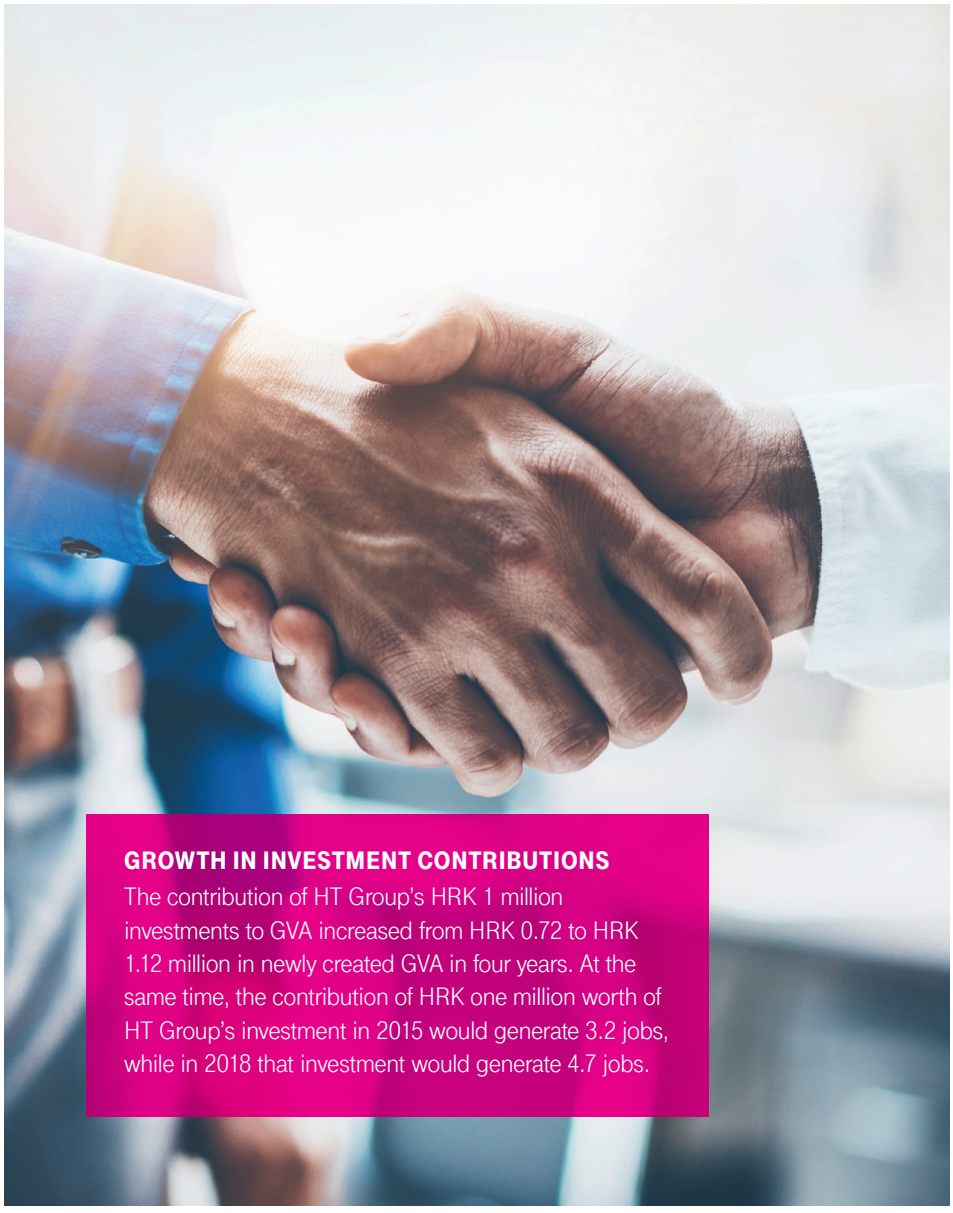
Source: EIZ calculation.

An analysis of the multiplier effects of digital infrastructure investments also suggests that an additional increase in investment resulting from the reduction of parafiscal charges would have positive economic effects. Parafiscal charges are a right-of-way fee for electronic communications infrastructure related to the fixed network and a fee for the use of the radio frequency spectrum related to the mobile network. Releasing the investment potential of the HT Group due to a possible reduction of these charges would generate new jobs and additional GVA and GDP that exceed the amount of lost revenue for the state budget resulting from the reduction of charges. At the same time, there would be a direct partial compensation of lost revenue for the state budget from the charge because new investments, in addition to GDP and jobs, would also induce new tax revenues. Namely, reducing the radio spectrum fee by one hundred million euros and using these funds for investments in the mobile network would, through the multiplier effects of that investment alone, generate 38 million euros in new taxes and contributions. By the same logic, reducing the right-of-way fee in the amount of one hundred million euros and investing this amount by HT d.d. to the construction of the access network would generate EUR 32 million in new taxes and contributions. This means that the losses to the general state budget as a result of the reduction of these parafiscal charges would be significantly lower than expected at first glance. Furthermore, the next chapter of the Digital Atlas will also outline the positive effects of improving fixed and mobile infrastructure on company operations. These effects are not covered by this calculation, although they also contribute significantly, not only to higher tax revenues, but also to the achievement of the strategic and development goals of the Republic of Croatia.

The expected increase in the technological complexity of investments can be expected to represent significant potential for future multiplier effects. The readiness of domestic companies to become more intensively involved in the value-added chain of the telecommunications industry through technological advancement of their own processes will determine the extent to which this potential will be harnessed in the Croatian economy, i.e. the percentage that will flow abroad.

TOTAL CONTRIBUTION OF HT GROUP INVESTMENT TO CROATIAN ECONOMY FROM 2015 TO 2018

The contribution of investments to the induction of newly created GVA increased cumulatively by 71% in four years, and the contribution of these investments to GDP growth increased in the same percentage. HT Group's contribution to GDP in 2018 reached HRK 1.89 billion, representing 0.5% of the total GDP.



GROWTH IN INVESTMENT CONTRIBUTIONS

The contribution of HT Group's HRK 1 million investments to GVA increased from HRK 0.72 to HRK 1.12 million in newly created GVA in four years. At the same time, the contribution of HRK one million worth of HT Group's investment in 2015 would generate 3.2 jobs, while in 2018 that investment would generate 4.7 jobs.

Apart from the contribution of HT's investments in the digital infrastructure, the contribution of the entire HT Group's gross value added, gross domestic product, and employment can also be estimated. An estimate was made for the period from 2015 (When the Economic Atlas was created) to the end of 2018. For the purposes of this analysis, investments of other Group companies are also included in the HT's investments, bearing in mind that HT's investments (mostly related to digital infrastructure) represent the most significant portion of the Group's total investments. For example, in 2018 and 2017 HT's investments were 94% of the Group's total investments.

The indicators presented in Table 6 suggest that the overall contribution of HT Group investments has increased over time, which is expected as the annual amount of investments has shown an upward trend over the observed period. The contribution of investments to the induction of newly created GVA increased cumulatively by 71% in the four observed years, and the contribution of these investments to GDP growth increased in the same percentage. HT Group's contribution to GDP in 2018 reached HRK 1.89 billion, representing 0.5% of total GDP that year. HT Group's investments in 2018 also induced almost 8 thousand jobs, which is also 71% more than in 2015 when the Group's investments generated 4,658 jobs.

TABLE 6: EFFECT OF HT GROUP'S INVESTMENT FROM 2015 TO 2018 ON TOTAL GVA, GDP, AND EMPLOYMENT IN THE REPUBLIC OF CROATIA

	2015	2016	2017	2018	Total in the period 2015 -2018	Change rate 2018/2015 (in %)
GVA and GDB in million HRK						
Direct contribution of investment goods suppliers	370	454	559	606	**1,989**	**64**
Contribution of the investment goods suppliers chain, including	**644**	**818**	**1,006**	**1,091**	**3,559**	**69**
Contribution of induced personal consumption	**303**	**394**	**484**	**525**	**1,706**	**73**
- Total GVA induced by HT Group investments	**946**	**1,212**	**1,490**	**1,616**	**5,264**	**71**
- Total VAT induced by HT Group investments	**160**	**205**	**252**	**273**	**890**	**71**
- Total GDP induced by HT Group investments	1,106	1,417	1,742	1,889	**6,154**	**71**
Employment						
Direct contribution of investment goods suppliers	**1,924**	**2,331**	**2,866**	**3,107**	**10,228**	**61**
Contribution of the investment goods suppliers chain, including	**3,230**	**4,110**	**5,052**	**5,478**	**17,870**	**70**
Contribution of induced personal consumption	1,428	1,859	2,285	2,477	**8,049**	**73**
- Total employment induced by HT Group investments	4,658	5,968	7,336	7,955	**25,917**	**71**
Total direct, indirect, and induced contribution of the HT Group						
- GVA in million HRK on million HRK in investments	**0,75**	**0,88**	**1**	**1,12**	**-**	**49**
- Employment on million HRK in investments	**3,2**	**3,7**	**4,2**	**4,7**	**-**	**47**

Source: EIZ calculation.

Average contributions per million kunas of investments on GVA and employment increase are also increasing, suggesting that the HT Group's investment structure has changed in favor of those investments that require, on the one hand, products of domestic sectors with high value-added and high level of productivity, such as investment in mobile networks, while on the other hand, more emphasis is placed on fixed network investment, which generates a significant number of jobs due to the engagement of the labor-intensive construction industry. Thanks to the described change in investment structure, the contribution of HRK one million of HT Group's investments to GVA increased from HRK 0.72 to HRK 1.12 million in newly created GVA over the four observed years. At the same time, the contribution of HRK one million worth of HT Group's investment in 2015 would generate 3.2 jobs, while in 2018 that investment would generate 4.7 jobs.

DIGITAL BUSINESS

One of the strategic determinants of the HT Group's operations is the digital transformation of businesses of all sizes, be it digitalization of processes, documentation or operations. The goals of such a digital transformation are to improve the efficiency, productivity and competitiveness of a business. The chapter outlines the most important digital solutions offered by the HT Group to its business customers, which enable faster and more efficient digital business transformation. The rest of this chapter presents the findings of the improvement effects assessment in digital infrastructure of HT d.d. on the operations of companies in the Republic of Croatia. More specifically, the impact was assessed of increasing the available speed in the fixed network and the realized data traffic on the establishment of new companies, employment, net wage, labor productivity, and export revenues generated by Croatian companies.

DIGITAL TRANSFORMATION OF ENTERPRISES

One of the strategic determinants of the HT Group's companies is the digital transformation of businesses of all sizes, be it digitalization of processes, documentation, or operations. The goals are to improve the efficiency, productivity, and competitiveness of business operations. HT d.d. and Combis d.o.o. in particular stand out with their solutions for digital business transformation and work digitalization.

HT d.d. offers all micro, small, and medium businesses Magenta 1 Business offering and ecosystems that incorporate ICT solutions depending on the vertical industry, while larger companies are offered integrated solutions and data center services. Introduced at the end of 2018, the **Magenta 1 Business** offering enables companies to choose fixed and mobile services and thus save, but also receive a special MAGENTA 1 BONUS thanks to which they can reduce the monthly fee for one or more **ICT services** of their choice and according to their business needs. ICT services that companies can choose from include, for example, lease of IT equipment, Microsoft Office 365, ERP, Mini CRM, Antivirus protection, Cloud Storage, Fiscalisation Service (Mini or Maxi fiscal cash register, professional Ccash registers), Cloud Exchange Mail, Cloud Fax, Fleet Management, and others.

HT d.d. and Microsoft have been successfully collaborating for years, during which time HT d.d. has expanded its portfolio with Microsoft services and tools that provide customers with many business benefits (faster and easier communication between teams, more efficient business organization, cost reduction, and greater competitiveness in the market), and at any time customers can rely on quality support. Thanks to this collaboration, HT d.d. was named Microsoft Partner for 2019 in Croatia, further positioning it as a leader in innovation in Croatia. This Microsoft award is given each year to Microsoft partners who, over the past year, have developed and delivered exceptional Microsoft technology-based solutions, and for the first time in Croatia were awarded to one telecommunications company. The awards were presented in several categories and the winners were selected from a group of over 2,900 participants from 115 countries, with HT d.d. recognized for providing outstanding solutions and services, as well as excellent affiliate engagement in Croatia. Collaboration of HT d.d. and Microsoft continues to provide highly standardized digital transformation services across the Microsoft Azure platform, Dynamics 365, and Office 365.

HT EDI (electronic data interchange) is a new service offered that enables sending and receiving e-invoices in the B2G and B2B segment. Thanks to this service, businesses can send and receive all types of business documents - invoices, purchase orders, delivery notes, receipts, payment notices, warehouse balances and the like - in standard electronic form. Business customers using EDI make significant savings and benefits, for example, saving on paper due to the lack of printing, archiving and invoicing. Furthermore, data processing operations are automated, reducing the possibility of human error when creating and sending documents, thereby increasing the accuracy of data. For businesses involved in public procurement, this service ensures compliance with the legislation since, in accordance with the Electronic Invoicing in Public Procurement Act, they are obliged since July 1, 2019, to send invoices to contracting authorities in electronic form.

HT d.d. has completed more than 200 projects in the hotel industry so far, equipping hotels with complete ICT solutions - from basic services like WiFi and IP telephony to smart solutions like hotel PMS (Property Management System) systems, hotel applications, telephone exchanges, Hotel TV, fiscalization, Cloud Fax, Cloud Human Resources, IT equipment, Digital signage, video surveillance, EV charging stations, smart parking, e-bikes and the like. Some of the hotels that have implemented the HT d.d. ICT solutions from the hotel segment includes Lišanj Hotel, Gospoja Hotel, Romana Beach Resort, and Valamar, the largest tourism company in Croatia.

HT d.d. invested HRK 62.5 million in the development of the data center in 2014, which offered a complete and high-quality solution for the accommodating, remote monitoring and managing ICT infrastructure and enabled significant business savings for all those business entities that chose to host their servers in it. The strictly controlled and secure data center is housed within a high availability space that meets defined technical and security standards (access control, fire protection, power, and cooling redundancy), where Uptime Institute and TIER certification are considered as the relevant authority. By accommodating equipment in a data center, businesses avoid the huge capital investment that goes with equipping their own data center. Server collocation comes with world-class security and 24/7 technical support, as well as dedicated network access to their equipment with a public IP address. ICT Collocation is a service that enables the server to be hosted in a secure HT d.d. data center, organized to the highest TIER 3 standards. In September 2019, the expansion of the data center infrastructure, HRK 16 million investment, is expected to be completed. In addition to being a state-of-the-art data center, it also includes the largest and most complete E2E portfolio of IaaS services - from collocation to reporting, backups, and professional services. HUP-Zagreb d.d., Addiko Bank, and HPB are some of the users of this data center.

Also, HT d.d. is the first in Croatia with Microsoft as a partner, to present Azure Stack and is positioning itself as an innovative technology leader in the market and a trusted partner to businesses in business digitalization. These are automated services that allow small and medium-sized enterprises and large companies to switch to cloud services in a very short time. Cloud solutions help customers start and

grow their businesses more efficiently. By using cloud, they no longer have to use their own IT center with multiple servers and associated technologies such as uninterrupted power supplies and equipment cooling devices. Thanks to this, companies make significant savings: 30 to 50 percent less cost than traditional IT operations they would do within the company. By expanding the data center with Azure Stack, HT d.d. is positioning itself as an innovative technology leader in the market and a trusted partner to businesses in business digitalization.
By using these technologies, Croatian companies can keep up with global trends and HT d.d. helps them to be more competitive in the domestic and global markets.

Combis d.o.o., a member of the HT Group since 2010, is a regional high-tech ICT company that has introduced on the Croatian market a wide range of IT solutions and services in the fields of digital business transformation, workplace digitalization, and cybersecurity. Services and business solutions that enable and facilitate digital business for businesses include cloud solutions, big data, digital infrastructure, the Internet of Things, a complete range of Managed Services, services in the field of customer relationship management (CRM), contact centers, Excursor platform, and consulting services. Part of cloud solution Combis d.o.o. offers to businesses is Cloud Awareness program that helps customers identify which services and how they can migrate to Microsoft Cloud, as well as what benefits they can expect for their business. Services offered include business continuity in the cloud, mobile business management, Dev/Test and DevOps in the cloud, collaboration in the cloud, and ComCloud. ComCloud is a solution that Combis d.o.o. independently developed, it is a highly modular solution for automated provisioning of cloud services and infrastructure management through self-service portals.

Combis d.o.o offers Husky solution as a unique big data platform that enables the collection, processing, security, and monetization of large amounts of data generated and stored by mobile operators, banks or other companies and organizations that have a large amount of information. Husky combines mobile network traffic data, transactional traffic from a Core banking system, or other vital systems of an organization with a CRM system, and creates valuable reports that can grow the business or direct the business to more profitable segments. All modules have been developed relying on open source technologies such as Spark, ElasticSearch, Kafka, Hadoop, Redis, and PostgreSQL. Digital infrastructure solutions include SDDC (Software-defined Data Center) and SDN (Software-defined Networking), automation and infrastructure management, workload management, application management and high availability, disaster recovery, business continuity, security storage and archiving, infrastructure and service monitoring and management, and consulting.

The business intelligence system for energy management in manufacturing - ComEnergy stands out among the Internet of Things solutions. The development of this solution was co-financed by the European Union from the Operational Program Competitiveness and Cohesion, of the European Regional Development Fund.

Combis d.o.o. has developed its portfolio of managed services, which provides every customer with a complete service that will ultimately increase the efficiency of the company and lower the operating costs. Some of the Managed Services are: Cloud managed services, CoMSEC - Managed Security Services, Printing -as-a-service, Hardware as a Service, infrastructure and data center management, Self-service and Retail IT solutions and automated foreign currency exchange.

Combis d.o.o. also offers Excursor - a platform designed for those who offer leisure tourism services to the market, such as tour operators, travel agencies, hotels, and other providers. Combis offers a number of CRM solutions that are tailored to the specific needs and requirements of each individual user.

Combis d.o.o. offers the following solutions in the field of job digitalization: desktop virtualization, Combis Ema, communication and collaboration, Hardware as a service, and consulting services. Combis Ema is a Mobile Device Management (MDM) solution that provides cloud service to users for secure enterprise mobile device management. There are two variants available - Combis Ema and Combis Ema+. Combis solutions from the areas of communication and collaboration include contact center solutions, Unified Communications, and collaboration solutions - hosted, hybrid - audio, video, virtual meeting & conferencing, Omni-channel services, and On-premise solutions. Combis d.o.o. also offers a HaaS (Hardware-as-a-Service) solution in which, by leasing IT equipment, instead of purchasing, the user company provides its employees with technologically optimal working conditions, and its business with flexibility, better cost management, and higher productivity. HaaS includes the sale or lease of IT equipment, necessary software and maintenance, consulting, image creation and installation on computers, and SLA (service-level agreement) solutions. The HaaS solution is shown to the user company as a monthly expense.

Combis d.o.o. has developed a security portfolio of solutions and services covering ComSec, Siem/Log Management and security analytics, security testing and consulting services, data classification and data loss prevention (DLP), firewall, IPS systems, EndPoint protection, advanced malware protection (ATP), Application Firewall (WAF), user identity management, data access control, and cloud resource security.

IMPACT OF DIGITAL INFRASTRUCTURE ON DIGITAL OPERATIONS OF ENTERPRISES

Basic infrastructure such as the high-speed and high-quality Internet is a crucial prerequisite for the development of digitally intensive businesses and their ability to lead the economy to higher income levels and a better standard of living.

Digital transformation of a business that can be started and/or intensified with the services provided by the HT Group companies is not possible unless the digital infrastructure is developed to the extent necessary for the digital business solutions to be implemented and used. **In other words, improving digital infrastructure opens up the unprecedented opportunities for new business ventures, improvement in performance, and entry of businesses into new activities**. Higher Internet speeds, the ability to send and receive large amounts of data, and a reliable high-quality network give businesses the opportunity to establish relationships with partners from all over the country and the world. In a world marked by fragmented product chains and relying on external sources in non-core business segments, a quality approach to basic technologies such as digital infrastructure makes it possible to replace the missing resources that would otherwise be an insurmountable obstacle to the emergence and development of businesses.

CATCHING UP WITH DEVELOPED COUNTRIES

Digital infrastructure makes it easier for the domestic economy to harness the potential of emerging sectors. One of the fundamental challenges for countries like Croatia is to catch up with developed economies and to reach the world economic and technological frontier.

However, the benefits mentioned are not equally widespread among all enterprises. Businesses in rural areas and, in general, those located at greater distances from administrative centers are more likely to encounter obstacles in accessing clients, suppliers or finding skilled labor. This is especially true for small businesses whose growth is limited by the size of the micro-location market and the lack of resources needed for growth and development. With the improvements in digital infrastructure, these companies can access more customers and rely on the resources of more suppliers. Also, digital infrastructure enables learning from the behavior of other businesses within their own sector as well as the support of professional and scientific stakeholders such as research centers, support agencies, universities and the like. The benefits of digital infrastructure vary from sector to sector. The modern manufacturing industry is characterized by fragmentation of the production process and other business activities. The above would not have been possible without the achievements in the field of information and communication technology that has taken place over the past decades.

Access to better digital infrastructure facilitates not only managing the overall business across multiple locations, but also remote management of complex product segments, such as those that take place within the Internet of Things. Manufacturing companies are particularly benefiting from this because of their involvement in the global value chain as subsidiaries of multinational corporations or as suppliers to foreign clients, but also as those whose manufacturing activities involve cooperation with suppliers from other regions or countries.

On the other hand, the service sector traditionally has a reputation for being a localized part of the economy due to the simultaneous emergence and consumption of services. Modern developments in the field of digital infrastructure have led to the evolution in the nature of the service sector as well. Due to faster and more reliable internet access, a growing number of manufacturing companies delegate specific segments, mainly service segments that are not part of the core business, to companies in other areas of the world, thus providing a strong impetus to the development of the service sector in developing countries. Access to basic infrastructure such as the internet also enables the exchange of knowledge over vast geographical distances, creating opportunities for collaboration between service companies from around the world.

Digital infrastructure makes it easier for the domestic economy to harness the potential of emerging sectors. One of the fundamental challenges for countries like Croatia is to catch up with developed economies and to reach the world economic and technological frontier. In the dynamic environment of the modern economy, such a task requires the ability to recognize and exploit the so-called window of opportunity arising from the changing technological framework in the digital economy. Basic infrastructure such as the high-speed and high-quality Internet is a crucial prerequisite for the development of digitally intensive businesses and their ability to lead the economy to higher income levels and a better standard of living.

Therefore, this chapter of the Digital Atlas of the HT Group assesses the effects of the improvement of Hrvatski Telekom's fixed network on the performance indicators of companies in the Republic of Croatia. The business performance indicators in this analysis imply the number of newly established companies, with an emphasis on the number of newly established digital businesses, labor productivity, average net wage, number of employees, and export revenues of the company. These indicators have been selected because their increase should be of strategic importance for the Republic of Croatia if our country wants to reach the standard of living enjoyed by the inhabitants of developed countries of the European Union. Due to the described differences in

effect of improvements in digital infrastructure on the operations of businesses in the manufacturing and service sectors, and businesses in rural (underdeveloped) compared to developed (urban) parts of the country, in addition to the effects of improving digital infrastructure on the operations of all entrepreneurs in the Republic of Croatia, special attention was given to differences in effects among the listed enterprise groups. Also, the effects of improving fixed infrastructure in digitally intensive enterprises, high technology-intensive industries (the so-called "High-tech" industries) and knowledge-intensive service companies were observed. Two types of infrastructure improvement effects were assessed: an increase in available speeds in the fixed network and an increase in data traffic in the fixed network for the period 2012 to 2017. The first type of effects was assessed at the level of local government units and the second type at the county level. A more detailed description of the digital infrastructure improvement effect assessment model is available in the Addendum to the Atlas.

EFFECTS OF INCREASING AVAILABLE SPEEDS IN THE FIXED NETWORK ON BUSINESS OPERATIONS

Increasing internet speed by 10% leads to the establishment of a new business, has the potential to create 81 new jobs annually in the average local government unit, leads to an increase in the average net wage of HRK 60, and boosts the average of HRK 42 million in exports per local unit.

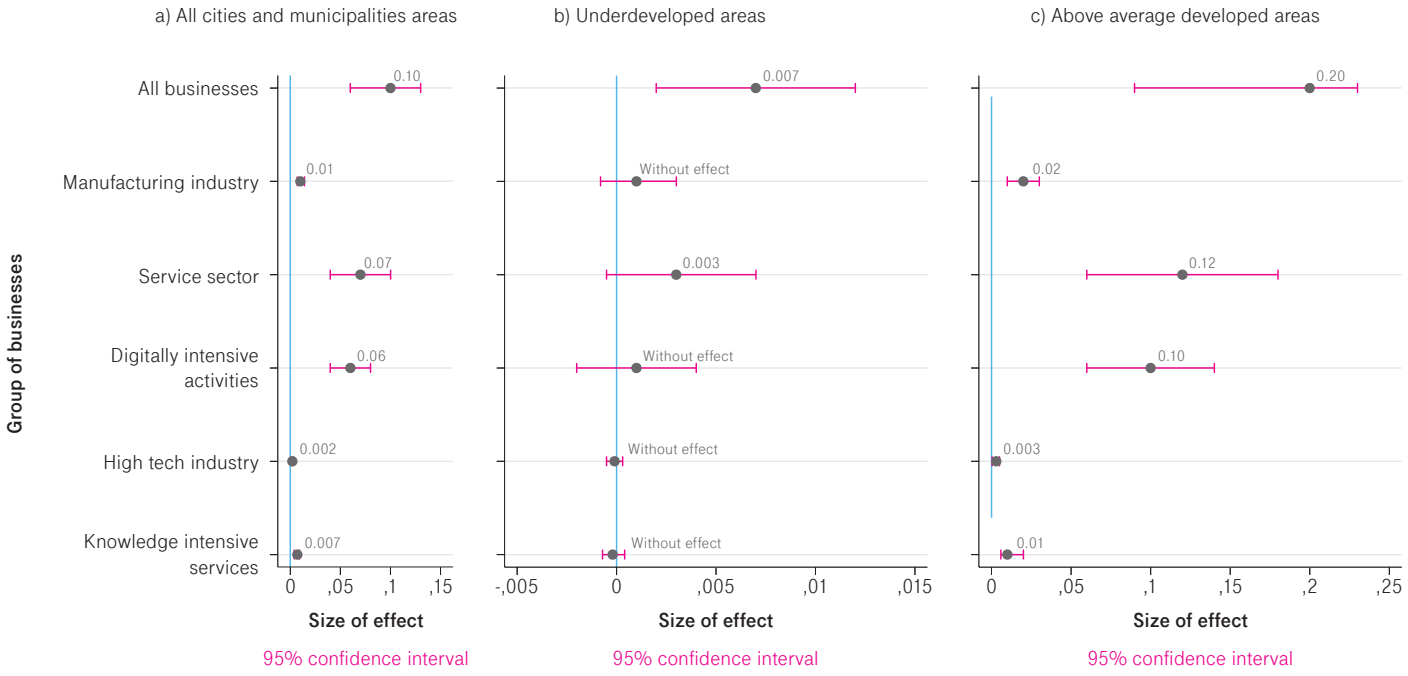
Using the model developed solely for the purpose of this research, the effect of increasing the speed of internet in the fixed network of Hrvatski Telekom by 1% on the establishment of new businesses in Croatian cities and municipalities was assessed. As speeds increased relatively rapidly in the previous period, in explaining the findings of the assessments shown in the figures in this chapter, they were multiplied by 10 to **give the effect of a 10% increase in the available fixed internet speed.**

The findings of the analysis presented in Figure 10 indicate the positive effect of increasing available internet speed on the emergence of new businesses. On average, increasing the internet speed by 10% leads to establishing one new company in each city and municipality.

The effect is slightly weaker in below-average developed areas where other factors also influence the emergence of new businesses. The effects in highly developed parts of the country range from about 2 new businesses with each 10% increase in speed on a local level.

This suggests that better access to digital infrastructure enables domestic businesses to replace resources that do not exist in the immediate environment, but also easier access to customers. Positive effects are also present if the manufacturing industry and service sectors are separately observed. The effects are somewhat stronger in the service sector, where a 10 percent increase in available internet speed increases the number of new businesses by 0.2 in each city or municipality

FIGURE 10: EFFECT OF INCREASING THE INTERNET SPEED BY 1% ON THE ESTABLISHMENT OF NEW BUSINESSES 2014-2017, EFFECT IN THE PERIOD T AFTER THE CHANGE



Source: EIZ calculation.

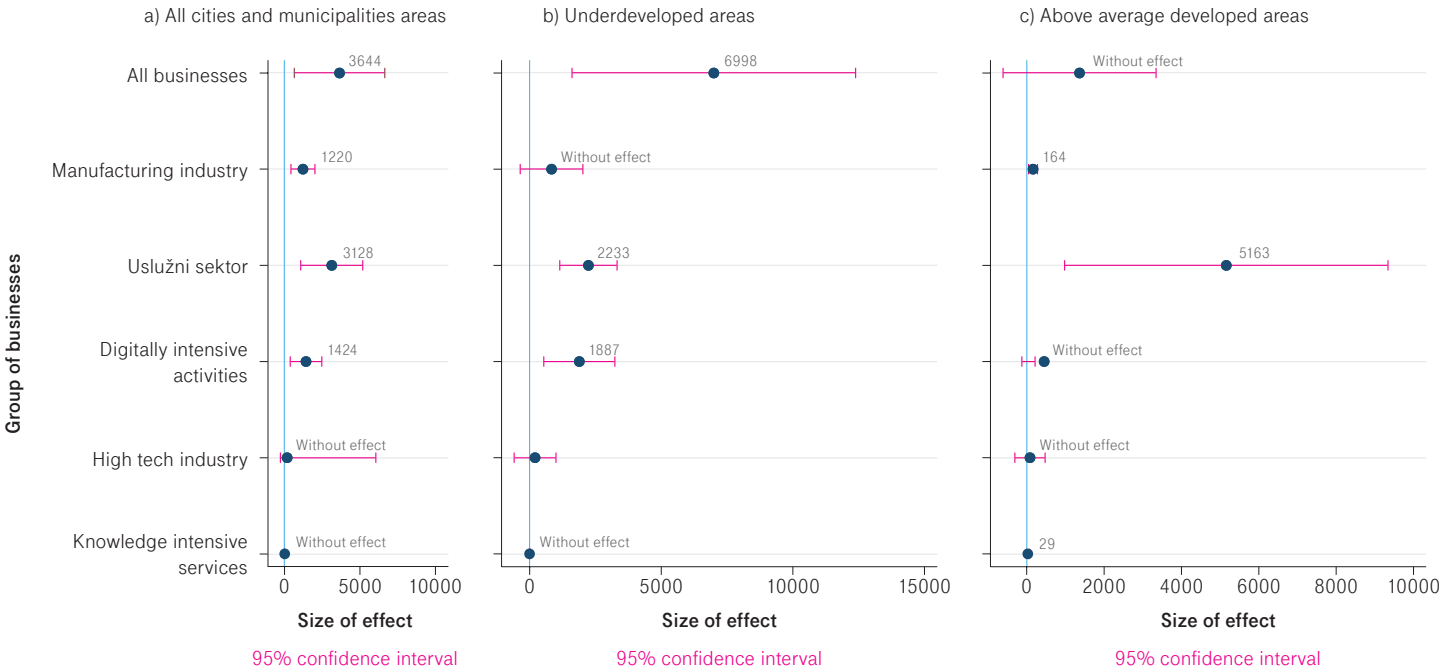
Particularly strong positive effects on the emergence of new businesses in activities that can be classified as digitally intensive by their characteristics are noticeable. In this sector, a 10% increase in speed increases the number of new businesses in each city or municipality by 0.6 per year. If we take into account that during the observed period the average internet speed in Croatia has doubled, it follows that the mentioned increase has created the potential for the emergence of 6 new companies in the digitally intensive sectors annually. These effects are stronger in the above-average developed cities and municipalities, where the contribution of increasing the speed of the internet enables the emergence of up to ten new digitally intensive businesses.

Finally, the positive effects of more modest intensity are also noticeable in technology and knowledge-intensive segments of the manufacturing industry and services, where a 10 percent increase in internet speed contributes to a 0.02 increase in the number of technologically intensive manufacturing businesses and a 0.07 increase in the number of knowledge-intensive service businesses.

In addition to the effect on the formation of new businesses, improving digital infrastructure has the potential to increase the productivity of existing businesses, where labor productivity is measured by income per employee in the business (Figure 11). **An increase in internet speed by 1% on average increases labor productivity by HRK 3,644 per employee per year**. These effects are almost twice as strong in the below-average developed parts of the country, where, with each 1% increase in speed, productivity increases by almost HRK 7,000 per employee per year. The positive effects are also noticeable if the manufacturing and service sectors are separately observed, with slightly stronger effects in the service sector. Finally, in digitally intensive industries we find the effects of increasing productivity by HRK 1,424 per employee.

Better access to digital infrastructure also creates new employment opportunities through several channels. Improvements in the operations of existing businesses increase the demand for work and enable the recruitment of new employees. The new business entry also creates jobs through self-employment or hiring new employees. Also, opportunities are provided to individuals also by penetration of new sectors, opening up of demand beyond the immediate geographical surrounding, and the effects of networking with businesses that delegate certain business activities beyond core business to external partners.

FIGURE 11: EFFECT OF INCREASING THE INTERNET SPEED BY 1% ON THE AVERAGE LABOR PRODUCTIVITY IN BUSINESSES (IN HRK PER EMPLOYEE) 2014-2017, EFFECT IN THE PERIOD T AFTER THE CHANGE



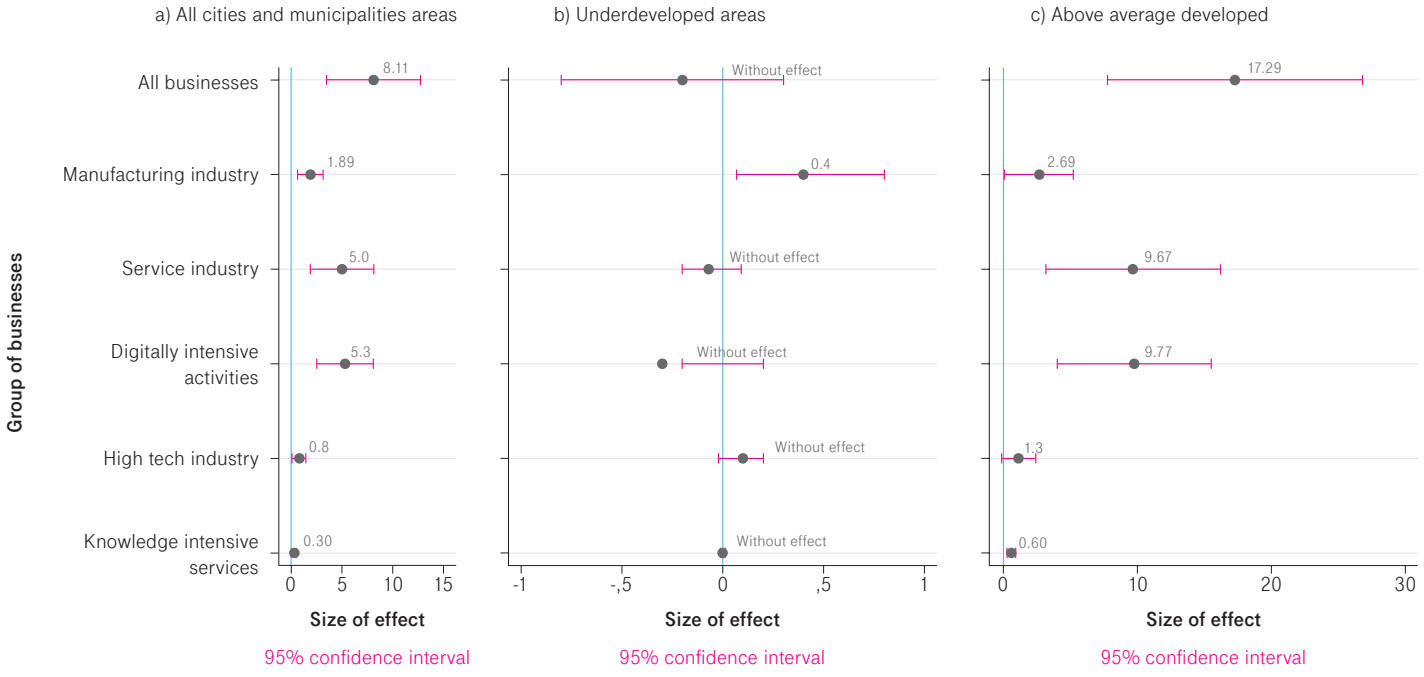
Source: EIZ calculation.

Judging by the assessments of the effects of improving internet speed on employment, there are relatively large positive effects (Figure 12). On average, a **10 percent increase in internet speed has the potential to create 81 new jobs annually in the average local government unit.** The effects on employment are mainly related to developed parts of the country. Thus, increasing the available internet speed by 10% in developed local government units, on average, increases the number of jobs by 172 annually.

This effect is significantly stronger in the service sector than in the manufacturing industry. On average, increasing the internet speed by ten percent in the service sector results in about 50 new jobs compared to 18 jobs in manufacturing industry per city or municipality. More than twice the effect in services can be linked to the prevailing structure of the Croatian economy, but also with the possibility of delegating certain business activities from the manufacturing industry to companies in the service sector discussed earlier.

It is interesting to note that in the sample of all businesses and in the part of the analysis focused on businesses in above-average developed parts of the country, we find positive effects on employment in the digitally intensive sectors characterized by a large share of ICT professionals, online sales, and penetration of artificial intelligence in the process of creating new value. According to the findings, a 10 percent increase in internet speeds leads to growth in employment by 53 new jobs per city or municipality, which is further evidence of the impact of digital infrastructure on leveraging opportunities in new sectors in addition to the positive impact on existing sectors.

FIGURE 12: EFFECT OF INCREASING THE INTERNET SPEED BY 1% ON THE NUMBER OF EMPLOYEES 2014-2017, EFFECT IN THE PERIOD T AFTER THE CHANGE

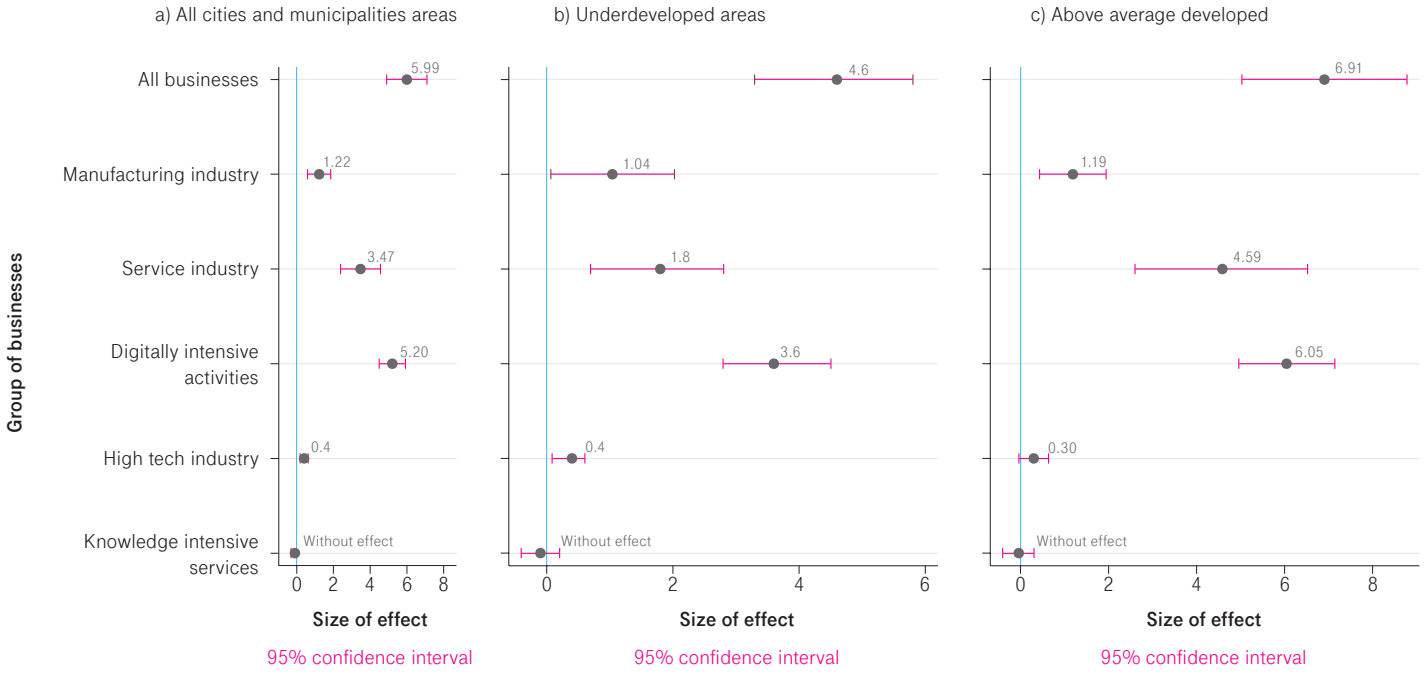


Source: EIZ calculation.

Business dynamics resulting from the improvement of digital infrastructure have the potential to improve standards of living through increased employee benefits. Thus, **a ten percent increase in internet speed leads to an increase in the average net wage of HRK 60 (Figure 13)**. The effects are greater for businesses in developed areas than businesses in less developed parts of the country, although we find positive effects in all analyzed groups, except for knowledge-intensive services. This can be interpreted as further evidence of the contribution of investments in digital infrastructure to the sustainability of the economy in Croatia.

If we look at sectors and companies of different technological intensity, we can see a positive effect on the growth of wages at the economy level as a whole and in above average developed areas. In more developed parts of the country, increasing internet speed by 10% results in a net wage increase of HRK 12 in manufacturing industries and HRK 46 in the service sector. In digitally intensive activities, a 10% increase in speed leads to an increase in the average net income of HRK 52. The effect in the below-average developed parts is around HRK 36, while the effect in the more developed parts of the country is much higher and is around HRK 60. The above suggests that digitalization is opening up the demand for highly skilled staff that enable business to grow in the global value chain.

FIGURE 13: EFFECT OF INCREASING THE INTERNET SPEED BY 1% ON AVERAGE WAGE (IN HRK) 2014-2017, EFFECT IN THE PERIOD T AFTER THE CHANGE



Source: EIZ calculation.

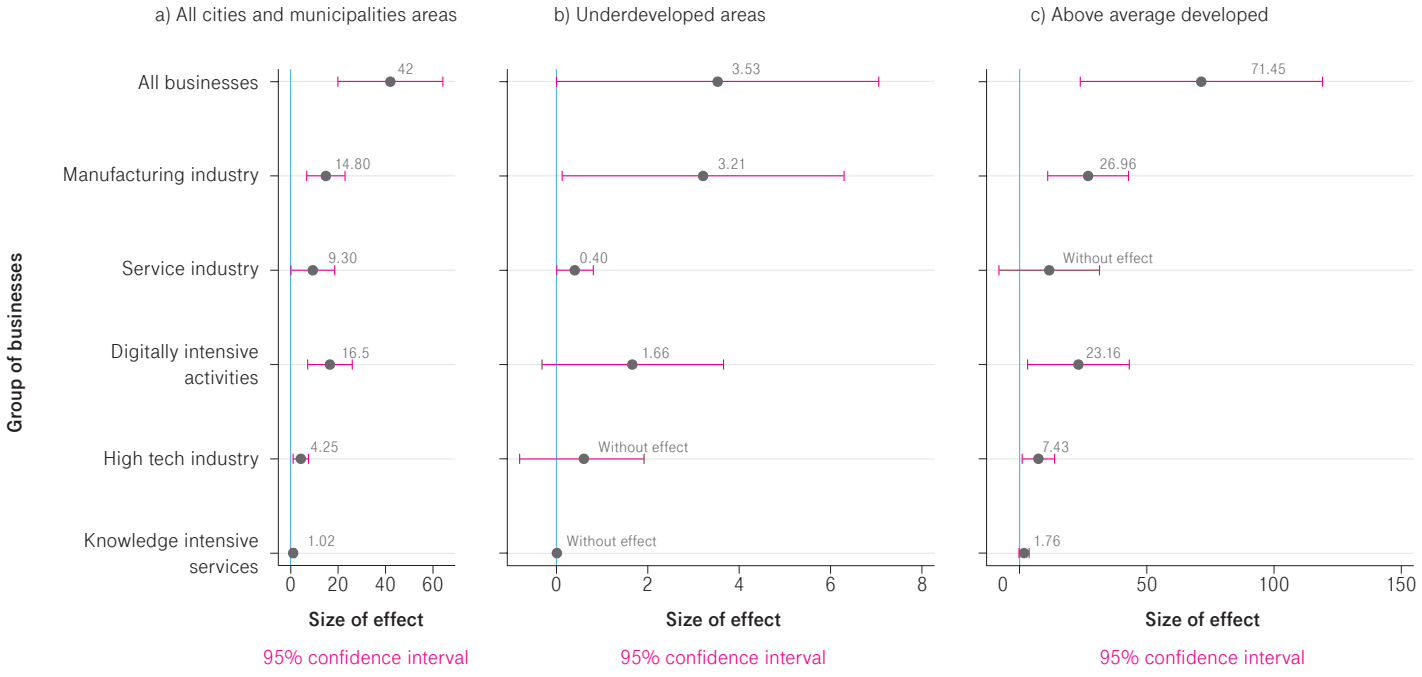
In small and open economies such as Croatia, the ability to grow and achieve a better standard of living is closely linked to the ability to place products and services on the international market. The improvement of digital infrastructure contributes to this goal in more ways. In the age of the Internet of Things, access to quality digital infrastructure opens up the possibility of remote management of production processes and numerous other business activities. This gives domestic companies the opportunity to integrate into the value creation process of foreign partners. At the same time, the knowledge that would otherwise be acquired through export is becoming available online through exports. Finally, businesses can absorb increased demand with lower operating costs if they can do a part of their business through the internet, using the so-called platform business models. For all these reasons, it is possible to expect a positive impact of improving the available internet speed on the export revenues of the company.

The conducted analysis suggests that the positive effect of digital infrastructure improvement on export revenues is present in almost all business groups (Figure 14). **A 10% increase in available internet speed is associated with an average of HRK 42 million in exports per local unit**. If we observe only digitally intensive sectors, the positive effect results in around HRK 16.5 million of new exports per local unit. Also, a positive effect can be observed in the manufacturing industry, the service sector and in the digitally intensive sectors, and in the high-tech segment of the manufacturing industry, segments of the economy with a high potential to utilize the benefits of improving digital infrastructure due to its immersion in the global value chain.

EFFECTS INCREASE OVER TIME

One part of the assessed economic effects is increased over time and through space, so that the total effects over a period of time are greater than the one-year assessments.

FIGURE 14: EFFECT OF INCREASING THE INTERNET SPEED BY 1% ON EXPORT REVENUES (IN HRK 100 THOUSAND) 2014-2017, EFFECT IN THE PERIOD T AFTER THE CHANGE



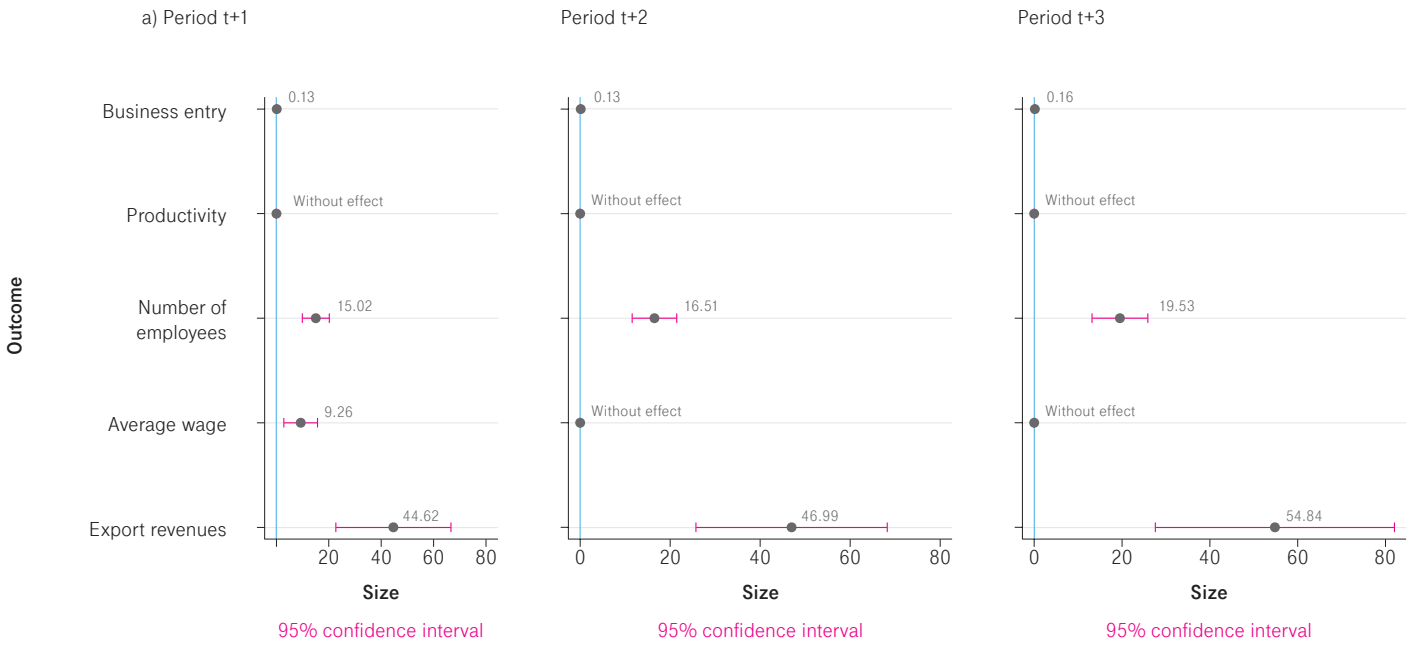
Source: EIZ calculation.

Economic effects of improving infrastructure are realized over a period of time during which demand, suppliers and the labor market adjust to new circumstances. The analysis described above assessed the impact of improvements to digital infrastructure within one year, although it is certain that more time is needed to fully materialize the impact of this improvement. Furthermore, the effect of improving infrastructure is not equally distributed to businesses located in the immediate vicinity of the improved infrastructure compared to the businesses further away from it. A further step in the analysis is an assessment of the effects of improving digital infrastructure over three years, combined with an assessment of the effect spillover from cities and municipalities where there is an increase in available internet speeds to neighboring self-government units where no such change has occurred. In other words, the analysis takes into account the impact of the changes in the quality of infrastructure within the cities and municipalities in which they take place and the effects realized by interactions between businesses, demand and labor market participants in neighboring cities and municipalities, as well as the overall effects that encompass the impact on economic outcomes within cities and municipalities and their environment.

Given the temporal dimension of effects of improving infrastructure on business operations and their spatial spillover, it is no surprise that some of the assessed effects increase over time and through space (Figure 15). Due to a 10% increase in the available speed, 1.6 new companies are established in cities and municipalities on average over three years, with only one company as a one-year effect without spatial spillovers. At the same time, the total effect on employment is 195 new jobs, which is more than double the number of 81 jobs created as a result of an increase in available speed by 10% over just one year and no spatial spillover effects of infrastructure improvements. Finally, a 10% improvement in infrastructure results in a total increase of export revenues per local unit of HRK 54.8 million, which is 30% more than the effect achieved in one year and without spatial spillovers.

Generally speaking, it can be concluded that investing in digital infrastructure has both immediate and lasting effects on improving business results at the level of cities and municipalities and that these effects spill over into neighboring areas, thus contributing to economic results in the wider geographical area.

FIGURE 15: TOTAL TEMPORAL EFFECTS OF INCREASING INTERNET SPEED, LOCAL + SPATIAL EFFECTS



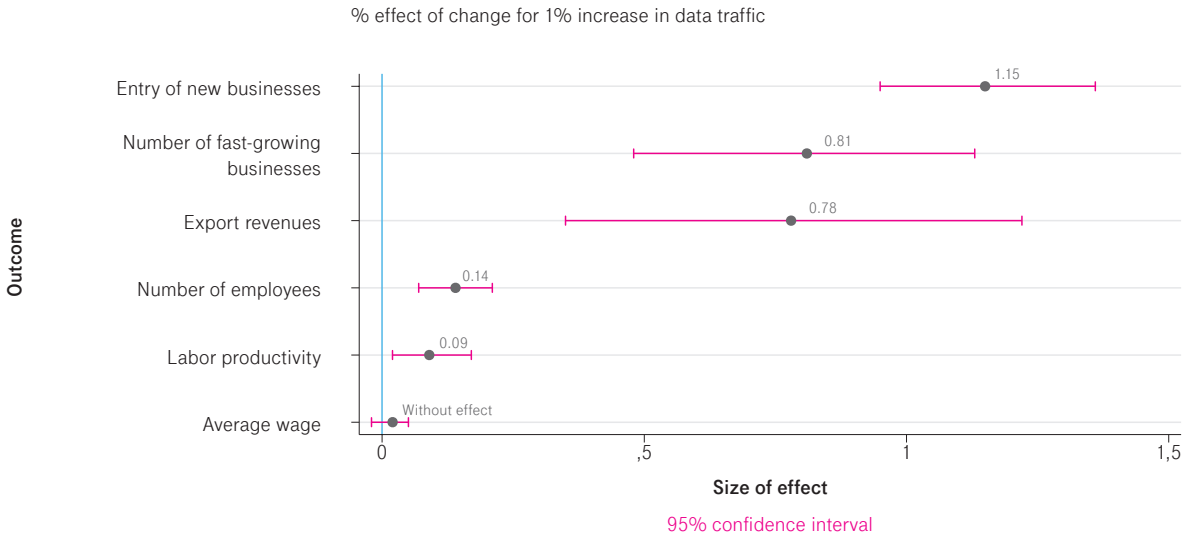
Source: EIZ calculation.

EFFECTS OF INCREASING DATA TRAFFIC IN FIXED NETWORK ON BUSINESS OPERATIONS

As pointed out in the previous sections, digital infrastructure and improving the speed of internet access are the key enabling technology for the development of the digital economy and society as a whole. Such development implies the transition of business as well as non-business activities into the digital sphere. Consequently, infrastructure upgrades can be expected to increase data traffic as businesses seek new business ventures, households enter the digital world, and ultimately establish relationships between households and businesses in the digital environment. Precise data for identifying individual channels that improve economic outcomes, such as online sales, digital management of supplier or customer chains, or use of Internet of Things in operations are generally not available at levels below the national level and such effects cannot be assessed Directly at the level of cities or regions. However, it is known that all such activities require large amounts of data traffic.

The results of assessing the effect of the increase in data traffic in Hrvatski Telekom's fixed network on selected economic outcomes of businesses available in the aggregate statement at the county level are shown in Figure 16. The assessment was conducted by observing the effect of a 1% increase in data traffic on the percentage increase in an individual business indicator. With the exception of county-level average net wage indicators, all other cases show a positive economic effect of an increase in data traffic. **Within a county, data traffic growth of 1% increases the number of new businesses by 1.15%**, which can be interpreted as a relatively strong effect. The same increase in data traffic increases the number of fast-growing **businesses by 0.81% and export revenues by 0.8%**. The positive impact of increasing data traffic on the number of employees and labor productivity is also visible, but these effects are slightly more modest than the previous ones, ranging from 0.09% in the case of labor productivity to 0.14% in employment. All this tells us that building digital infrastructure opens up many opportunities for networking, access to new markets, easier access to knowledge and other resources that do not exist in the immediate business environment, which ultimately leads to new business ventures, the growth of fast-growing businesses, or those with the largest potential for improving regional and national competitiveness and enhancing the ability to market their products on the international market, which is

FIGURE 16: EFFECTS OF INCREASING DATA TRAFFIC ON ECONOMIC OUTCOMES IN CROATIAN COUNTIES 2012-2016



Source: EIZ calculation.

DIGITAL SOCIETY

Digital society is one of the essential material topics for HT's responsible and sustainable business. Digital society is a contribution to the achievement of the Digital Agenda for Europe, which aims to enable citizens and businesses to best utilize digital technologies. In this sense, digital society encompasses digital inclusion and digital literacy. Digital inclusion is the responsibility for infrastructure and development of fixed broadband infrastructure, better access to new generation networks and higher speeds, collaboration with the state related to infrastructure development in areas where this is not economically viable, and the development of new innovative products and services that will be applied in different areas. Digital literacy includes teaching literacy to young generations and future consumers, supporting the state's efforts in digital literacy programs, collaborating with the state on digital literacy projects, and contributing to the adoption of the STEM knowledge and skills needed to face a new wave of technological change. The chapter Digital Infrastructure explains in detail digital inclusion, and the focus is on activities in the field of digital literacy.


SAMSUNG

DONATION PROGRAM

HT's donation program traditionally covers many activities. In 2018 and 2019 these activities include Generation Now, Junior Engineer Academy, Idea Knockout, Hack It!
Hackathon, Warp Future Communication Program, Sea Hero Quest, and Women Stem Awards. HT d.d. has a leading role in investing in STEM programs in Croatia. Investing in STEM directly contributes to the goal of promoting digital literacy since STEM skills are crucial for society to successfully prepare for and embrace a new wave of technological change that will result in a better quality of life. Namely, in the last four years, HT d.d. invested almost HRK four million in STEM education. As a result of the investment, 160 schools in Croatia have been equipped with the latest IoT (Internet of Things) equipment and funds needed to carry out the STEM program. Through cooperation with the Institute for Youth Development and Innovation (hereinafter IRIM), more than two hundred mentors were trained and a range of educational activities was conducted for more than two thousand children through three hundred registered projects. In addition to Generation Now, the text presents other prominent donation programs in 2018 and 2019.

GENERATION NOW

Generation Now is one of the most successful donation programs to promote the development of STEM skills. Generation Now is a continuation of the successful donation program Generation Next. HT d.d. is the initiator, creator, and project owner, and the partner IRIM is the author of the curriculum and operational project implementer. Other important project stakeholders in the process of implementing it in Croatian schools are the Ministry of Science and Education, the Agency for Science and Education, user institutions, students, and mentors. With the Generation Now donation program, for the fourth consecutive year with HRK 900,000 HT d.d. supports the development of projects based on the practical application of STEM knowledge. Potential applicants are educational institutions, nonprofit organizations, multiple related nonprofit organizations, or educational institutions organized around the same project in partnership, and libraries.

This donation contest aims to link existing and new knowledge in the field of technology in the creation of IoT projects, develop creativity, innovation, and understanding of modern technologies, create an opportunity for students to realize the project from concept to finished model, to learn from each other and thus gain confidence. In other words, the goal is to encourage children to actively participate in creative problem solving and learning through research by creating IoT projects.
In 2019, the Generation Now donation program will provide equipment, mentor training, and activities for students, and will develop a STEM curriculum for extracurricular activities by age groups that will be available to all schools and educational institutions wishing to work with children on cutting-edge technologies. More specifically, since 2019, the curriculum for extracurricular activities has been adapted to the following age groups: the first is the lower grades of elementary schools (1-4), the second is the upper grades of elementary schools (5-8), and the third is high schools.

[1] IRIM encourages the development of STEM competencies in elementary and high school students by using robotics and automation as ideal tools for entry into the world of programming and, in general, STEM occupations. IRIM focuses on developing digital and scientific literacy, technological and other competencies within the STEM area for young people in Croatia and other countries, to become equal citizens of the 21st century. In addition to Generation New, IRIM projects include Croatia's WER Open Cup, STEM Car, Promikro, Internet of Things and Logo, Croatian Makers League, BBC Micro:bit STEM revolution.

This curriculum is expected to help introduce extracurricular STEM activities into formal education and can be taken up by any school and educational institution to provide children with knowledge for the jobs of the future.

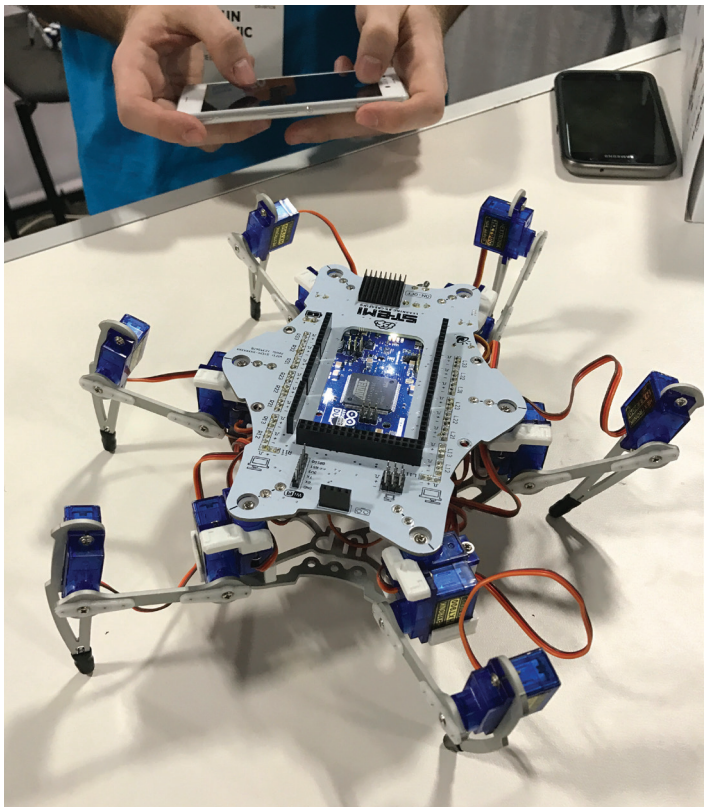
The expected results of the donation program are to enhance students' ability to integrate existing and emerging technology and engineering knowledge in the design of creative IoT projects, develop computational thinking, problem-solving skills, and programming skills, and develop creativity and innovation through the design, development, and implementation of creative projects. Students will also be able to critically present, argue and evaluate their own and others' work with the development of entrepreneurship, understand that a particular problem can be solved in many ways, understand the principles of technology, as well as identify interests and preferences regarding continuing education and adopt the need for continuous training and lifelong learning.

In 2019, HT d.d. also organized the first Open Door Day, during which the interested public, teachers, students, and parents could learn more about the donation program and see firsthand the best projects of the last contest.

JUNIOR ENGINEER ACADEMY

The role of HT d.d. as the forerunner of the STEM revolution is also evident in the introduction of the Junior Engineer Academy program presented in March 2019, also aimed at developing competencies that will prepare young people for the future, but through the cooperation of the education and business sectors. The project resulted from the collaboration of Deutsche Telekom Stiftung, the Institute for Youth Development and Innovation, and Hrvatski Telekom. A key feature of the program is establishing and maintaining close contacts with businesses and universities that provide students with an early insight into the world of work of engineers and skilled professionals in all fields of technology and science. In the first phase of the project, IRIM selected 15 vocational schools to participate in the implementation of the project, distributed advanced technology equipment and financial donations, and educated mentors who will transfer the acquired knowledge to students and work with them on transforming creative ideas into solutions using IoT technologies. The second phase of implementation is connecting selected schools with related educational institutions and the business sector, and throughout the process of creating project solutions, IRIM ensures continuous mentoring of its experts. The ultimate goal is to establish continuous cooperation between the education and business sectors, which will result in a stronger and more productive integration of educational institutions with the labor market.

In collaboration with IRIM, HT d.d. has implemented many other projects such as the Internet of Things and Logo project in Croatian schools in 2017. Through the "Together We Are Stronger" contest, 60 schools across Croatia were included, giving more than 450 students a unique opportunity to learn about advanced technology and ways to manage things from our environment over the internet.



WOMEN STEM AWARDS 2019

Women STEM Awards is a big international project of Deutsche Telekom, which Croatia joined six years ago on the initiative of HT d.d. The project aims to encourage young women to start careers in STEM fields. This is an international competition which selects the best graduate or master's thesis and dissertation in the STEM field of all the

applications submitted by final year female university students around the world. The competition is being held for the sixth consecutive year, with strategic topics for 2019: Internet of Things, Artificial Intelligence, Cyber Security, Networks of the Future, and Cloud. This project raises awareness and motivates women to pursue a career in the STEM field and to take on leadership roles.

IDEA KNOCKOUT 2019

Idea Knockout is the largest regional competition for technology ideas, held for the sixth consecutive year under the general sponsorship of HT d.d., organized by the Bug Magazine. The teams at Idea Knockout 2019 will compete on September 26, 2019, for an award that includes covering the cost of a trip to Las Vegas and a booth at CES 2020. CES (International Consumer Electronics Show) is the world's most influential consumer electronics, gadgets, technology innovation, and startup fair in the world, held every January in Las Vegas, bringing together over 170,000 strictly selected technology industry stakeholders from around the world that shape the future. Over the past five years, the Idea Knockout project has enabled successful participation at CES of winning teams from the startups Orqa, MAKERbuino, STEMI, Streaming Solutions, and DivIT. The general sponsorship of Idea Knockout is part of the long-term strategy of HT d.d. to get established as the largest startup accelerator in Croatia.

HACK IT! HACKATHON

The third edition of HACK IT DAYZ organized by HT d.d. concluded on November 24-25, 2018. The competition resulted in four winning teams winning prizes in a fund worth over HRK 50 thousand. The Emoji team came in first place with an application that allows the hearing impaired to communicate with video calls through recognition of the sign language. Second place went to the MIOC 2.0 team with a video platform that facilitates learning using additional content and interactivity, and third place is shared between the IVS team with a smart conferencing system and the Gopnik team, which had a similar idea but focused more on video call transcription. The teams worked with the help and guidance of mentors from Hrvatski Telekom, Algebra, Zagrebačka banka, and other ICT professionals.

SEA HERO QUEST

HT d.d. has been participating in the #gameforgood global initiative for more than two years the part of which is the launch of Sea Hero Quest, a mobile game that is an important part of the broader anti-dementia initiative launched by Deutsche Telekom and headed in Croatia by HT d.d. Thanks to the popularity of the game, scientists who research dementia received the largest database ever collected, which would normally take more than 12,000 years of lab research.

WARP FUTURE COMMUNICATION PROGRAM

The program is designed for startups that can bring innovations to communication services and related areas such as speech recognition, parental control, artificial intelligence (AI), sending and receiving voice messages and digital life, and generally enrich the voice communication and video conferencing experience. WARP Future Communication results from collaboration of Nokia, offering a technical platform, Deutsche Telekom, offering a distribution channel, and the hub:raum start-up accelerator that provides the know-how and the tools needed to build, develop, and commercialize products. In Croatia, the project is supported by HT d.d.

SMART LIFE SOLUTIONS

This chapter lays out in detail smart and digital services that the HT Group develops and offers, which make everyday life easier, more secure, and more comfortable. Such services focus on digital transformation of cities and schools and a digital tool to manage telecom services.

DIGITAL TRANSFORMATION OF CITIES

HT has invested more than HRK 7.5 billion in the necessary infrastructure for smart cities over the last four years. By way of illustration, it is an investment worth four Pelješac bridges, confirming the status of HT as one of the leading private investors in Croatia.

Hrvatski Telekom is strategically oriented towards the building of smart cities and their digital transformation, which involves the application of modern technologies to increase the quality of life of citizens, increase the efficiency of public administration, optimize local resources, and develop entrepreneurship. HT d.d. develops its role in the digitalization of society and cities through a service portfolio, the construction of the necessary infrastructure, and support in obtaining EU funds for cities, as well as through education. The company has invested more than HRK 7.5 billion in the necessary infrastructure for smart cities over the last 4 years. By way of illustration, it is an investment worth four Pelješac bridges, confirming the status of HT d.d. as one of the leading private investors in the Republic of Croatia.

A significant part of these investments was transferred to mobile networks without which the digital economy could not be developed. Smart cities are based on a plethora of connected IoT devices and sensors. As these devices send minimal amounts of data, it was necessary to introduce a network that would ensure their connectivity in an efficient and cost-effective way. Responding to it, in April of 2018 HT d.d. is the first in Croatia to introduce Narrowband IoT (NB-IoT) network technology. NB-IoT network specializes in connecting a large number of devices and sensors from the Internet of Things (IoT) segment, based on the global industry standard for mobile networks, characterized by excellent widespread availability, low cost, high signal quality, and high security and reliability levels in line with global telecommunications standards in mobile networks. Due to its advantages, NB-IoT technology is suitable for application in numerous solutions for business and residential users, such as smart parking, smart waste management, air quality monitoring, tracking of items and shipments, smart meters, smart home, smart public lighting, monitoring the health of persons, locating family members, pets and property, etc. Thus, NB-IoT technology is not only a technological innovation in the Croatian market, but also enables new business models such as smart city solutions, that is, for the development of the entire IoT ecosystem with high growth potential.

Key solutions from the smart city segment, HT d.d. developed and implemented in collaboration with its partners, include smart parking, EV charging stations, municipal waste management, air quality monitoring, the introduction of WiFi in public transport, WIFI4EU, and other smart solutions, which will be presented below.

SMART PARKING

Estimates show that up to 30 percent of urban traffic is caused by drivers searching for parking. Smart parking aims to improve the management of existing parking spaces without having to increase the number of parking spaces. Specifically, smart parking technology enables the faster and easier location of vacant parking spaces thanks to sensors built into them. Benefits for citizens are multiple - from fewer traffic jams and time and fuel savings to less stress and lower emissions. The smart parking project was implemented in Split, Krk and Dubrovnik. Details of the projects are presented in Table 7.

TABLE 7 SMART PARKING IMPLEMENTATION

City	Year	Project description
Split	End of 2018	HT d.d. and Mobilisis installed 12 sensors in parking spaces for people with disabilities. Sensors, operating on the HT's NB-IoT network, are set up at the intersection of Matoševa and Zrinsko-Frankopanska streets and are connected to the Split parking application through which citizens of Split can see the vacant places. The sensors were installed as part of a campaign by the City of Split under the name "You want to change places?" to help people with disabilities search for parking spaces and reduce improper parking in those places. In addition to improving the quality of life for people with disabilities, the project aims to help reduce urban traffic jams. The NB-IoT network played an extremely important role in this project as it enabled the installation of parking sensors without major infrastructural changes, resulting in a lower cost.
Krk	End of 2018	Occupancy detecting sensors are installed in 60 parking spaces.
Dubrovnik	July 2019	Together with partner companies, HT d.d. implemented the largest project in the field of smart cities in Croatia and the region, and one of the largest smart parking projects implemented on the NB-IoT network in the world. 1909 sensors were installed all Dubrovnik. Parking space occupancy data is available through the application on smartphones and twenty public information displays that help drivers find free parking spaces faster and easier, alternative free spaces, and fairer collection and control. The project was realized as part of the umbrella project "Dubrovnik Smart City" and is derived from the strategy paper of the City of Dubrovnik "Strategy of the Smart City of Dubrovnik".

Particularly interesting is the recent project of introducing smart parking service throughout the city of Dubrovnik, worth HRK 3.2 million, which HT d.d. implemented in collaboration with Mobilis and other partner companies. This is the largest Smart city project in Croatia and the region and one of the largest smart parking projects realized on the NB-IoT network in the world, as part of which 1909 sensors were installed to help find free parking space and reduce traffic jams. HT d.d., chief technology partner and project owner, provided the entire network infrastructure for sensor communication based on NB-IoT technology, unique access and VPN network, mobile connections for other devices (displays and devices used by parking controllers), a server environment for the software part of the integrated solution function, and to accommodate all systems in its data center, ensuring the highest level of security and quality. This project is part of a series of activities within the umbrella project "Dubrovnik Smart City" and was implemented on the state-of-the-art NB-IoT network of Hrvatski Telekom.

DUBROVNIK GETS SMART PARKING

The Smart Parking project in Dubrovnik is the largest smart city project in Croatia and the region and one of the largest smart parking projects implemented on the NB-IoT network in the world. As part of the project, 1909 sensors were installed to help find free parking space and reduce traffic jams. This project is part of a series of activities within the umbrella project "Dubrovnik Smart City" and was implemented on the state-of-the-art NB-IoT network of Hrvatski Telekom, specialized in connecting a large number of devices and sensors in the Internet of Things segment.

ELECTRIC VEHICLE CHARGING STATIONS

In collaboration with its partners, Hrvatski Telekom has installed and commissioned 130 publicly available electric vehicle charging stations with 180 spots for all types of electric vehicles, representing more than 50 percent of all EV charging stations installed in Croatia. Puni.hr network, which includes EV charging stations set up by HT d.d., is today the largest regional Network of EV charging stations. Electric vehicle charging station service is an open ICT ecosystem that connects infrastructure, electric vehicles, and electric vehicle users in real-time. More than 50,000 charging sessions have been registered so far, resulting in more than 2 million green kilometers. The network construction project of EV charging stations helps significantly in environment protection, as it encourages an increasing number of drivers to use electric vehicles, thereby directly reducing emissions. The solution has been implemented so far in Rovinj, Varaždin, Zagreb, Krk, Split, Belišće, Đakovo, Velika Gorica, Sveta Nedelja, Zaprešić, Vrbovec, Dugo Selo, Ivanic Grad, Sv. Ivan Zelina. Details of the projects are presented in Table 8.

TABLE 8 IMPLEMENTATION OF EV CHARGING STATIONS (SEPARATE PROJECTS)

City	Year	Project description
Krk	End of 2016	The largest network of **11 EV charging stations** in Croatia until then was opened.
Rijeka	June 2018	HT d.d. and Tower Center Rijeka set up the first fast EV charging station in the City of Rijeka as part of the project "Comprehensive fast-charging corridor network in Southeast Europe" which ensured top-of-the-line charging service for domestic EV users, as well as an increasing number of tourists who come to Croatia on holiday by electric vehicles.
Zagreb	June 2018	The fast station was launched in the area of the City of Zagreb in front of the HQ of Hrvatski Autoklub at Avenija Dubrovnik.
	End of 2018	As part of the "Comprehensive fast-charging corridor network in Southeast Europe" project, HT d.d. Set up the eighth fast EV charging station at the "Rox" gas station on Slavonska avenija. This is the first gas station in Croatia where a fast EV charging station was set up that enables charging of all types of electric vehicles. This project is co-financed by the EU Connecting Europe Facility program and enables the development of green e-mobility corridors in Central and Southeast Europe. This project is a good example of how, in addition to setting up, the company also helps site owners who decide to open an EV charging station in obtaining EU funds.
HT d.d. has set up EV charging stations also in **Albania**, **Montenegro**, **Romania**, **and Northern Macedonia**.		

MUNICIPAL WASTE MANAGEMENT

The Smart Waste system allows cities to more easily address waste disposal and smart waste management. The system includes smart waste containers with embedded chips (the so-called Bigbelly), which announce in real time that the container is full, after which the system independently plans and predicts the best collection schedule. The Bigbelly container is completely independent, powered by solar energy, presses mixed waste, and enables recycling. Thanks to the integrated press, the Bigbelly container has five to seven times the capacity of conventional containers, which is especially important for tourist destinations. Based on the information obtained from the sensors on the containers, the route is calculated which trucks have to take to empty them, and they go out to the field when the container needs to be emptied.

By implementing this solution, which HT d.d. developed in collaboration with EcoMobile, the number of field trips is optimized, and the service provider can better manage employee time, reducing operational costs. In addition to more efficient management of city resources, the citizens themselves have direct benefits, as the smart waste system enables charging for the service according to their actual consumption. The smart electronic waste management system has already been implemented in Koprivnica and has excellent results. **Makarska, Dubrovnik, Split, Sv. Ivan Zelina, Dugo Selo and Velika Gorica** are just some of the Croatian cities that have implemented smart waste management solutions on their streets.

AIR QUALITY CONTROL

Hrvatski Telekom, in collaboration with Smartsense, has developed an air quality control service ("Air Quality"). Sensors inform citizens about the air they breathe, and so they get more information about their health. These are measuring devices that measure five types of harmful gases and three types of microparticles. The sensors are located in small boxes that can be mounted on streetlamps anywhere in the city where air control is to be measured. The sensors also measure the air temperature and humidity, the air quality index and ambient noise, and transmit all the data to a platform that is online and available to the public in the form of a website or mobile application. These solutions have been implemented in **Koprivnica and Dubrovnik and in Bonn and Greece.**

WIFI IN PUBLIC TRANSPORT AND WIFI4E

Hrvatski Telekom enabled the introduction of an open, fast, and stable WiFi network in trams and the solution was implemented in 80 out of 142 trams so that passengers could access the internet for free, send e-mail, etc., which is considered standard in the public transportation in developed countries. It should be noted that through the WIFI4EU project, the European Commission promotes the introduction of free WiFi for citizens and visitors in public spaces across the European Union, such as parks, squares, public buildings, libraries, health care institutions, and museums, funding local government units to procure the most up-to-date equipment for free Wi-Fi in public areas. As a technology partner, HT d.d. presents to the local government units the best options for their needs and how to implement the project. Croatia has received 224 such projects so far, a smaller portion of which in larger cities, while the rest relates to smaller towns.

Other Smart City solutions are presented in Table 9.

Of the solutions HT d.d. is currently working on, **Smart Metering, Smart Transport** should be emphasized

HT d.d. continues to develop technologies for smart metering of gas and water consumption, as well as for measuring water flow in city pipes to reduce water loss. Smart metering technology enables users to monitor energy consumption, control costs and save by changing habits. The NB-IoT network enables remote monitoring of consumption with the communication of each device directly through the network with a central platform/application that will serve as an ecosystem for communication with other devices. Such readout devices can monitor household electricity consumption, gas or water consumption, and users can check the status of their home on their cellphone. Although this technology makes life easier for end-users, it has proven to be even more useful for relevant services which introduced it. Workers no longer have to go out to the field to read meters, and if an error or problem occurs, alarms are triggered in real-time and services can respond. This reduces water pipeline cracks and potentially dangerous gas pipeline problems. In the future, smart meters will be even smarter and be able to communicate with all devices around them, not just the centers.

When it comes to **smart transport**, HT d.d. plans to create a multimodal transport system in one place that will connect road, rail and shipping, and through which the user could buy all the tickets they need in one place. It is a set of hardware and software solutions for buying and reading tickets that will completely remove paper tickets from circulation. The sensor network will monitor all public transport and provide all key information to users and operators. So far, the commercial part has ticketing and software solutions (T-transport online booking, WiFi on buses and Cloud vehicle monitoring) that provide intercity transport service and cover major companies such as Čazmatrans and Arriva Group.

NEW SOLUTIONS

Of the solutions HT is currently working on, Smart metering and Smart Transport should be emphasized. Smart metering technology enables users to monitor energy consumption, control costs and save by changing habits. When it comes to smart transport, HT plans to create a multimodal transport system in one place that will connect road, rail and shipping, and through which the user could buy all the tickets they need in one place.

TABLE 9 OTHER SMART CITY SOLUTIONS

Smart solution	Location	Description of solution
Bike-sharing	Orahovica, Erdut, Lonjsko polje, Lopud.	Public city bicycles and electric bicycles system consists of electronic bicycles, stands for receiving and charging bicycles and programs to manage the rental system. Rent of a bicycle can be paid with credit cards and end-users have a mobile app at their disposal. All bikes have a GPS tracking system that reduces the possibility of theft. The goal of this smart solution is to encourage citizens to use bicycles more often in transport, to reduce the use of cars and the public city transport thus reducing emissions. The service provides easier public transportation for citizens and guests of the city and give businesses an additional source of revenue.
Smart lighting	Dubrovnik, Krk	HT's solution for the public lighting system allows for automatic management of LED lighting in the city: switching on and off, dimming, motion sensing and contains all the necessary energy consumption information. LED lighting consumes less electricity compared to standard lamps and emit less CO_2 into the environment. This solution represents potentially significant savings for cities, considering that cities spend up to 30 percent of their budget on public lighting today
Analytics of traffic and tourism („Heat maps")	Dubrovnik	A pilot project called Crowd Management for traffic and tourism analytics has been implemented as part of a solution for traffic and tourism analytics in Dubrovnik. Using HT's mobile network and Big Data technology, it is possible to reliably determine the number of passers-by at any location in Croatia and analyze their demographic structure and time spent at the location. HT d.d. is the only one in Croatia and among the first in the world to offer a service of collecting information on the movement of passers-by at key locations.
ICT video nadzor	Dubrovnik, Krk	ICT Video Surveillance is a complete turnkey solution that enables the surveillance of cities 24 hours a day and can be accessed via a computer connected to the internet at any time. ICT Video Surveillance is a service that is easy to maintain and use and no additional IT skills are required. The introduction of video surveillance in urban real estate and public spaces results in less crime rate: 25-77%, depending on the application. Cities that have implemented similar services also report a significant drop in traffic accidents at video-controlled locations.
Pametne klupe	58 gradova u RH, Makedoniji i Rumunjskoj	HT d.d. has set up 58 smart benches in Croatian cities and municipalities. In addition to its basic function - seating, the bench provides various additional options - from wireless and USB charging of mobile devices, mobile internet, LED lighting, cooling system, and a place to sit to the system that sends alarms in the event of theft or bench functioning problems. Bench software provides information on using the bench (battery status, temperature, number of USB chargings, etc.) in an online application. By analyzing bench usage data, the software automatically optimizes the collection and consumption of electricity.
ICT video surveillance	Koprivnica	Smart City ISO certification is designed to allow cities with smart solutions to compare against each other by certain measurable criteria. The certificate is awarded by World Council on City Data (WCCD) while HT d.d. with a partner company can certify Croatian cities. If the city meets the certification criteria, the results are published on the internet pages of WCCD and allow comparison of a certified city with other certified cities regardless of city size and the area in which they are located, thanks to the methodology used in the certification. Cities with ISO 37120 certification can use the results to evaluate the performance of city services and the quality of life in the city, such as prioritizing the city budget, supporting ICT Smart City solutions, aligning public and private investment in infrastructure and communicating with citizens and potential investors in that area in the best possible way.

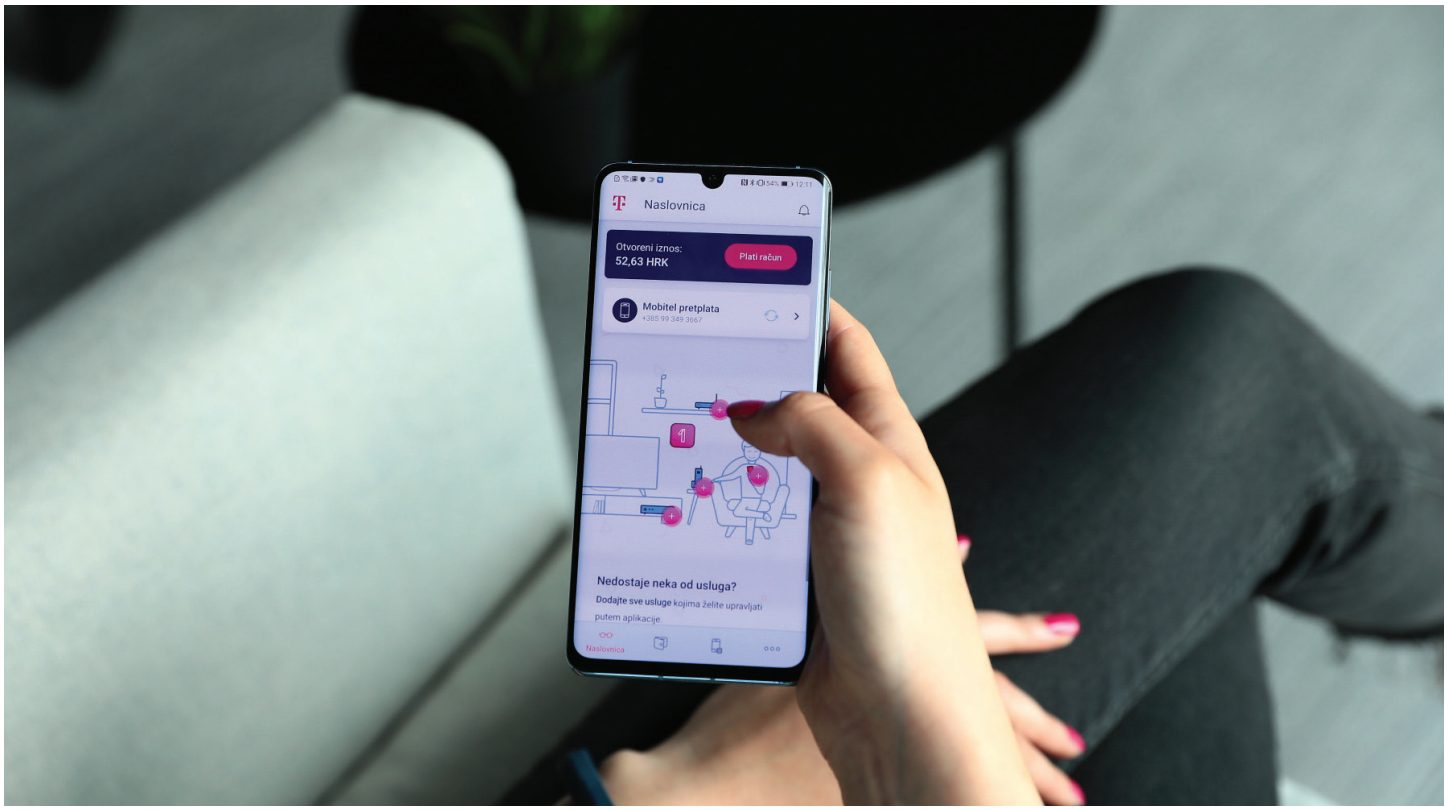
DIGITAL TOOL TO MANAGE TELECOM SERVICES

My Telecom app aims to be the focal point of communication between customers and HT and achieve flawless customer experience. The use of the My Telecom application is growing strongly and at the end of the first half of 2019, had around 233 thousand users.

HT d.d. has improved the customer experience by introducing My Telecom application. It is a digital tool for managing telecom services faster and easier. The use of the My Telecom application is growing strongly and at the end of the first half of 2019, had around 233 thousand users. The application aims to become a focal point of communication between customers and HT through flawless customer experience.
The application, among other things, gives customers a detailed overview of all telecommunication services in the fixed and mobile networks and consumption, allows for the payment of invoices, top-up with vouchers, easy activation of e-invoice, manages tariffs and options, and gives an overview of internet availability through an interactive map.

Apart from digitalizing customer experience, one of the most important functionalities provided by the application is cost control. Invoices first arrive to the app where they can be instantly viewed and paid for in just a few clicks. An overview of outstanding amounts, paid and unpaid invoices, is easily and intuitively displayed within the app. Mobile data usage and additional costs are already visible on the homepage. The application facilitates the purchase of HT services, without paperwork and at the relevant moment. For example, a customer can purchase MAXtv content just before the match, buy and send a voucher directly from their directory, or buy tariffs and options when they need it most (e.g. travel abroad) without waiting or going to the T-Center.

The application reduces the need for customers to call customer service with a functionality that answers the most common customer questions and problems: the user can report the problem and monitor the status of its resolution; and if they have purchased a new service, they can book a technician's date of arrival, track the delivery status of the device, see a detailed description of the service purchased, learn about the switching time, change MAXtv PIN. If they have questions or need help, customer service can be contacted easily and quickly via chat within the app.



DIGITAL TRANSFORMATION OF SCHOOLS

As part of the Net at School project, HT with CARNET activated 1273 adsl/vdsl remote accesses to the Private Network, while as part of the School for Life project, HT implemented 785 Metroethernet links in 1470 schools, allowing faster internet access.

HT d.d. also takes part in the digitalization of the school and education system run by CARNET and the Ministry of Science and Education. Back in 2002, CARNET started with Hrvatski Telekom the "Net at School" project, where 1273 adsl/vdsl remote accesses to the Private Network were activated.

"School for Life" is a project aimed at computerization of schools in the Republic of Croatia from 2019 to 2021. As part of the School for Life project, HT d.d. has implemented 785 Metroethernet links in 1470 schools, and by the end of 2019 up to 900 Metroethernet links are planned, which enable faster Internet access.

CONCLUSION

As a technology leader and leading provider of telecommunications services in Croatia, the HT Group has a responsibility to encourage the digitalization of Croatian society and to enable everyone in Croatia to use technology for a better life and more successful business. The Digital Atlas of HT Group is a summary of the Group's activities aimed at promoting Croatia's digital transformation. Atlas also presents the findings of the evaluation of the effects on the Croatian economy that the Group is achieving as a result of its activities. The following conclusions can be drawn from the findings of the analysis described in the Atlas:

- **The HT Group comprises digitally intensive companies that, through their business operations and digital transformation, make a significant contribution to the Croatian economy in the context of a continuous decrease in the prices of telecommunication services:**
  - HT Group's total GDP impact is assessed at HRK 11.3 billion, representing 3% of GDP achieved in Croatia in 2018.
  - The HT Group generated a total of 30,239 jobs in 2018. (2.1% of total employment in Croatia)
  - for each job in the HT Group, the Group's activities generate another 5.11 jobs in the rest of the economy
  - HT Group generated around HRK 3.2 billion in taxes paid (2.2% of total tax revenue in 2018)
  - despite the continuous decrease in the prices of telecommunication services with the simultaneous presence of an increase in the prices of other goods and services in the economy, the total impact of the HT Group on the Croatian economy in the period 2015-2018 remained unchanged

- **The HT Group is an important driver of investment activities aimed at developing digital infrastructure, reducing digital exclusion and achieving the goals of the Digital Agenda for Europe, with particular emphasis on fixed network investments (construction of the optical access network and upgrading of the copper access network), the mobile network and data centers:**
  - between 2010 and 2018, the HT Group invested more than HRK 12 billion, or an average of HRK 1.35 billion annually.
  - HT d.d. is the first among large Croatian companies in terms of investment intensity and the first among private service companies by total investment; in 2018, HT d.d. invested every fourth kuna of realized income
  - investments in the mobile network have the largest multiplier effect on gross value added and tax revenues; € 100 million invested in the mobile network induces € 110 million in new gross value added and € 38 million in new taxes
  - investments in the fixed access network have the largest multiplier effect on employment; an investment of EUR 100 million in the improvement of the fixed network induces 3,873 new jobs
  - reduction of parafiscal charges (right-of-way fees for telecommunications infrastructure and radio frequency spectrum fees), and investment of these funds in digital infrastructure would result in significant multiplier effects for the Croatian economy and the state budget

- **By developing its own digital products and services and improving its digital infrastructure, the HT Group supports business and enables the digital transformation of businesses in Croatia. 10% increase of available internet speed in HT's fixed network is associated with:**
  - establishing, on average, one new company in each city and municipality; 60% of businesses created in this way are digitally intensive startups
  - increase in labor productivity in Croatian companies, measured by earned income per employee, by an average of HRK 36,440 per year
  - creating 81 new jobs in an average local government unit
  - with an average increase in export revenues of HRK 42 million per local government unit
  - an increase in data traffic in the fixed network by 1% is associated with an increase in the number of startups (an increase of 1.15%), an increase in the number of fast-growing businesses (growth of 0.81%) and an increase in export revenues (growth of 0.8%)
  - an increase in data traffic in the fixed network by 1% is also associated with an increase in the number of employees in businesses (growth of 0.09%) and labor productivity (growth of 0.14%)

- **For the entire society to enjoy the benefits of the technology, along with infrastructure and devices, digital skills need to be built. The HT Group encourages the development of the digital society by initiating and actively promoting programs that foster digital literacy and inclusion. Of the many programs, the following are particularly noteworthy:**
  - The four-year Generation Now donation program initiated by HT d.d., implemented in collaboration with the Institute for Youth Development and Innovation; more than 200 mentors have been educated through the program and a series of educational activities have been conducted for more than 2,000 elementary and high school children through 300 projects submitted
  - The Junior Engineer Academy program that establishes contacts with companies and universities that provide school students with early access to the world of work of engineers and skilled professionals in all fields of technology and science; the ultimate goal of the program is to create a stronger and more productive link between educational institutions and the labor market
  - Idea Knockout as the largest regional competition for technology ideas, held for the sixth consecutive year under the general sponsorship of HT d.d. The winning team receives funding for the trip and showcasing their product at CES - the largest consumer electronics fair in the world. This donation program is part of the long-term strategy of HT d.d. to get established as the largest startup accelerator in Croatia.
- **As a technology leader and leading provider of telecommunications services in Croatia, the HT Group has developed a range of smart products and services that make life easier, more connected and secure. In this way, the HT Group makes its contribution to making life in the digital age accompanied by smart solutions.**

Indicators described in the Digital Atlas suggest that the HT Group successfully keeps pace with trends in the telecommunications market and, in the conditions of continuous reduction of the prices of these services, the process of own digital transformation, and intensive investment in digital infrastructure, it achieves a high level of GVA for the total economy and provides an adequate level of income for employees, profit to owners, but also sufficient funds to continue the investment cycle, which is a necessary condition for improvement of business and maintaining a leading position in the Croatian market. The indicators also clearly suggest that all stakeholder groups, from the company's owner, to employees, suppliers, the state budget (state) take part and directly benefit from the success of the company Numerous donation programs, headed by the Generation Now program, play an important role in the wider distribution of the Group's success, with the company participating in the establishment and promotion of a digital society and a simpler, more connected and more secure life.

ADDENDUM

INPUT-OUTPUT METHOD

The assessment of the total contribution of the HT Group presented in Chapter 3 of the Atlas, and the contribution of digital infrastructure investments in Chapter 4 of the Atlas is based on the application of the input-output methodology. In its most known form, input-output analysis refers to the application of a static input-output model designed by American economist of Russian descent, Wassily Leontief.
In the input-output approach, the national economy is divided into n sectors, and the value structure of deliveries of each sector can be described by the following equation system:

$x1= a11^{D}x1+... + a1j^{D}xj + ...a1n^{D}xn + f^{D}1$
$xi= ai1^{D}x1+... + aij^{D}x2 + ...ain^{D}x3 + f^{D}i$
$xn= an1^{D}x1+... + anj^{D}xj +... ann^{D}xn + f^{D}n.$

X represents the value of the gross production of each sector (from 1 to n), while the right side of the equation is the value structure of deliveries of each sector. Indicators aij are called technical coefficients that describe the proportion of goods and services for intermediary consumption that the sector i supplies to sector j in the value of sector j production. Thus, the gross production of each sector is delivered to other production sectors at a value determined by the technical coefficients and gross output of those other sectors, and to final consumers (f^{D}).
The deliveries of the HT Group can be shown as a single line, or a specific equation in the system. The total value of telecommunication services production is delivered to final consumers (f^{D}) and to other manufacturers in the national economy in accordance with the share of telecommunications services in their output. In the matrix view, the input-output model in which the uses of goods and services are separated into domestic and imported origin can be more clearly written as:

$A^{D} x + f^{D} = x$
$x-A^{D} x = f^{D}$
$(I - A^{D})x = f^{D}$

Matrix A^{D} is a matrix that describes the manufacturing technology of each of the manufacturing sectors. Each column of the matrix shows the proportion of domestic inputs required to produce the unit of output of sector j (aij, i=1 to n). Multiplying the matrix A^{D} and the output value
(x) gives the total intermediary consumption of each sector. The sum of total intermediary and final consumption is equal to the value of production in the national economy for each of the n sectors, and the final demand is equal to the difference between output and intermediary demand. The solution of the system, i.e., determining the level of domestic production, with the given final consumption of domestic products and services, is:

$x = (I - A^{D})^{-1}f^{D}.$

Matrix $(I-A^{D})^{-1}$ is referred to in the economic literature as the Leonti inverse matrix, and the sum of each column shows the production multiplier for a particular manufacturing sector, or the indicator of the total increase in output in the national economy resulting from the increase in final demand for one unit of production of that particular sector. The total demand for telecommunications services is determined by the final demand (personal consumption, state and non-profit consumption, investments, and exports). Consumers determine by their demand the amount of directly delivered services to final consumers, as well as the level of delivery of telecommunication services to other domestic manufacturers that use telecommunication services in their production processes.
In addition to the level of production required to deliver a set amount of final demand, the input-output model also answers questions about gross value added and employment by productive sector, which is required to deliver a certain amount of final uses.
The vector of gross value added, denoted by v = (v1, v2... vn), represents the sum of the components of the gross value added v=w+t+o, with each component also
n- a dimensional vector showing the distribution of individual value added components by product sector. The share of gross value added in each production sector is the input coefficient vi=vi/xi. As labor and capital are also inputs used in the production process, Leonti's production function used in the input-output model also assumes their fixed share in gross value added. If we define matrix V as a matrix of gross value added which contains, by columns, the elements of the share of each of the components of GVA in the total production of a given sector, then the gross value added from the production needed to satisfy the set level of final deliveries can be calculated based on the input-output model.

$BDV = V(I - A^{D})^{-1}f$

V = matrix of share of individual components of gross value added.

$$V = \begin{bmatrix} w1 & \dots wi \dots & wn \\ t1 & \dots ti \dots & tn \\ o1 & oi & on \end{bmatrix}$$

With a set exogenous level of final demand for goods and services, it is possible to calculate not only the level of gross output but also the gross value added that will be achieved in each of the manufacturing sectors in production processes intended to meet the final demand.

TYPE I OUTPUT MULTIPLIER (DIRECT AND INDIRECT EFFECTS ONLY)

An increase in the final consumption of domestic products directly affects revenues, i.e., gross production of telecommunications, but also of all other sectors that directly supply goods and services

intended for additional final consumption. In order to produce the required quantity of final production, telecommunications services suppliers must procure production inputs from other domestic and foreign producers in accordance with the characteristics of the production process. The input-output model presumes the existence of the Leontief production function characterized by a fixed share of production inputs in the amount of production of a particular production sector, as described by the matrix A. In the first step, an increase in the final demand for telecommunications sector's products implies an increase in production value, but also in the consumption of intermediary goods and services delivered by suppliers. Domestic intermediary consumption of the sector is defined by existing technology described by input-output coefficients. In the second step, an increase in the intermediary consumption of the i sector influences the increase in revenues of domestic sectors producing goods and services consumed in the i sector's production process. By increasing the production of all sectors supplying goods and services to HT, their intermediary consumption also grows according to the structure of the inputs they use, which is also described by the corresponding columns of the matrix A. The total value of the increase in domestic production, which is directly and indirectly related to the increase in autonomous final demand, is shown by the Leonti inverse, or the matrix $(I - A^D)^{-1}$.

Sector output multiplier is defined as the total value of the output of all economic sectors in the total national economy, which is required to meet the final demand for telecommunication services in the amount of one unit stated in the monetary statement.

$$\text{Mult}(oj) = \sum_{i=1}^{n} lij.$$

TYPE I GROSS VALUE ADDED MULTIPLIER

The analysis of the effects of a change in exogenous final demand is usually related to the effects on the movement of gross value added, which is equal to the difference between gross output and intermediary demand. The production sectors use inputs from other production sectors, and only the difference between gross output and the value of inputs consumed is a measure of the value-added that remains available for allocation to income components - gross salaries, net taxes, and operating surplus, which are spent on final goods and services thus increasing the level of prosperity in the national economy.

$$BDV = V(I - A^D)^{-1}f^D$$

V = matrix of share of individual components of gross value added.

$$V = \begin{bmatrix} w1 & \dots wi \dots & wn \\ t1 & \dots ti \dots & tn \\ o1 & oi & on \end{bmatrix}$$

The elements of matrix V represent the input-output coefficients for gross value added, i.e. the share of individual components of gross value added in the gross output of each sector of the national economy. If the product of multiplication of the Leontief inverse matrix and the final demand is pre-multiplied by the matrix of shares of individual components of gross value added, this will result in an increase in gross value added arising from the growth of final demand for domestic production sectors' products, specifically telecommunications services.

The ratio between the individual elements of row $v(I - A^D)^{-1}$ vector and the elements of row v vector showing the share of gross value added in the gross output of each activity is called the gross value added multiplier. As a result of the unit increase in final demand for telecommunication services, gross output will increase directly and, accordingly, the gross added value of the sector. However, by spreading multiplier effects on other production sectors, an increase in gross output of all sectors will also result in a multiplier increase in gross value added in the total national economy, and a ratio between total gross value added, directly and indirectly, related to the delivery of telecommunications services and gross value added directly realized in HT is called the gross value added multiplier.

TYPE I EMPLOYMENT MULTIPLIER

Similar to gross value added, pre-multiplying the Leontief inverse matrix and the row vector e gives the total direct and indirect increase of employment in the total national economy as a result of a unit change in the final demand for HT's goods and services.

The ratio between the total increase in employment, which includes the direct and indirect effects of the change in final demand $e(I - A^D)^{-1}$, and the ratio of the number of employees and production of each of the production sectors (in this case, telecommunications services), which reflects only the direct needs for the production labor factor for each of the sectors is called the employment multiplier type I.

MODEL S ENDOGENIM SASTAVNICAMA FINALNE POTRAŽNJE, INDUCIRANI UČINCI I MULTIPLIKATOR TIPA II

In accordance with the economic theory, individual components of final demand can be expected not to be fully exogenous, but dependent on other model variables, such as gross value added level and generated income level. This primarily refers to personal consumption, which in most macroeconomic models depends on generated income level and the increase of output and gross value added which is distributed within the economy and increases disposable household income, where it will, in turn, result in an additional increase in personal consumption.

With regard to the exogenism of final demand, two model types are to be distinguished in input-output terminology: open and closed. Openmodel divides economies into two segments. The first

segment comprises production sectors where there is an inter-sectoral connection among different sectors in accordance with their technological processes and where each sector's production level depends on the production generated by other sectors. The second segment comprises non-production sectors driving final demand, which is fully exogenous under the assumptions of the open model. In the open model, exogenous final demand determines, through the demand for production sectors' goods and services and inter-sectoral technological connection, the total production level in the economy, where, however, production and income levels have no impact on final demand.

TYPE II GROSS VALUE ADDED MULTIPLIER COMPRISING DIRECT, INDIRECT, AND INDUCED IMPACTS

In a technical sense, induced impacts are included by constructing the matrix H, which, in addition to direct and indirect impacts comprised by the type I multiplier, includes an additional row, i.e. a column with household sector's income and spending. This allows for the inclusion of induced effects pertaining to the increase of each sector's production and resulting from both the existence of inter-sectoral links among production sectors and the production generated to meet additional personal consumption induced by income growth. Production growth in each sector entails household income growth resulting from an increase in gross salaries. Since in the closed model personal consumption depends on income earned and the additional increase in personal consumption, and consequently, domestic production intended to meet induced personal consumption.

TYPE II GROSS VALUE ADDED MULTIPLIER

In the closed model with the household sector, the gross value added multiplier, in addition to direct and indirect changes of GVA, comprises also induced effects, i.e. the gross value added generated also by the producers delivering goods and services to meet additional personal consumption induced by a growth in economic activity related to telecommunications services delivery. The ratio between the total growth (direct, indirect, and induced effects) of gross value added, which is induced by a unit increase in final demand, and the direct growth of GVA in the unit directly delivering products for final consumption is called the type II gross value added multiplier. In addition to total gross value added multipliers, it is possible to calculate multipliers for individual components – gross salaries, net taxes, and operating surplus – in such a way that instead of the vector v, a corresponding vector using the share of an individual component of gross value added (w, t, o) is used.

In the closed model, the type II multiplier, which shows the total change in the number of employees induced by growth of exogenous final demand is based, as well as gross value added, on the pre-multiplication of the matrix Hx and the row vector e (indicator of the required number of employees per output unit). The ratio between the total employment increase, which includes direct, indirect, and induced impacts of the change in final demand eHx, and the ratio of the number of employees and the production of each production sector reflecting only direct needs for production labor factor e, is called the type II employment multiplier. The application of the type I multiplier for the telecommunications sector allows for the quantification of indirect impacts on gross production value, gross value added, and employment. The multiplier from officially published input-output tables has been applied to the 2010-2012 period, while to the period from 2013 to the present, the multiplier resulting from the RAS method, which updates old technological coefficients in accordance with the more recent data on structural characteristics of the economy from the national accounts system of the Republic of Croatia, has been applied. It is evident that the indirect effects are the strongest in terms of employment engaged by all manufacturers involved in the overall product chain of telecommunications services.

ANALYSIS OF PANEL DATA

The analysis was performed on a model developed for the purpose of the fifth chapter of the Atlas, which seeks to cover a number of factors in the field of infrastructure and institutional framework recognized in the existing scientific and professional literature as determinants of local economic activity. In general form, the model takes the following format:

$$y_{it} = \alpha + \beta_1 lnmbit_{it} + \beta_2 lndens_{it} + \beta_3 lndist_i + \beta_4 lnrash_{it} + \beta_5 lngi_{it} + \sum_{i=2}^{8} IR_i + \sum_{i=2}^{21} county_i + \sum_{i=2015}^{2017} year_i v_{it}$$

In the above equation, the dependent variable takes many forms - the number of new enterprises, labor productivity, employment, average net wage, and export revenues (in HRK 100,000). Independent variables include: the logarithm of the average internet speed in a local government unit i in year t, our key variable. Higher values of this variable are expected to contribute to an increase in business outcomes (dependent variable).

The set of control variables includes the population density logarithm defined as the number of residents per km^2 in the unit local government, the logarithm of the distance from the administrative (county) center in kilometers, logarithm of the amount of investment of a local government unit in tangible assets, logarithm of the sum of the square deviation of the share of individual industry in employment of each local unit (indicator of agglomeration externalities), and seven categorical variables corresponding to the category into which the city or municipality is classified according to the development index. Also, the model includes 20 categorical variables for each of the counties in which the unit is located and three categorical variables for the years in which the analysis is conducted. In the previous three groups of variables one category was excluded from the analysis and represents the base category.

TABLE P1: DEPENDENT VARIABLES.

Variable	Description
jlsentry	Number of new businesses in the city/municipality *i* in the period
lnprod	lnprod Logarithm of labor productivity (revenue per employee) in city/municipality *i* in period t
totalemp	Total number of employees in city/municipality *i* in period t
netwage	Average monthly net wage in city/municipality *i* in period t
export	Total export revenues in city/municipality *i* in period t

The impact analysis of the dependent variables was performed for multiple groups of companies as follows:

i) All businesses available in the sample
ii) Businesses in the manufacturing industry
iii) Service sector businesses
iv) Businesses in digitally intensive industries in accordance with OECD classification
v) Businesses in high-tech intensive manufacturing industries according to the OECD/Eurostat classification
vi) Businesses in knowledge intensive services in accordance with the Eurostat classification

TABLE P2: INDEPENDENT VARIABLES.

Variable	Description
lnmbit	Logarithm of average internet speed in the city/municipality *i* in period t
lndens	Logarithm of the average population density in the city/municipality *i* period t
lndist	Logarithm of road distance from the county center in the city/municipality *i* in period t
lnrash	Logarithm of the average amount of investment in tangible assets in the city/municipality *i* in the three years preceding period t
lngi	Logarithm of the sum of the square deviation of the share of each industry in the employment of each local unit (Elison Glaeser index component)
IR2-IR8	Categorical variables - 1 if the city/municipality belongs to the appropriate category according to the development index
County2-County21	Kategoričke varijable – 1 ukoliko grad/općina pripada odgovarajućoj županiji
Year2-Year4	Categorical variables – 1 for each year in the 2015-2017 period

Two methodologies were used in the analysis. Random effects method was used to assess the effects in period t. This panel method is suitable for analyzes in which the emphasis is on average differences in outcomes between units over a period of time, and in which analyzes involve a number of categorical variables. Given that the purpose of the analysis is to evaluate the effects of the difference in internet speed on economic outcomes at the local level, it follows from the above that the method selected is suitable for the stated purpose. The second part of the analysis uses spatial econometrics methods. The purpose of this method is to assess the impact of changes in internet speed on economic outcomes within the local unit where the change is taking place and the neighboring local units. Also, this part of the analysis defines the outcomes in such a way as to assess the impact within a period of up to three years from the change. The

spatial econometric method used was the spatial cross-section Durbin Method. The reason for using cross-section instead of panel technique lies in the fact that only 4 years of observed data is available, which makes it impossible to use panel methods when assessing the impact on outcomes in the next two to three years. The Durbin spatial estimator method was selected because it allows modeling of spatial effects in dependent and selected independent variables, which in our case implies a variable that measures changes in internet speed. For all models assessed , direct and indirect spatial effects were calculated and interpreted.

The interpretation of the assessed coefficients is as follows. Since the dependent variable is in its original form and the independent variables in logarithmic form, the interpretation is performed in such a way that 1% of the change in the independent variable has the effect of X/100 in the unit value of the dependent variable. In Figures 10-16, an adjustment was made for the interpretation.

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