Firmographic analysis and the role of ICT in advancing green economy and sustainability in Tashkent

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Abstract. Firmographic data and analyses demonstrate their usefulness, especially when integrated with Information Telecommunication Technologies (ICT), in optimizing state administration and local government functions. Companies and organizations with diverse characteristics have varying interests and challenges, making segmentation crucial for tailored strategies. For instance, a high-revenue entity is more likely to adopt advanced ICT solutions than a lower-revenue one. Firmographic segmentation is used to group entities into smaller, more targeted segments for effective strategy deployment. This method enhances the relevance of messages and solutions offered, increasing the likelihood of successful adoption and implementation. For example, targeting specific administrative needs with ICT tools tailored to their challenges fosters digitalization and superior e-governance practices. This approach underscores the critical role of ICT in promoting efficiency, supporting sustainability, and aligning operations with green economic goals. This paper examines how ICT facilitates firmographic segmentation, fosters green economic activities, and embeds sustainability into the mechanisms of government bodies in Tashkent. Key findings highlight ICT's role in enhancing operational efficiency and advancing eco-friendly governance strategies.

1 Introduction

State administration and local government bodies play a pivotal role in shaping socio-economic development, managing public services, and improving residents' quality of life. In Uzbekistan, these bodies face unique challenges in resource management and operational efficiency, making the integration of ICT crucial for driving innovation and sustainability. ICT has emerged as a transformative tool in this context, enabling real-time data collection, enhanced decision-making, and streamlined administrative functions. By leveraging technology, state and local governments can align their operations with the goals of a green economy, which prioritizes reducing environmental risks and fostering sustainable

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development. A critical area of focus is transport services, a cornerstone of public administration efficiency and a significant contributor to carbon emissions. GPS-enabled fleet management systems, for example, help minimize fuel consumption by optimizing routes, demonstrating how digital tools can simultaneously reduce costs and environmental footprints. Such advancements contribute to the broader objectives outlined in Uzbekistan's "Development Strategy 2030," which emphasizes digital transformation and ecological responsibility. The importance of firmographic segmentation cannot be overstated in this context. Firmographic data information about organizational size, resources, and operational scope is essential for tailoring ICT solutions to specific administrative needs. High-resource entities tend to adopt ICT solutions more readily, achieving better outcomes in both efficiency and sustainability. For instance, segmentation can identify which entities would benefit most from e-governance platforms or predictive analytics tools, helping optimize resource allocation and improve service delivery.

The role of ICT in public administration has been extensively documented in global studies. Brynjolfsson and McAfee [1] emphasize the potential of ICT to revolutionize efficiency through data-driven processes. Roberts [2] highlights the role of digital tools in integrating sustainability into governance. Domestically, Xikmatov and Ziyadullayev [3] have illustrated how ICT applications in Uzbekistan's transport sector can enhance service management and support green economic goals. The economic implications of these advancements are equally significant. Borger [4] discusses how ICT integration into firmographic segmentation can reveal opportunities for sustainable interventions. By adapting global frameworks like the Standard Industrial Classification (SIC) to local contexts, public administrations can better address regional challenges, fostering tailored solutions that balance efficiency, cost-effectiveness, and ecological responsibility.

This paper explores the intersection of firmographic analysis, ICT integration, and sustainability initiatives, focusing on their application within Tashkent's state administration and local government bodies. By examining these elements, the study highlights the potential of ICT-enabled tools to transform public services and promote a green economy in Uzbekistan.

2 Materials and methods

The research employs a structured approach to examine the organizational and economic mechanisms involved in providing transport services to state administration and local government bodies in Tashkent. The focus is on ICT's role in advancing the green economy and embedding environmental sustainability into management practices. Data was obtained from official reports, enterprise records, and public administration databases. Key indicators included organizational size, budget allocations, and ICT adoption levels. The Standard Industrial Classification (SIC) system was adapted to assess the use of ecological technologies and classify enterprises accordingly [1-3]. Metrics included the deployment of digital platforms such as e-government systems and sustainability reporting tools. Special attention was given to predictive analytics and fleet optimization software for reducing operational inefficiencies [2, 4]. Semi-structured interviews were conducted with 15 officials from local government bodies and ICT managers. The aim was to identify barriers and opportunities in implementing green ICT solutions [3]. Detailed analysis of transport services provided by "Avtotransport vositalariga xizmat ko'rsatish" SUE was undertaken to evaluate the effectiveness of current ICT practices and suggest improvements [4]. Quantitative data was analyzed using descriptive statistics to classify entities based on their readiness to adopt ICT solutions. Regression analysis highlighted the relationship between firm size and ICT efficiency in reducing environmental footprints [1]. Data from interviews were processed using thematic coding to identify recurring issues, such as limited digital literacy and

inadequate funding for ICT initiatives [2, 3]. The study uses a multi-criteria framework to evaluate economic efficiency through cost reductions and improved resource allocation due to ICT-driven solutions, environmental benefits measured by reductions in fuel consumption and emissions via optimized transport routes, and administrative effectiveness assessed through improvements in service delivery and stakeholder satisfaction [1-4]. Tools like SPSS were employed for quantitative data evaluation, while NVivo supported qualitative data organization and coding [5]. GIS was used to visualize ICT and green technology adoption across Tashkent, providing spatial insights into policy impacts [3]. The study faced challenges, including incomplete data on firm-level ICT adoption and reliance on self-reported information, which may introduce biases. Limited generalizability to rural areas also constrains the scope [4]. Ethical compliance included obtaining consent from participants and securing data confidentiality. All analyses adhered to the research guidelines of the Tashkent University of Information Technologies [5].

3 Results and discussion

The analysis results showed gaps in ICT adoption and its application in green economic practices across different segments of Tashkent's public administration. Larger organizations with higher budgets showed a greater propensity for integrating advanced ICT tools, including predictive analytics and sustainability reporting systems, compared to smaller entities that often lacked resources and technical expertise. This trend underscores the importance of targeted support and training programs to bridge the digital divide [2, 3]. One of the key aspects of the automotive industry is the growing competition among car manufacturers in the Uzbek market, driven by its dynamic development. The main challenge is managing this competition effectively. In this context, firmography plays a crucial role. It's important to recognize that while firmography considers company characteristics such as size, industry, geographic location, and decision-makers, demographics focuses on individual indicators like age, gender, income, and education.

The Standard Industrial Code (SIC) classification system is utilized by government agencies, researchers, and analytical service companies to analyze and compare economic activities across various sectors. It provides a numerical code that categorizes the economic activities of enterprises within the country. This system facilitates the organizational and economic management activities of state administrations and local authorities, while also enhancing their control functions. By adapting the U.S. SIC framework to our country's economic infrastructure and refining it into a national "Standard Network Economic Classification," we can better fulfill the social and economic objectives of public administration and local government bodies, particularly in relation to the use of motor vehicles. This adaptation necessitates the coding of motor vehicles utilized by enterprises. Additionally, classifications such as the NTEE (National Taxonomy Codes for Tax-Exempt Organizations), UNSPSC (UN Standard Products and Services Code), and GICS (Global Industry Classification Standard) are recommended to emphasize economic aspects in their classification processes. This approach is crucial, as it significantly influences the development of firmography within the service sector (Fig. 1).

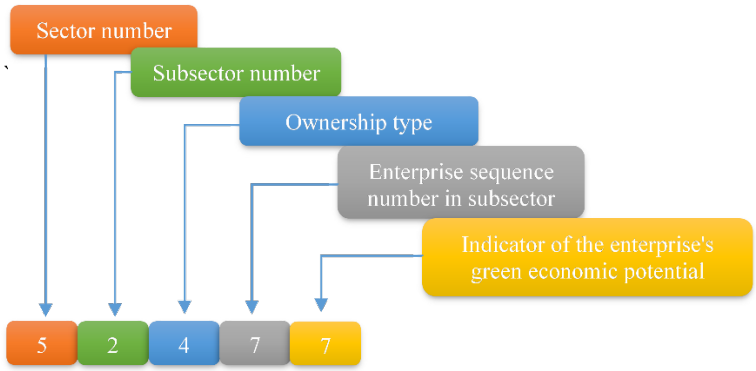

Fig. 1. SNEC-Standard network economic classification.

In this coding system, the division by sector and sector number is limited based on the number of sectors present in the country. The classification is organized according to ownership types rather than the ownership of the enterprise itself, specifically as follows: 1 - Joint Stock Company (JSC); 2 - Limited Liability Company (LLC); 3 - State Unitary Enterprise (SUE); 4 - Cooperative (Co.); 5 - Joint Venture (JV); 6 - Foreign Enterprise (FIE). If the ownership structure is mixed, the classification begins with the type of society, followed by the description of the enterprise. For instance, in the case of JV "SamAvto" LLC, which is categorized as both an LLC (2) and a JV (5), it will be assigned a two-digit number coded as 25.

The enterprise number within the network represents its unique identifier, and it is advisable to compile this summary separately for each region. Additionally, the number indicating the enterprise's potential in the green economy reflects its use of ecological products and technologies. This is digitized using three values: 0 for enterprises using traditional and ecologically unimproved technologies; 1 for those providing services based on semi-ecological and semi-traditional technologies; and 2 for those producing with fully ecological technologies. This coding enhances firmographic effectiveness (Table 1).

Table 1. Firmographoscopic evaluation for SNEC.

Name of the evaluation indicator	**Evaluation criteria**	**Criterion description**
Approximate evaluation according to the quality indicator	$R_q^2 = 1 - \frac{(T-1)}{(T-k)} R^2 = 1 - \frac{(T-1)SSM}{(T-k)YSM}$	**R** $_q$ - quality indicator; **T** - number of observations; **k** - estimated parameters; **R** - the duration of the enterprise's quality indicator; **SSM** - product standard quality indicator; **YSM** - additional quality indicator
Cross examination	$I_{qr} = f^* - f^m;$	I_{qr}- intersection of indexical indicators; f^*- ratio of firmographic factors; f^m- original qualitative description of firmographic factors;

An Information Criterion	$AIC = 2k - 2ln(l(\theta\|Y))$	ɵ- vector of information model parameters (by k factors); Y is a vector of organizational indicators in reality; L- logarithmic probability function;

Firmography is typically used in the B2B (business-to-business) industry to better understand a company's potential fit for a product or service, allowing businesses to tailor their marketing and sales strategies accordingly. In our case, since the service pertains to local authorities, it falls under the categories of G2B (Government to Business) and G2G (Government to Government). G2B refers to a set of software and hardware tools that facilitate online interaction between government bodies and commercial enterprises to support and promote business development. This includes information websites of government agencies, e-procurement systems, and more. One of the advantages of firmographic segmentation in this context is the rational use of company resources. Segmentation enables companies to direct their sales and marketing efforts toward customers who are most interested and financially capable of making purchases (Table 2).

Table 2. Analysis of "Avtotransport vositalariga xizmat ko'rsatish" State Unitary Enterprise according to the e-commerce model (firmographic segment [6])

B	**B2B**	**B2G**	**B2C**	**B2E**
	Not available	Available: Employee training; Providing services to drivers of enterprises that are not local governments, on the basis of a medical examination agreement (SaaS; CRM; consulting)	Not available	Not available
G	**G2B**	**G2G**	**G2C**	**G2E**
	Available SNEC coding; Gas station and its storage warehouse	Eat: electronic signature; www.egovernment.uz ;	Not available	Not available
WITH	**C2B**	**C2G**	**C2C**	**C2E**
	Not available	Available: Car alarm installed; Digital surveillance cameras installed; A dispatch service has been created;	Not available	Not available
E	**E2B**	**E2G**	**E2C**	**E2E**
	Not available	Not available	Not available	Not available

Effectively utilizing the activation of the Standard Network Economic Classification (SNEC) for firmography necessitates the development of a specialized evaluation system. This system is designed to assess firmographics through approximate accuracy, cross-checking, and peer review. To determine the ratio of estimated parameters and firmographic factors in the assessment process, it is essential to study these factors and organize them into a table format.

Table 3 represents that the approximate level of the quality indicator for the transport service was 46 percent in 2019, it decreased slightly in 2019 due to Covid-19, but a sharp growth rate was observed from 2021 to 2023, in which the product of Uzbekistan's strategy

of “Development 2030” strategic measures and the implementation of digital and business models such as e-government will be observed.

Table 3. Firmographoscopic analysis indicators for SNEC in Tashkent city, 2023, in percent

Name of the evaluation indicator	2019	2020	2021	2022	2023	Criterion description
Approximate level according to the quality indicator	46	44	67	77	79	0-24% low; 25-44% lower middle; 45-74% medium high; 75-90% higher; 90-100% is extremely high.
Cross examination	34	37	41	44	52	0-44% low; 45-74% medium; 75-100% higher.
Information criterion (An Information Criterion)[7]	23	23	29	29	34	0-44% low; 45-74% medium; 75-100% higher.

However, it is necessary to develop software tools aimed at improving the organizational and economic mechanism for ensuring the reliability and expected performance in improving the service quality of motor vehicles [8]. Based on a cross-sectional survey, the level of mobility of the car transport service aimed at ensuring proportionality in terms of socio-economic, as well as organizational and economic, from 34 percent in 2019 to a medium level in 2023 and reached 52 percent. The quality of infrastructure, resource allocation, and maintenance also saw notable improvements during this period [9]. ICT-based tracking and maintenance scheduling systems further contributed to enhancing operational efficiency and vehicle reliability, ensuring better service delivery and reduced costs in the long run. However, in this case, the importance of increasing the influence of factors in increasing the firmographic efficiency of mutual vehicles increases, accordingly, it is necessary to increase its participation in transformational processes [10]. According to the information criteria, as a result of the assessment, the weight of the transport service was 23 percent in 2019 and it will increase to 34 percent by 2023 without drastic changes. Expanding the scope of firmographic data usage to include predictive maintenance and real-time analytics is essential for sustaining this growth trajectory [11]. Due to insufficient firmographic information on vehicles, it is necessary to expand its application in the transport service.

4 Conclusions

The “Avtotransport vositalariga xizmat ko’rsatish” State Unitary Enterprise under the Tashkent City Administration currently relies on manual entry for all organizational and economic data related to services provided to official organizations. This manual process not only causes significant inconvenience and complicates report generation but also weakens control and oversight functions. Integrating Information and Communication Technology (ICT) into these processes offers an opportunity to streamline operations, improve accuracy, and enhance overall efficiency, while aligning with the principles of a green economy. The enterprise can serve as a model for G2B (Government-to-Business) coding within the Standard Network Economic Classification (SNEC). Additionally, car gas station management processes and storage warehouse operations could be digitized and optimized.

The enterprise could extend its services by establishing agreements with legal entities, utilizing ICT-driven solutions such as e-commerce platforms to strengthen G2G (Government-to-Government) transactions.

To address the gaps in G2C (Government-to-Citizen) and G2E (Government-to-Employee) models, creating an official website is crucial. This platform would enable electronic advertising of job vacancies, facilitate transparent communication, and contribute to sustainable organizational growth. ICT adoption in these areas not only increases operational efficiency but also aligns with sustainable development goals by minimizing resource use and promoting eco-friendly practices. Firmographic segmentation, coupled with ICT, provides valuable insights into customer dynamics and market needs. Categorizing a broad customer base into smaller, targeted segments such as by employee size (e.g., 50–100, 100–250, or 250–500 employees) enables the delivery of tailored and effective messaging. Presenting products and services to the right customer segment with a relevant, eco-conscious approach improves engagement and increases the likelihood of successful transactions. Conversely, untailored messages risk disinterest, such as unopened emails or abandoned websites. By integrating ICT tools, adopting environmentally sustainable practices, and utilizing firmographic analysis, the enterprise can enhance its operational framework. This approach not only supports economic development and administrative efficiency but also aligns the enterprise with the broader objectives of a green economy and environmental sustainability, ensuring long-term resilience in an evolving global landscape.

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