Assessing the business models of Ukrainian IT companies

NESTOR SHPAK, ANASTASIYA KARPYAK, OLGA RYBYTSKA, MARYANA GVOZD, WŁODZIMIERZ SROKA

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Abstract

The characteristic features of Ukrainian IT companies are identified and analysed in the article. These characteristics are considered in the context of the application of business model elements from the point of view of creating value for customers of digital services and products. Data clustering was carried out in order to distinguish similar groups of IT companies. The principles of evaluating the value of IT enterprise products and the effectiveness of the applied business models were developed based on cluster analysis. Using the k-means method, clustering according to the following groups of indicators was carried out: the share of the various types of industry of customers of the company's services/products in relation to the total volume; the share of types of services provided by the enterprise in relation to the total volume; the number of IT specialists at a given enterprise, taking into account the share comprising those registered in Ukraine; and the share in the client base of enterprises of certain categories (based on annual turnover). The calculation of the optimal number of clusters was carried out using the elbow method and the simplified silhouette estimation method. In the homogeneous groups formed by the applied business models, an analysis of the connections between these elements was carried out. It has been shown that the main factors in the creation of the value of IT products on the global market are the ability to provide high-quality services (a spectrum of services provided); the ability to provide services to certain types of industries; as well as the ability to form a national or transnational team of specialists that work towards the previous two factors. To evaluate the effectiveness of the applied business models, the value of the average declared cost of an hour of project implementation work, as well as the spectrum of the client base by categories of financial turnover (small, medium-sized or large businesses) are proposed. Given the state of the national economy and the prevailing transnational activity of a large share of Ukrainian IT companies, the propor-

Nestor Shpak
e-mail: nestor.o.shpak@lpnu.ua
Lviv Polytechnic National University, Ukraine

Anastasiya Karpyak
e-mail: karpyak.anastasiya@gmail.com
Lviv Polytechnic National University, Ukraine

Olga Rybytska
e-mail: olha.m.rybytska@lpnu.ua
Lviv Polytechnic National University, Ukraine

Maryana Gvozd[1]
e-mail: mariana.y.hvozd@lpnu.ua
Lviv Polytechnic National University, Ukraine

Włodzimierz Sroka
WSB University, Dąbrowa Górnicza, Poland
& the University of Johannesburg, South Africa

[1]Corresponding author

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tion of employees registered in Ukraine is an equally important factor in assessing the effectiveness of the business model. It has been shown that the most effective business models of IT enterprises are those that ensure the involvement of professionals in a team, capable of providing high quality of a sufficiently narrow range of services to a medium range of industry types, and also create the possibility of a permanent improvement in employee qualifications in order to provide unique services. Business models that ensure the involvement of highly qualified managers from countries with developed economies in order to attract the client base of large and medium-sized businesses are also effective. The results of the research can be useful for adjusting the business models of IT enterprises in order to increase their efficiency by ensuring the possibility of providing services which cost above the average global market level and optimising the client base.

Key words

business model, clustering, IT company, IT product, product value, human capital, company management.

Introduction

The IT sector in today's digital world is an important factor in increasing the competitiveness of countries, as it is a driver of social and economic progress (Halkiv et al., 2021). This gives grounds for directing the main attention of the global scientific community and practitioners to the rapid global development of the information society. In this situation, conditioned by the accelerated development of digitalisation, priority strategic tasks for the development of the information society throughout the world and in Ukraine, in particular, are the accelerated implementation of modern information technologies in all spheres of the economy and public life, the development of the digital and sustainable economy, the development of the national information infrastructure, strengthening the integration of Ukraine into the global information space and improving cyber security (Melnyk et al., 2018).

In recent years the global IT industry has been characterised by active development, in particular the creation of IT clusters based on new forms of cooperation in the IT sphere, conditioned by the integration of joint efforts of IT companies, educational institutions, public organisations and other business entities.

It can be stated that the IT industry is a priority driver of economic development at both the national and global levels, because it provides opportunities for the emergence of new types of economic activity and the development of those areas of activity where business models are built on the use of an IT product (Shpak et al., 2020). This is confirmed, for example, by global trends in the development of electronic commerce (Ohinok et al., 2022; Pyroh & Horyachka, 2019). The accelerated development of digitalisation affects all processes within enterprises – reengineering of business processes (Shpak et al., 2018), automation of production processes, analysis of Big Data, the Internet of Things, distance learning, and so on (Chukhrai & Shcherbata (2016),

etc.). Nowadays enterprises and industries are increasingly utilising IT products in order to ensure their competitive advantages. It is the products and services of IT companies that make it possible to optimise processes, reduce work time and costs, diversify their activities (Kuzmin, 2015), optimise production processes, etc. With the development of the IT industry, new risks arise, in the context of which it is important to evaluate the capabilities of human resources in the conditions of rapid technological changes to ensure the stability of the state security system (Yemelyanov et al., 2018).

The fact that the development of the IT industry is a generator of the progress of all phenomena and processes creates the fundamental foundations for the development of the global economy, forming a growing interest in the activities of IT companies as separate elements of the IT sector. In particular, attention is mainly directed to the study of models of functioning, tactics of activity, and strategies of the development thereof; whereas with the development of IT industries, business models of IT companies also develop and differentiate. In view of this, everything described above actualises the problems of researching the business models of Ukrainian IT enterprises.

However, assessing the effectiveness of the functioning model of a modern enterprise, in particular in the field of information technologies, is becoming an increasingly difficult task. This is due to a number of objective reasons, among them the globalisation of production processes, the possibility of teams of specialists from different countries performing certain subtasks in the global development process of a digital product, the absence of boundaries between customers and service providers, the existence of various forms of labour relations, the lack of information pertaining to the income of companies, etc. There is also the problem of identifying the components of companies-brands, since a fairly large number of individual companies registered in different cities in Ukraine, as well as abroad, are often united under the name of a Ukrainian IT company. Common indicators of the management efficiency of a company such as the amount of capital turnover and profit, the amount of taxes paid, the number of full-time employees, etc. become blurred and ambiguous, which complicates the process of analysis.

The IT companies of today are required to quickly reorganise and respond flexibly to the needs of the modern market, to organise work ahead of schedule, to attract highly qualified and creative employees, and to organise continuous training for them. All of the above gives reason to state that the main capital which an IT company possesses is high-quality professionals. Accordingly, the term 'human capital' is becoming increasingly materialised, because in the field of information technologies it is the main source of profit growth, a key link in the value creation chains. Therefore, we consider the scale of human capital, which is measured by the number of employees, to be one of the main indicators characterising the effectiveness of the business models of IT enterprises. Since a large proportion of Ukrainian IT companies are transnational, it is important to research the share of their employees registered in Ukraine.

Nowadays, a concept such as the value of the enterprise's product to individual consumers (B2C) or other businesses (B2B) comes to the forefront of the description of the efficiency of the enterprise's business model in the scientific literature. It is the permanent growth of value for the consumer, which the company creates or can create, that is becoming a key indicator of the effectiveness of a certain business model. However, it is quite difficult to single out effective business models which are the foundation of successful IT enterprises, because factors such as the possibility of temporary work, or the wide use of a popular form

of employment in Ukrainian IT companies – namely, the sole tradership – are increasingly blurring the notion of the staff of IT companies, making it impossible to apply established approaches to evaluating the effectiveness of management. Diverse and often individual business models underlying the activities of IT enterprises greatly complicate the comparative analysis and classification thereof according to specific characteristics. However, from the point of view of the value of the product to consumers, inclusion in chains of the creation of added value, as well as earning profits, the authors suggest a comparative analysis to investigate characteristics such as the types of services provided by the IT company, the types of industries to which the company provides services, the size of customer companies and the average declared cost per hour of employees' work.

The purpose of the study is to analyse the business models of IT enterprises and evaluate the value of the elements therein, identified by means of cluster analysis.

To achieve the goal, the following tasks are defined in the article: analysis of the elements of business models of Ukrainian IT enterprises using cluster analysis; scientific substantiation of the influence of interrelationships between the factors that shape the value of the products of Ukrainian IT enterprises, taking into account the range of services and industries to which these services are provided; investigation of the relationships between the scale of companies (determined by the criterion of the number of employees) and the percentage of employees registered in Ukraine, the scale of enterprises-clients, the average cost of an hour of work and the product value creation system: target client base (industry focus) and types of services (service focus).

The article is structured as follows. Firstly, the authors present the theoretical foundations of the research, focused on studying the features of business models of IT enterprises and evaluating the elements therein, as identified by the clustering method. Next, the researchers present the practical significance of the methodology used. The subsequent part of the paper presents the results, followed by the conclusions, recommendations and limitations of the study.

1. Literature review

In modern conditions, considerable attention is paid to the development of the IT sphere, since it contributes to the optimisation of the management of economic processes through the introduction and use of information technologies, and also creates opportunities for the formation of powerful integrated IT clusters with high economic capacity, which is necessary for the development of the national economy (Melnyk et al., 2018). The growth of the IT industry depends directly on the development of IT enterprises as separate industry elements. In this context, special attention needs to be paid to the functioning of the IT enterprise, which directly depends on the business models that form the basis of their management. In view of this, the issue of studying theoretical and practical aspects of evaluating individual elements of the business models of IT enterprises, which are formed and analysed on the basis of cluster analysis, is becoming increasingly relevant.

The results of scientific research on this issue indicate the growing interest of scientists and practitioners in the functioning and development of IT companies, the analysis of their business models, the use of the cluster analysis method, etc. Such research demonstrates the diversity of views and concentration on the analysis of certain aspects of the problem. Thus, we have singled out the following key areas of scientific research: the interpretation of the economic essence of the term 'business model', the analysis of the features of business models of IT companies, the analysis of the clustering method

and the areas (examples) of its application. Below we will consider research/scientific works in these identified scientific directions in more detail.

1.1. Interpretation of the economic essence of the term 'business model'

Numerous scientists have provided definitions of the term 'business model', as well as the classification of the structural elements thereof. Zott (2010) describes it as a set of the ways and rules of conducting business in a company, which is analysed through a prism of its structure, products, methods of delivering products and services, increasing market value, which are the basis of the strategy by means of which the company creates value to customers and profits.

Ukrainian economists (Bublyk et al., 2018; Kuzmin et al., 2020; Pyrog & Poritska, 2020; Shpak et al., 2018) have conducted research on the conceptual foundations of the business model; models of functioning and administration of companies, in particular, in the IT sphere; and the factors which form value for consumers. Thus, Kuzmin et al. (2020) noted that a business model logically describes how an organisation creates products or services, delivers them to customers, and acquires various forms of value – economic, social, and others. Pyrog & Poritska (2020) revealed the economic essence of the business model as a description of the value that enterprises offer to various customers, which reflects the capabilities of the enterprise necessary to create, promote and supply this value to customers, as well as the capital relations necessary to receive sustainable revenues. Shpak et al. (2019) presented a set of related model elements defining the internal and external environment of the company within a single system, describing described diversification models of sales activity for the steady development of an enterprise.

Spieth et al. (2014) justified the practical feasibility of building business models based on innovation. According to scientists, this will ensure the successful integration of companies into the business environment in modern conditions and their effective response to future challenges. Scientists argue that effective business models should be based on three goals: business explanation, business management, and business development. This view is shared by other scientists (Villi & Picard, 2019), who describe the need to transform business models through the prism of innovation. The authors postulate that with the development of information technologies, models of the functioning of companies must also change in order to ensure the adaptability of the latter to new business challenges such as increased competition, rapid changes in consumer needs/requests, and so on.

Thus, in the scientific literature, the concept of the business model is used to describe the principles, methods, rules, tools, and strategies that underlie the management of an enterprise, to ensure its effective functioning in modern market conditions of business, as well as its adaptation to new challenges of the business environment, with the aim of creating value, increasing competitiveness and making a profit.

1.2. Analysis of the features of the business model of IT companies

Bonaccorsi et al. (2006) analysed business models of IT companies which are based on entry strategies in the IT industry. The authors proposed a new definition of the business model and conducted a survey of 146 Italian software development firms. The results of the study showed that firms have adapted to an environment dominated by existing standards, combining open source software and proprietary software. The authors investigated determinants of business models and substantiated the practical significance of hybrid business models of IT enterprises in the context of the evolution of this industry.

Ansong & Boateng (2019) investigated business models of IT companies in the context of developing tactics and strategies for the survival of enterprises in modern conditions. Harmash (2021) analysed modern business models of managing enterprises in the IT sector. After all, in order to adapt to rapidly changing conditions in the business environment of the IT industry, it is necessary to change the business model of IT companies. Pech & Vrchota (2020) scientifically justified the need to classify IT companies into small and medium-sized enterprises according to the level of implementation of Industry 4.0, which directly affects the choice of the appropriate business model to ensure the maximum efficiency of the company's activities.

Research into the practical aspects of IT company activity showed that, in general, companies can be conditionally divided according to their functional focus into service companies that operate according to the principle of outsourcing and/or outstaffing, and product companies. According to this, the basis of company management should be appropriate models of functioning of IT companies, which provide the possibility of managing them as efficiently as possible, taking their functional orientation into account.

1.3. Content of the clustering method and analysis of the spheres (examples) of its application

The cluster analysis method was proposed in 1932 (Driver & Kroeber, 1932), and since then has been actively developed and used in various sciences and fields of activity. Shortly after its origination, scientists noted that it works even when there is little data and the requirements of the normality of distribution of random variables and other requirements of classical methods of statistical analysis are not met, and it is also useful when it is necessary to classify large amounts of information (Hartigan, 1975). Research has shown that there are many different definitions of this term; however, we would keep to the following: "cluster analysis is a set of statistical methods for discovering new group/class structure when examining data sets" (Flynt & Dean, 2016). In this article, the authors consider popular libraries/commands for various types of cluster analysis, which expand the possibilities of its practical use and increase the value of the obtained results. The packages/functions analysed by the authors cover various methods of cluster analysis for continuous data, categorical data, or the combination thereof.

Antonenko et al. (2012) consider cluster analysis to be a group of statistical methods that have great potential for analysing huge amounts of data. The authors provide examples to illustrate the use of the hierarchical and non-hierarchical clustering method. Jain & Dubes (1988) thoroughly described the data clustering algorithm. Jasiński et al. (2021) presented the cluster analysis algorithm as a type of data intelligence technique, substantiating the feasibility of the k-means algorithm for long-term data and presenting methods for obtaining the optimal number of clusters. Finally, Zhang (2019) proposed an improvement of the k-means method, which makes it possible to significantly reduce the sensitivity of the clustering result to the selection of the initial centroid.

It is difficult to overestimate the practical significance of cluster analysis, as has been confirmed by numerous scientific works where completely different tasks are solved using this method. After all, cluster analysis is used in various spheres and industries, in particular the following: medicine – for the classification of diseases or the symptoms thereof, taxonomy of patients, drugs, etc.; psychiatry – for the correct diagnosis of symptoms such as paranoia, schizophrenia, etc., which is a decisive factor in successful therapy; marketing – for the segmentation of competitors and consumers, the

analysis of consumer behaviour, the grouping of consumers into homogeneous classes to assess the behaviour of the client from each group and the factors affecting it; management – for the division of personnel into different groups, clustering of consumers and suppliers, and the identification of similar production situations that cause shortages; sociology – to divide respondents into homogeneous groups; geoinformatics – for data visualisation, image segmentation, and intelligent searching; economics – for the analysis of markets and financial flows, and the derivation of regularities on stock exchanges; astronomy – for the selection of groups of stars and galaxies, etc. (Hartigan, 1975).

Garuso et al. (2021) propose a methodology based on mixed data clustering techniques that is appropriate for credit risk assessment. Chen (2007) describes the risk assessment of knowledge sharing in virtual enterprises based on grey cluster analysis. Choudhury et al. (2016) applied rainfall cluster analysis to establish a drought insurance index. Flath et al. (2012) conducted a cluster analysis of smart metering data. Dumuid et al. (2017) investigated the academic performance and lifestyle of Australian school students. Using cluster analysis, Franco (2021) investigated the influence of the external and internal environment of multinational enterprises on the sustainability of their subsidiaries. Jasiński et al. (2021) carried out a cluster analysis of power quality measurements and substantiated the problem of choosing the optimal number of clusters. In the work of Hitka et al. (2017), cluster analysis was used as a strategic advantage of human resource management in small and medium-sized enterprises in the woodworking industry. Hosseini et al. (2010) describe cluster analysis using data analysis to develop a CRM methodology for assessing customer loyalty. Scutariu et al. (2021) conducted a cluster analysis of e-commerce business behaviour in the context of the COVID-19 pandemic. IT market researchers Rybyska & Karpyak (2022) used cluster analysis as a tool for researching the motivational component of business models of IT companies in Ukraine.

In general, the results of the research on this topic can have significant practical value, because they can form the basis of the development strategy of existing IT companies and ensure an improvement in their operational efficiency in the conditions of a dynamic business environment and political and economic instability in Ukraine. The latter is due to the treacherous invasion by Russia, which has brought about the large-scale destruction of infrastructure, in particular in education, and the loss of a significant number of qualified personnel (due to military service and forced emigration). The abovementioned factors, destructive as they are to the economy and social development, have led to a decrease in the number of employees of IT enterprises, a decrease in the cost of an hour of work, and may have a negative impact on the scale and results of the activities of Ukrainian IT enterprises in the near future.

For this reason, the study of the influence of factors shaping the value of the products of Ukrainian IT companies on the development of the Ukrainian IT industry requires special attention from scientists today. The results of such studies may have a great deal of practical significance, as they can be a reference point in adjusting the business models of IT enterprises in order to increase their efficiency.

A thorough analysis of scientific sources and statistical information from available sources made it possible to formulate the following research hypotheses.

Hypothesis 1:

Understanding of the relationships among the factors that shape the value of the products of Ukrainian IT enterprises, given the range of services provided and of industries to which these services/products are provided, positively affects

the development of the Ukrainian IT industry.

Hypothesis 2:
There is a relationship between the scale of the IT companies (based on the criterion of the number of employees) and the percentage of employees registered in Ukraine, the scale of enterprises-clients, the average cost of an hour of work and the value creation system: the target client base (industry focus) and types of services (service focus).

2. Methodology

To substantiate the proposed hypotheses and achieve the research goal, the research methodology used in this article includes the following stages:

Stage 1. Collection of data on elements of the business models of Ukrainian IT companies from available open sources.

Stage 2. Justification of data use.

Stage 3. Clustering of the IT enterprises according to individual indicators.

Stage 4. Description of centroid companies of the resulting clusters.

Stage 5. Grouping of the IT enterprises according to the similarity of their model elements.

Stage 6. Selection of the scale of enterprises that form the client base and determine the average cost per hour of work of employees as key success factors of the selected model.

In order to identify the common features of groups of IT enterprises from the point of view of the similarity of business models, which are attributed to the characteristics of product value, the authors propose to apply clustering methods.

Clustering is the division of a set of objects into non-intersecting subsets (clusters) with the aim of grouping the most similar objects into separate groups. Objects that differ significantly due to clustering belong to different clusters.

Caruso et al. (2021) describe the advantages of using the clustering method in the case of a large amount of mixed data, which is a characteristic feature of the activity of IT companies.

The task of clustering can be formulated as follows: a given set of n vectors, each of which has dimension d, must be divided into subsets (according to a given optimisation criterion). Usually, the optimisation criterion is the minimisation of distortion, that is, the total deviation from the centroids, due to the distribution of data between subsets (areas) that do not intersect and are represented by the centroid element and the "distance" of the rest of the cluster elements from the centroid. The main advantages of using this method are simplicity and guaranteed convergence during several iterations.

In this paper, the method of averages is used for clustering (Zhang, 2020; Syvogolovko, 2011). The term 'k-means' was first used by J. McQueen in 1967, although its idea was first described by H. Steinhaus in 1957, while the standard algorithm was first proposed by A. Lloyd in 1957.

K-means clustering divides the input set of n vectors into k clusters S^j ($j = 1,2,\ldots k$), each of which has a centroid associated with it $c_j = (c_{1j},c_{2j},\ldots,c_{dj})$. Let us mark as $S = \{x\}$ a set of power n of input vectors $x = (x_1,x_2,\ldots,x_d)$. Let $D(x,c)$ be the distance between the vector X and the centroid c. This article uses the unweighted Euclidean distance:

$$D^2(\mathrm{x},\mathrm{c}) = \sum_{i=1}^{d} (x_i - c_i)^2 . \qquad (1)$$

Let us denote the set of centroids obtained at iteration t as follows: $Sc^{jt} = \{c^{jt}\}$.

The traditional version of the k-means clustering algorithm is described as follows:

1. We set $t = 0$ and set the initial location of the centroids Sc^{j0}.

2. For a given set of centroids Sc^{jt} we perform the actions indicated in stages 2.1 and 2.2 and obtain an improved set of centroids Sc^{jt+1}:

2.1. We find the following partition S^j, which distributes the original set of n input vectors into k clusters $S^j\ (j = 1,2,..k)$ and satisfies the condition:

$$S^j = \left\{ \mathrm{x}:\ D(\mathrm{x},\mathrm{c}^r) \le D(\mathrm{x},\mathrm{c}^s)\ \ r \ne s \right\}$$

2.2. We calculate the centroid c^{jt} for each cluster $S^j\ (j = 1,2,..k)$, to obtain a new set of centroids Sc^{jt+1}:

$$c_s^j = \frac{1}{m_j} \sum_{i=1}^{m_j} x_{si}^j, s = 1,...d ,$$

where m_j– the number of vectors belonging to the cluster S^j.

3. We calculate the total distortion $E^2 = \sum_{x \in S} D^2(\mathrm{x},\mathrm{c})$ for Sc^t. If it differs from the one obtained in the previous iteration by a sufficiently small amount, we bring the process to a halt. Otherwise, we assign $t \to t+1$ and return to step 2.

The clustering error and number of iterations depends on the initial choice of centroids, so it is common practice to run k-means multiple times with different initial candidate centroids.

In this paper, the selection of the number of clusters was made based on the comparison of the results obtained by the elbow and silhouette methods. The main idea of the elbow method is to select a number of clusters such that the total variation between clusters (the total variation within the cluster) is minimised. There are several algorithms for this method, and the algorithm used in the paper defines the total variation within the cluster as the sum of the squared Euclidean distances between the elements and the corresponding centroid:

$$W(C_k) = \sum_{x_j \in C_k} (x_j - \mu_k)^2 .$$

To determine the optimal number of clusters by means of groups of all the described indicators, the parallel use of two methods is proposed: the elbow method and the simplified silhouette estimation method. The advantages of the elbow method are its simplicity and illustrative informativeness. The possibility of choosing the number of clusters is shown by the curve, which at these points (abscissa – the number of clusters) has a refraction in the direction of growth or slows down the rate of decline.

Since there is a high probability that the input data will not be clearly distributed between clusters and, as a result, the division obtained by using the elbow method will not correspond to a high level of the partition quality (Syvogolovko, 2011), the suggestion was made to combine the elbow method with the simplified silhouette estimation method, which allows one to clarify the results obtained by the elbow method, based on the results of the analysis of the elements set, which differ significantly from the centroids.

Therefore, in order to evaluate the effectiveness of selected business models of Ukrainian IT enterprises, the suggestion was made to divide the investigated IT companies

into clusters based on individual elements of the business model. The group of elements that create a product value system includes the range of types of services provided, the range of industries in which the recipients of services/products operate, and the scale of the enterprise, taking the percentage of employees registered in Ukraine into account. The formation of groups of similarity (homogeneity) according to the elements that create the product value system, and a comparative analysis of companies that have been allocated to homogeneous groups according to the scale of their client base and the average cost of an hour of work, allows for the evaluation of the selected business model.

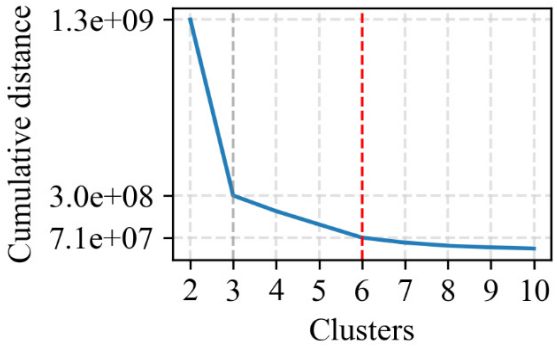
3. Research results

Due to the lack of official statistical data on the number of employees, the types of services provided, client base, profits, wages, etc., data published by online platforms were used as the main source, namely the DOU website (Trendy Jobs.dou.ua 2019–2022); Clutch, an international platform for ratings and reviews of IT, marketing and business providers (clutch.co); and LinkedIn, the world's largest social network (company profiles on linkedin.com).

3.1. Clustering of collected data

Due to the lack of complete data on all IT enterprises registered in Ukraine, the authors focused the research on 242 (based on the scale of enterprises) and 255 (other elements) companies, about whose activities it was possible to collect full information regarding the investigated indicators from personal profiles on the abovementioned platforms.

Figure 1. Determination of the number of clusters according to the scale of Ukrainian IT enterprises using the elbow method

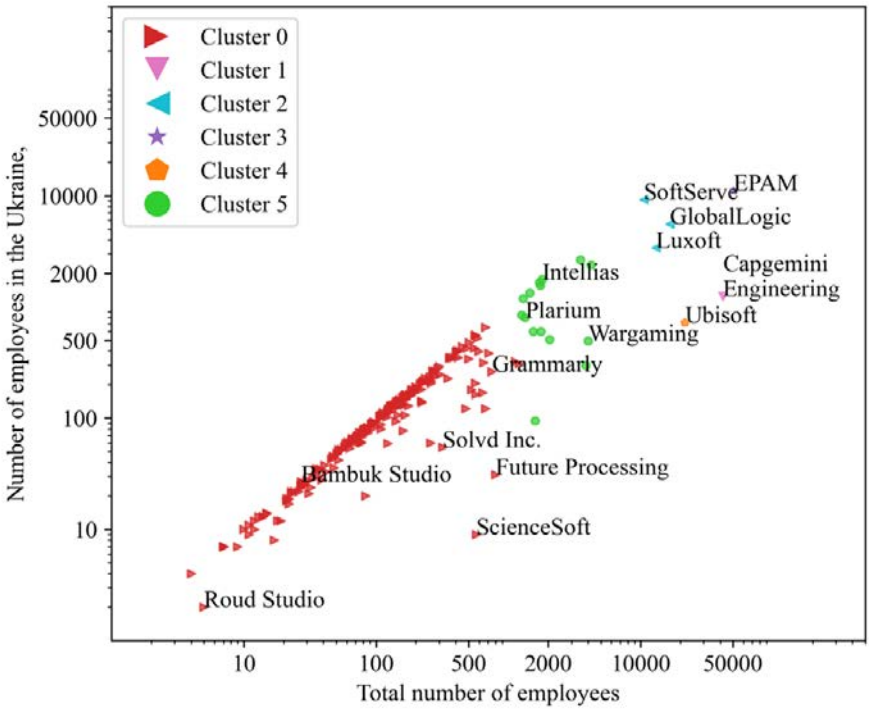


Source: own elaboration

3.2. Clustering according to the scale of enterprises

Clustering according to the scale of the IT companies that position themselves as Ukrainian brands and have offices in Ukraine made it possible to investigate the relationship between the total number of employees and the share of specialists registered in Ukraine (clustering was carried out by means of two indicators: the total number of employees and the number of employees registered in Ukraine, using data from LinkedIn). Using the elbow method, results pertaining to the optimality of the division into six clusters were obtained (Fig. 1).

Figure 2. Results of clustering of Ukrainian IT enterprises according to scale indicators



Axis: OX – total number of employees, OY – number of employees registered in Ukraine

Source: own elaboration

The results of clustering of IT enterprises are as follows:

Cluster 0 is the most numerous, consisting of small and medium-sized enterprises (4-1,211 employees). This cluster includes 223 companies, 18 of which have 100% of employees registered in Ukraine, 125 companies in which the share of Ukrainian employees is 90-99%, 46 companies with 75-90% Ukrainian staff, 15 companies with 50-74%, 17 companies with 10-50%, as well as two international companies at which the percentage of Ukrainian specialists as a share of the total is less than 10%. In all the following clusters, which include larger companies, there is not a single company that is comprised of 100% Ukrainian specialists.

Cluster 1 – the international giant Capgemini Engineering (42,000 employees), where the percentage of Ukrainian specialists as a share of the total is only 2.9%.

Cluster 2 – giant enterprises with a significant share of Ukrainian employees. The cluster includes three companies – SoftServe (10,500 employees) with 87% of specialists being Ukrainian, GlobalLogic (16,500 employees) with 33% Ukrainian specialists and Luxoft (13,000 employees) with 26%.

Cluster 3 – the international giant EPAM (50,300 employees) with more than 11,000 Ukrainian specialists, which is 22% of the company's total workforce.

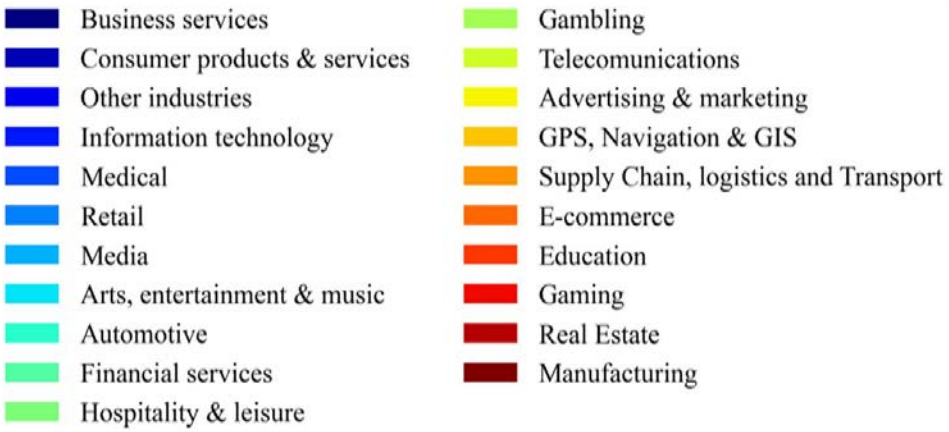
Cluster 4 – the international giant Ubisoft (21,600 employees), where the share of Ukrainian specialists at the company is only 3.3%.

Cluster 5 – large enterprises (1,200–4,200 employees). The cluster included 13 companies, of which four companies (among them Intellias and N-iX) have more than 90% Ukrainian employees, three companies (Plarium, Ciklum, DataArt) with 50–90%, three companies (among them Grid Dynamics) with 20-50%, as well as three international companies (Itransition, Valtech, and Wargaming) where the share of Ukrainian employees is only 6-15% of the total.

Despite the fact that the majority of companies under investigation are concentrated in cluster 0, the main employers and customers of services of individual entrepreneurs in the field of IT are large companies from clusters 2-4. However, four giant companies – EPAM, SoftServe, GlobalLogic and Luxoft – have more IT specialists than all 223 companies belonging to cluster 0. This gives reason to believe that it is such giant companies that shape the trends, regularities, and rules of functioning of the IT market in Ukraine. It is also important to note that enterprises that are 100% composed of employees registered in Ukraine are small companies, the largest of which is Anadea, which has only 129 employees. Enterprises based in Ukraine which enter international markets, in addition to registering and physically locating the vast majority of their employees in Ukraine, continue to register companies and hire employees in other countries where customers are registered, as this allows them to comply with the legislation of future business partners.

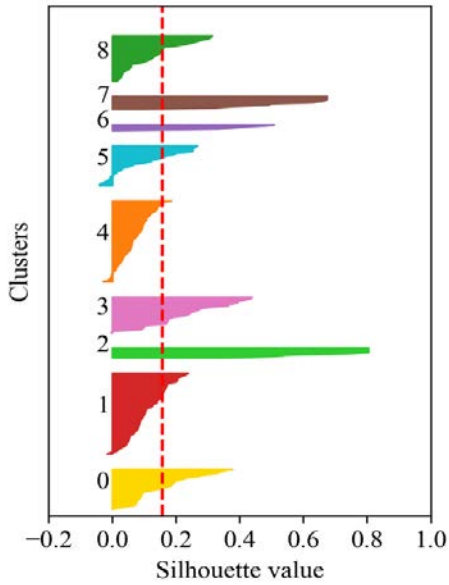
Distribution of Ukrainian IT companies by industry based on clustering (255 companies whose profiles are presented on Clutch were studied):

According to data posted on personal profiles on Clutch (clutch.co), Ukrainian IT companies provide services and products for the following main sectors of the economy (a total of 20 sectors plus a further catch-all category of "other industries"): financial services, medicine, information technology, business services, e-commerce, education, retail, gaming, etc. In Figures 5-13, the share of the respective industries is depicted in the corresponding colours:



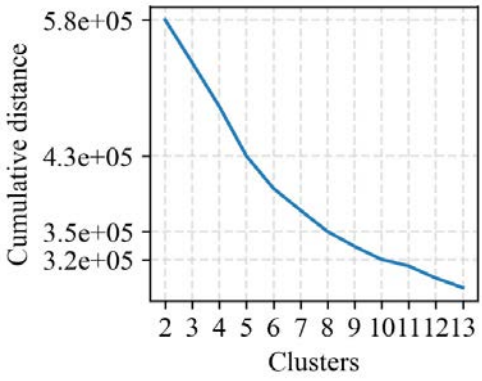
Calculation of the number of clusters by industries serviced (industry orientation, as a percentage of the entire client base) was carried out using the elbow method (Fig. 3) and the silhouette method (Fig. 4). The results obtained show that the division of IT companies into nine clusters is most effective. Below is a description of the IT companies included in each cluster.

Figure 3. Determining the number of clusters by industry orientation using the elbow method



Source: own elaboration

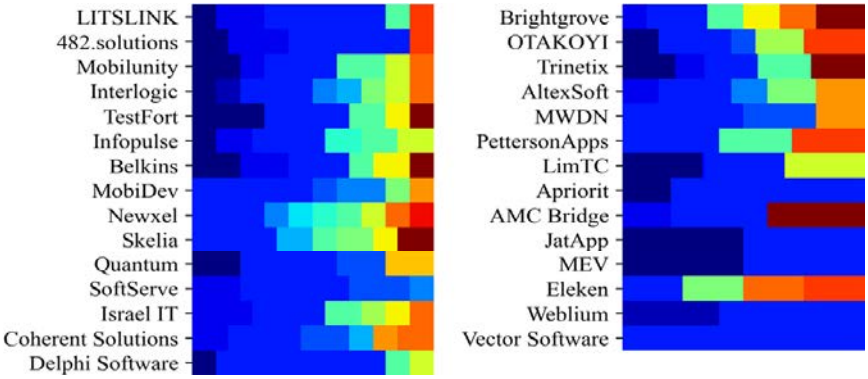
Figure 4. Determining the number of clusters by industry orientation using the silhouette method



Source: own elaboration

Cluster 0 – companies serving the information technology (centroid 41.89) and business services industry groups (centroid 11.55). The cluster includes 29 companies (Fig. 5). The companies closest to the centroid of the cluster are LITSLINK, 482.solutions and Mobilunity.

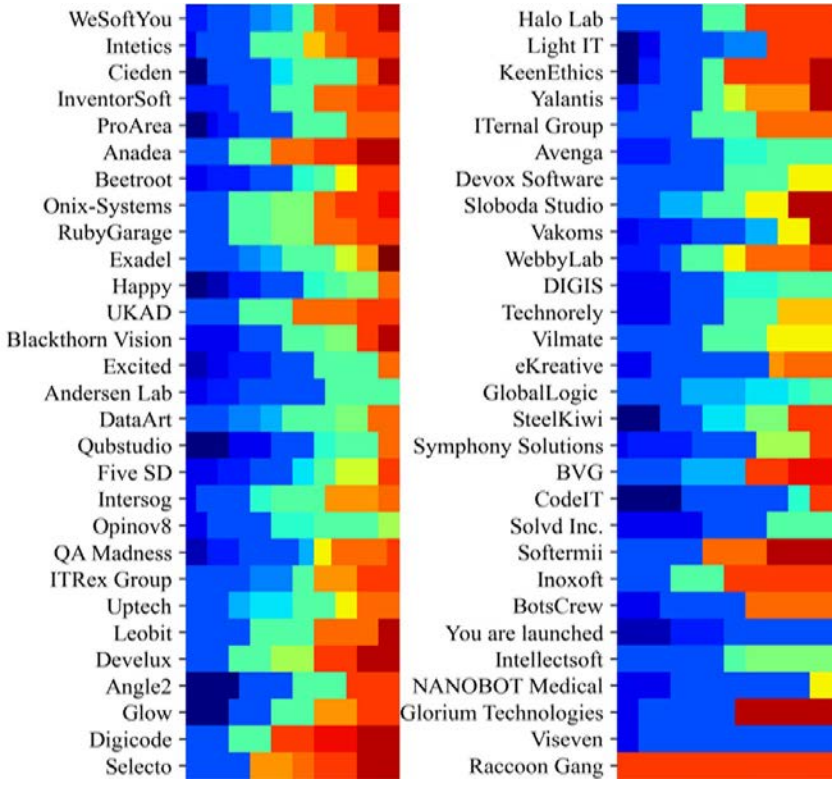
Figure 5. Enterprises belonging to cluster 0 by industry orientation



Source: own elaboration

Cluster 1 – companies that provide services mainly for the medical (centroid 29.53), education (centroid 11.13) and e-commerce (centroid 7.81) industries. The cluster includes 57 companies (Fig. 6). The companies closest to the centroid of the cluster are WeSoftYou, Intetics, Cieden and InventorSoft.

Figure 6. Enterprises belonging to cluster 1 based on industry orientation

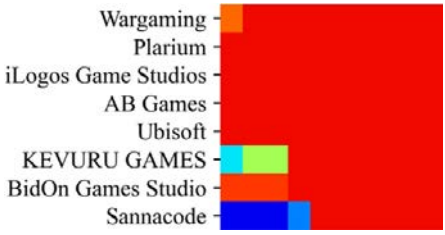


Source: own elaboration

Cluster 2 – companies that mainly provide products/services to the gaming industry (centroid 86.25). The cluster included eight companies (Fig. 8), of which Wargaming and Plarium are the closest to the centroid.

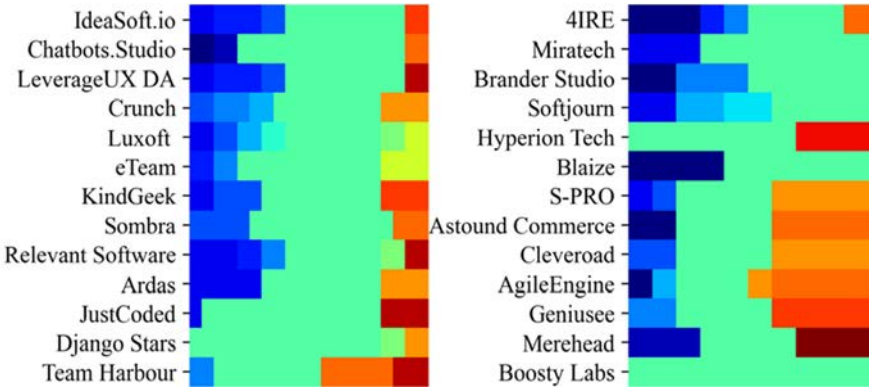
Cluster 3 – companies specialising in services for the financial services (centroid 52.88) and e-commerce (centroid 5.57) sectors. The cluster includes 26 companies (Fig. 7), of which the companies closest to the centroid are IdeaSoft.io, Chatbots.Studio, LeverageUX Design Agency and Crunch.

Figure 7. Enterprises belonging to cluster 2 based on industry orientation



Source: own elaboration

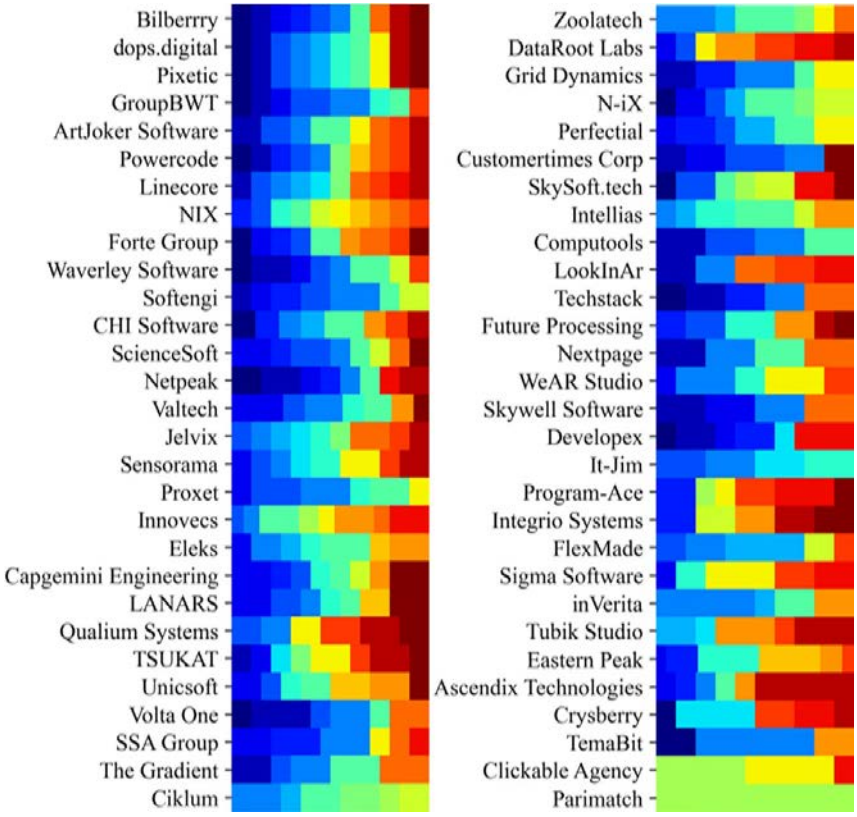
Figure 8. Enterprises belonging to cluster 3 based on industry orientation



Source: own elaboration

Cluster 4 – companies specialising in providing services to a wide range of industries, mainly retail (centroid 12.89), financial services (centroid 9.12), medical (centroid 7.7), consumer products & services (centroid 6.12), the aforementioned catch-all "others" category (centroid 5.96) and advertising & marketing (centroid 5.22). This cluster includes 58 companies (Fig. 9). The companies closest to the centroid are Bilberrry, dops. digital high-end visual, Pixetic, GroupBWT and ArtJoker Software.

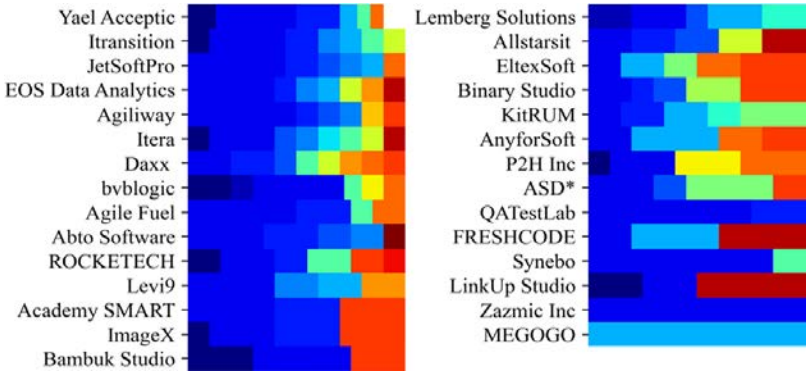
Figure 9. Enterprises belonging to cluster 4 based on industry orientation



Source: own elaboration

Cluster 5 – companies specialising in providing services for other industries (centroid 36), media (centroid 10.44) and education (centroid 7.41) (Fig. 10). The cluster includes 29 companies, of which the companies closest to the centroid are Yael Acceptic, Itransition, JetSoftPro and EOS Data Analytics.

Figure 10. Enterprises belonging to cluster 5 based on industry orientation

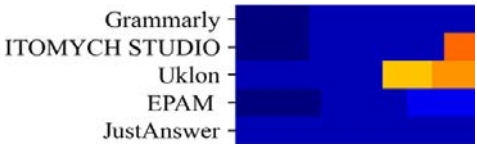


Source: own elaboration

Cluster 6 – companies specialising in consumer products & services (centroid 64) and business services (centroid 19). The cluster includes five companies (Fig. 11), of which the closest to the centroid is Grammarly.

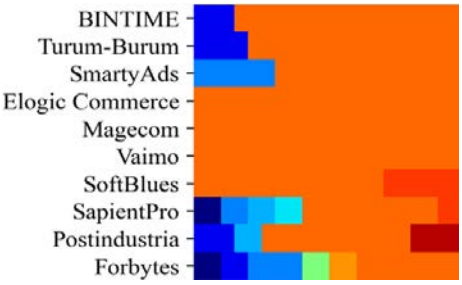
Cluster 7 – companies specialising in e-commerce (centroid 75) and other industries (centroid 6). The cluster includes 10 companies (Fig. 12). The companies closest to the centroid are BINTIME and Turum-Burum.

Figure 11. Enterprises belonging to cluster 6 based on industry orientation



Source: own elaboration

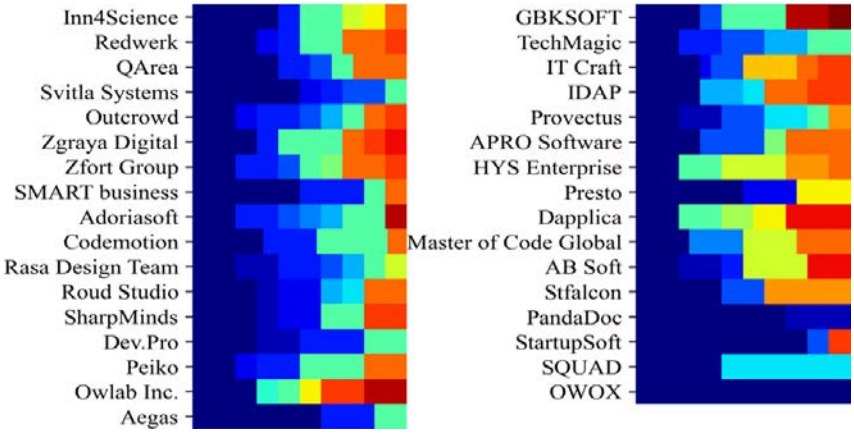
Figure 12. Enterprises belonging to cluster 7 based on industry orientation



Source: own elaboration

Cluster 8 – companies specialising in providing services for the business services (centroid 35.69), financial services (centroid 11.45), information technology (centroid 8.93) and e-commerce (centroid 7.54) sectors. 33 companies belong to the cluster (Fig. 13). The companies closest to the centroid are Inn4Science, Redwerk and Qarea.

Figure 13. Enterprises belonging to cluster 8 based on industry orientation



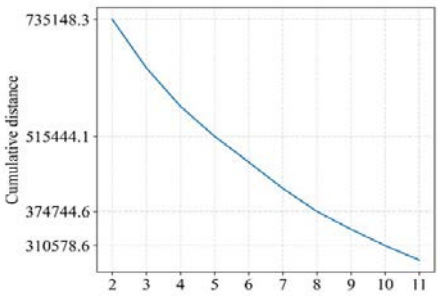
Source: own elaboration

The range of services provided by the company (service focus) (255 companies whose profiles are presented on Clutch were studied).

The clustering of the IT companies in terms of service focus (as a percentage of the total number of services provided by the company) is based on data collected on the Clutch platform. Companies submit this data about themselves by registering on the platform. 'Service focus' reflects the services in which the company specialises (a total of 29 types of services and a similar catch-all category combining the remaining ones under the name "other types of services").

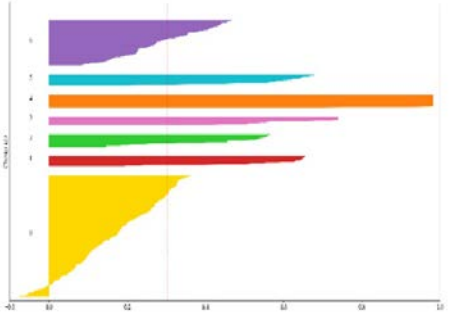
According to the elbow (Fig. 14) and silhouette (Fig. 15) methods, the division into seven clusters is optimal for service focus data.

Figure 14. Determination of the optimal number of clusters for the range of services provided by the company based on the elbow method



Source: own elaboration

Figure 15. Determination of the optimal number of clusters for the range of services provided by the company based on the silhouette method

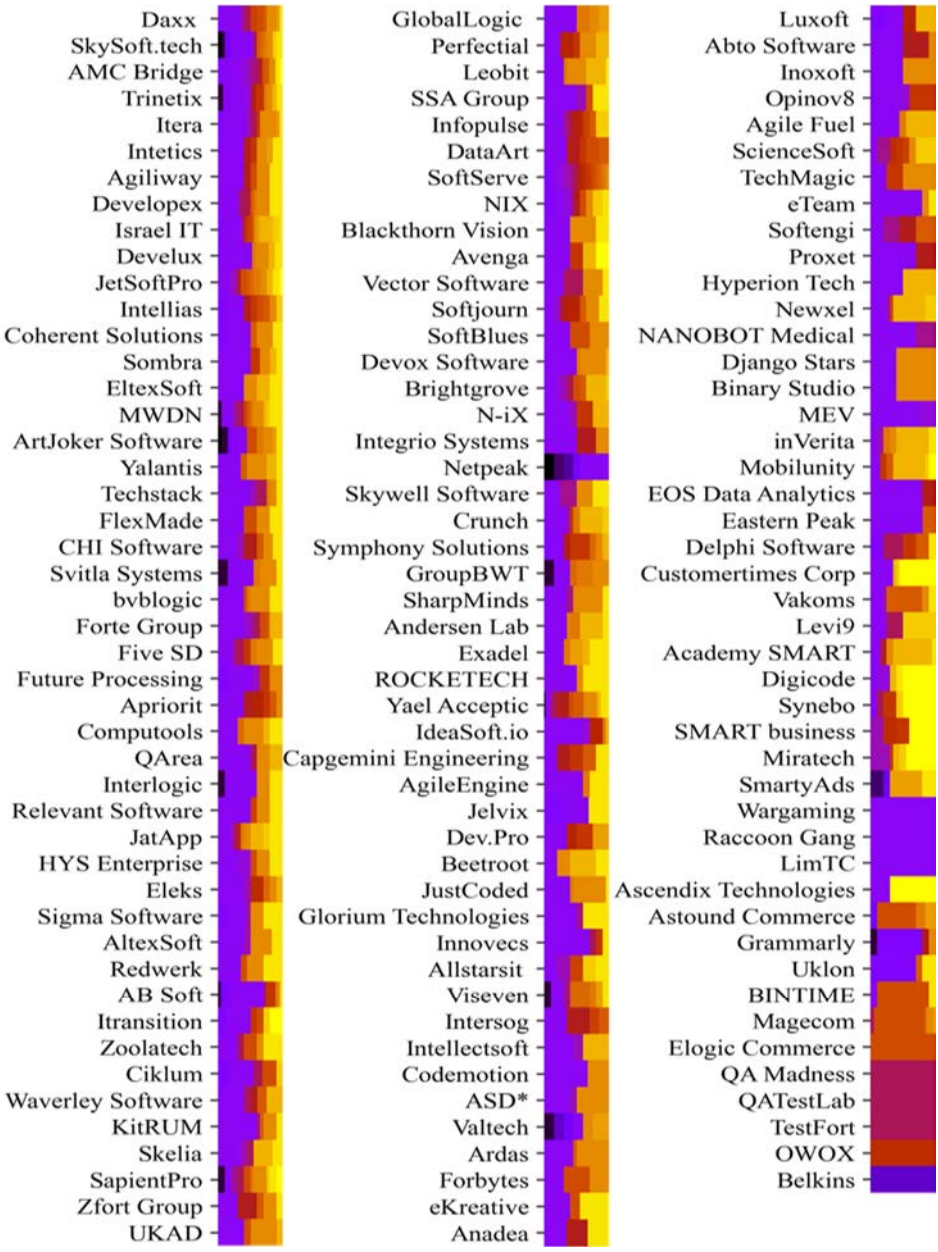


Source: own elaboration

In Figures 16-22, the share of the services is depicted in the corresponding colours:

Cluster 0 – companies in which the following types of services are dominant: custom software development (centroid 34.01), web development (centroid 12.32) and mobile app development (centroid 8.12). This cluster includes 139 companies (Fig. 16), among which the closest to the centroid are Daxx, SkySoft.tech and AMC Bridge.

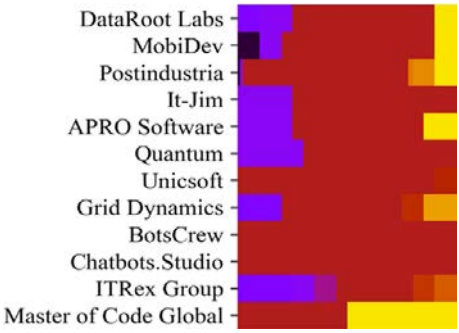
Figure 16. Enterprises belonging to cluster 0 based on the range of services provided



Source: own elaboration

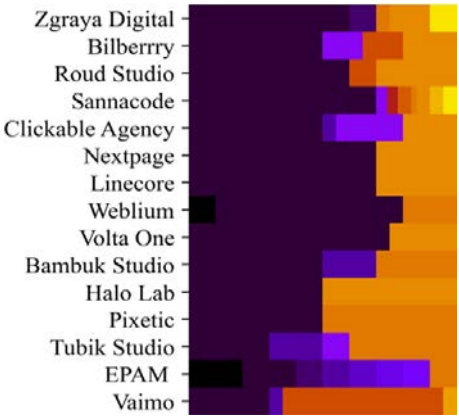
Cluster 1 – companies focused on providing services in artificial intelligence (centroid 70.41), mobile app development (centroid 7.91) and business intelligence & Big Data consulting (centroid 4.58). The group includes 12 companies (Fig. 17). Among them, the companies closest to the centroid are DataRoot Labs, MobiDev and Postindustria.

Figure 17. Enterprises belonging to cluster 1 based on the range of services provided



Source: own elaboration

Figure 18. Enterprises belonging to cluster 2 based on the range of services provided

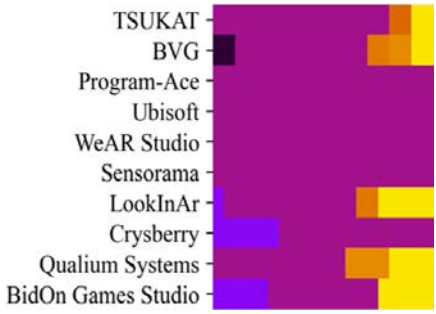


Source: own elaboration

Cluster 2 – companies specialising in web design (centroid 53.66), UX/UI design (centroid 10.46) and e-commerce development (centroid 5.66). The group includes 15 companies (Fig. 18). The companies closest to the centroid are Zgraya Digital, Bilberrry and Roud Studio.

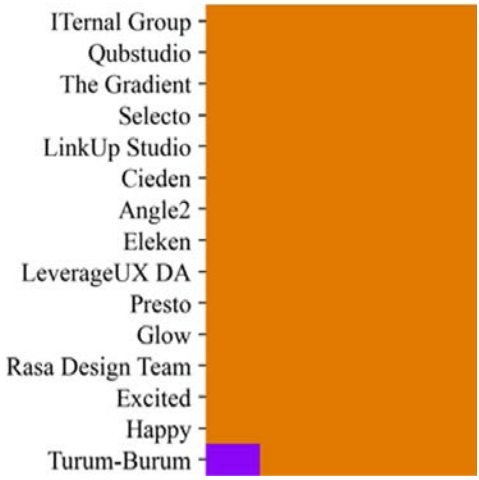
Cluster 3 – companies specialising in AR/VR development (centroid 78) and mobile app development (centroid 9). The cluster includes 10 companies (Fig. 19). The companies closest to the centroid are TSUKAT and BVG Software Group.

Figure 19. Enterprises belonging to cluster 3 based on the range of services provided



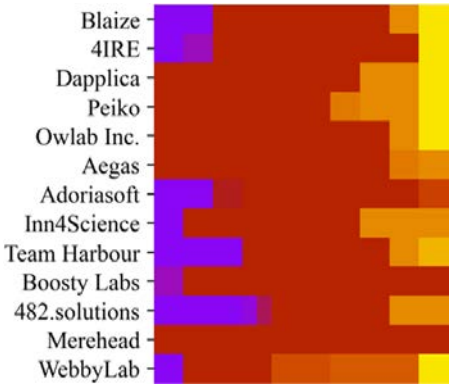
Source: own elaboration

Figure 20. Enterprises belonging to cluster 4 based on the range of services provided



Source: own elaboration

Figure 21. Enterprises belonging to cluster 5 based on the range of services provided



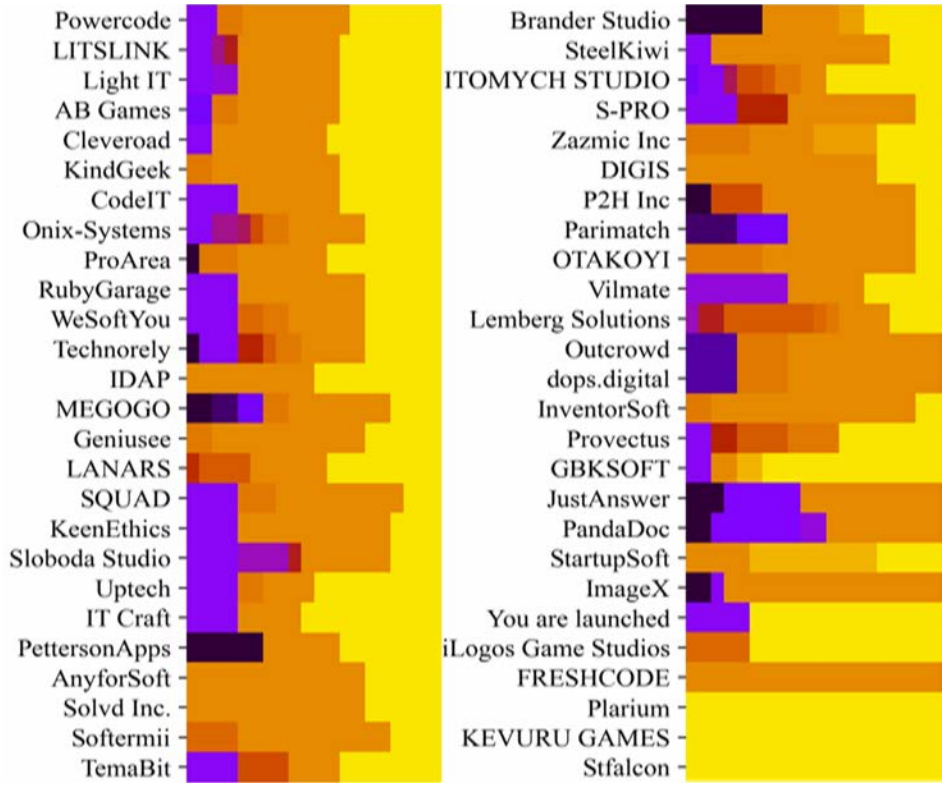
Source: own elaboration

Cluster 4 – companies specialising exclusively or almost exclusively (Turum-Burum company) in UX/UI design (centroid 98.66). 15 companies belong to the cluster (Fig. 20).

Cluster 5 – companies specialising in blockchain technologies (centroid 65.38) and mobile app development (centroid 4.61). The cluster includes 13 companies (Fig. 21), of which the closest to the centroid are Blaize and 4IRE.

Cluster 6 – companies specialising in web development (centroid 40.13), mobile app development (centroid 33.48) and custom software development (centroid 6.48). 52 companies belong to the cluster (Fig. 22), of which the companies closest to the centroid are Powercode, Powercode, Light IT, AB Games and Cleveroad.

Figure 22. Enterprises belonging to cluster 6 based on the range of services provided



Source: own elaboration

3.3. Grouping of companies with homogeneous business models according to the elements that form IT product value: industry orientation and the range of services provided

As mentioned earlier, for the assessment of the effectiveness of the business model chosen by the company based on the factors of value formation (industry orientation and range of services provided), the following indicators were chosen: the declared cost of an hour of work for the implementation of projects, as well as the scale of the client base (small, medium-sized or large business). Statistical information on these indicators was obtained from the profiles of companies presented on the Clutch platform.

Companies are considered homogeneous if they simultaneously belong to the same cluster, in terms of both industry orientation and the range of services provided. As a result of such a grouping, 27 groups were obtained, which include 239 companies; 17 companies under investigation do not belong to any group. In each group, the calculation of the average cost of an hour of work revealed the following (Table 1):

- the highest declared average cost of an hour of work of $81.25 is in group 2-3. Companies in this group provide services for the Gaming industry. These companies specialise in providing AR/VR development and mobile app development services;
- an average cost of $78.13 per hour of work was declared by members of group 4-1, comprised of companies that provide services to a wide range of industries, mainly retail, financial services, medical, consumer products & services, other industries and advertising & marketing, specialising in artificial intelligence, mobile app development and business intelligence & Big Data consulting;
- Companies from groups 1-1, 6-0, 6-6 and 8-2 have an average hourly rate of $75.00. They provide both a fairly narrow and a wide range of services and their client base consists of companies from various branches, namely medical, education and e-commerce, consumer products & services, business services, financial services, and to a lesser extent information technology. These companies specialise in the following services: artificial intelligence, mobile app development and business intelligence & Big Data consulting, web development, custom software development, web design, UX/UI design and e-commerce development.

Table 1. The average cost of an hour of work in homogeneous groups

	The cluster to which IT companies belong based on the range of services provided, cluster №						
The cluster to which IT companies belong based on industry orientation, cluster №	0	1	2	3	4	5	6
0	55.5	56.25					50
1	54.02	75			60.93		44.12
2				81.25			56.25
3	55.68					45	45
4	55.47	78.13	62.5	48.21			46.88
5	43.75						64.58
6	75						75
7	56.25						
8	46.86	56.25	75		37.5	50	51.56

Source: own development

The most numerous are groups 4-0 (34 companies) with an average cost of $55.50; 1-0 (28 companies) with a cost of $54.00; 0-0 (21 companies) with an average cost of $55.50 and 5-0 (20 companies) with a cost of $43.75. The lowest cost per hour of work ($37.50) is

in group 8-4 specialising in business services (centroid 35.69), financial services (centroid 11.45), information technology (centroid 8.93) and e-commerce (centroid 7.54) and exclusively in UX/UI design (centroid 98.66).

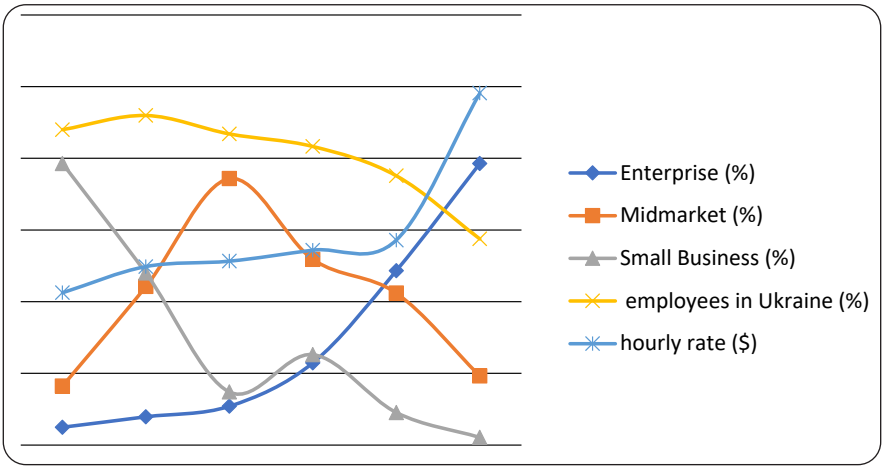
Therefore, the cost of an hour of work does not significantly depend on the industry, but to a greater extent on the uniqueness of the services provided. The services provided by the sixth cluster of companies – specialising in consumer products & services (centroid 64) and business services – turned out to be consistently quite highly paid. Also, an hour of work at companies from the first cluster is remunerated at an above-average rate. These companies focus on providing services in artificial intelligence (centroid 70.41), mobile app development (centroid 7.91), and business intelligence & Big Data consulting (centroid 4.58). Enterprises that exclusively provide application testing services for business services or with a significant share of service types such as e-commerce development, CRM, ERP consulting and SI, and cloud consulting also declared a high cost of one hour of work.

3.4. Manifestation of product value according to the size of companies-customers of IT services

An important factor in the success of the business model is the inclusion of companies with significant financial turnover in the client base. Based on the information provided on the Clutch platform in the Client Focus section, data on the financial turnover of IT enterprises' client companies was obtained. According to the Clutch methodology, all clients that use the services of IT enterprises are divided by annual turnover into the Enterprise (>$1B), Midmarket ($10M – $1B) and Small Business (<$10M) categories.

The existence of certain interrelationships between the scale of the IT company (belonging to cluster 0-5 based on the number of employees and the percentage of staff registered in Ukraine), the average cost of an hour of work and the respective percentages of companies from the Enterprise, Midmarket or Small Business categories in the client base is illustrated in Fig. 23.

Figure 23. The relationship between the average cost of an hour of work, the percentage of the client base in each category (Enterprise, Midmarket, Small Business), the average percentage of employees registered in Ukraine, and the scale of the enterprise



Source: own elaboration

However, the use of clustering methods provides a more accurate scientific justification of the relationships described above.

Data on the share of projects for customers of different scales was clustered, based on which the results indicated the most effective division into six clusters.

The numbering of clusters from 0 to 5 is carried out according to the following principle: cluster 0 denotes enterprises with almost no large businesses in the client base, and then a higher cluster number corresponds to the growth of the corresponding percentage. Table 2 shows the values of the centroids of the corresponding indicators for the IT enterprises belonging to six resulting clusters – the percentage in the customer base of Enterprise, Midmarket, and Small Business companies, respectively, as well as the average indicators of declared hourly labour costs and the percentage of employees registered in Ukraine.

Table 2. Values of the centroids of indicators of the percentage composition of the scale of client enterprises, averaged indicators of the declared cost of an hour of work and the share of employees registered in Ukraine

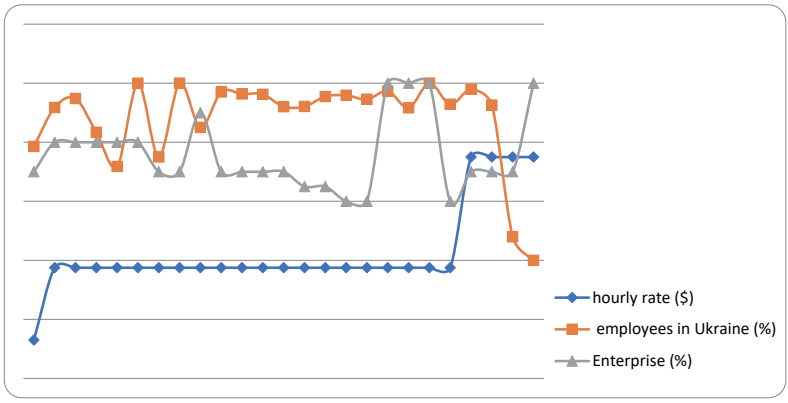
	Enterprise, %	Midmarket, %	Small Business, %	Hourly rate, $	Employees in Ukraine, %
cluster 0	4.964286	16.46429	78.57143	42.52	88.01344
cluster 1	7.884058	44.24638	48	49.80952	91.97136
cluster 2	10.82609	74.34783	14.82609	51.31579	86.81032
cluster 3	22.95	51.81667	25.23333	54.38596	83.32944
cluster 4	48.64865	42.40541	9.081081	57.19697	75.15178
cluster 5	78.57143	19.28571	2.142857	98.21429	57.5214

Source: calculated by authors

Thus, the formation of a client base by SMEs is typical for enterprises of cluster 0 (Fig. 24). The values of the centroid coordinates are: Small Business – 78.57, Midmarket – 16.46, and Enterprise – 4.69. The average hourly cost of labour in this cluster ($42.14) is the lowest among all clusters. The average share of Ukrainian employees in the cluster is 88%. This indicator is higher (91.97) only in companies that form cluster 1 (Fig. 25). The average cost of an hour of work in this cluster is higher ($49.81) compared to cluster 0, due to larger shares in the client base of companies of the Midmarket (centroid 44.25) and Enterprise (centroid 7.88) segments.

With the growth in the share of enterprises of the Enterprise segment (centroids 10.83; 22.95; 48.65, respectively) and the decline in the share of Ukrainian employees (centroids 86.81; 83.33; 75.15), the average rate declared per hour of work continues to increase (centroids 51.32; 54.39; 57.20) (Fig. 26-28).

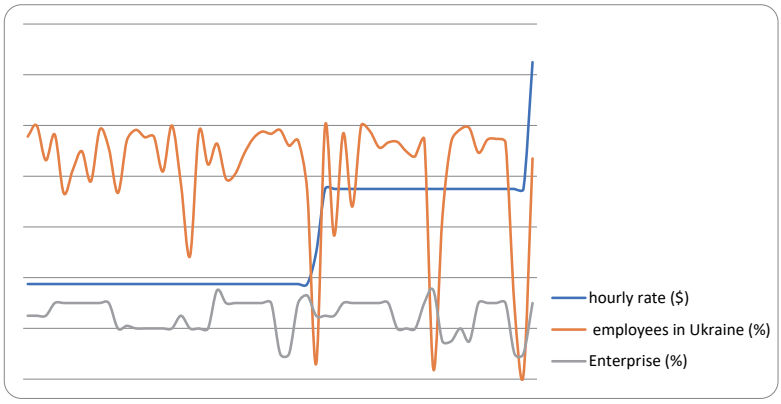
Figure 24. Indicators of companies of cluster 0 based on the annual turnover of client companies



(% of large and medium-sized businesses)

Source: own elaboration

Figure 25. Indicators of companies of cluster 1 based on the amount of annual turnover of client companies

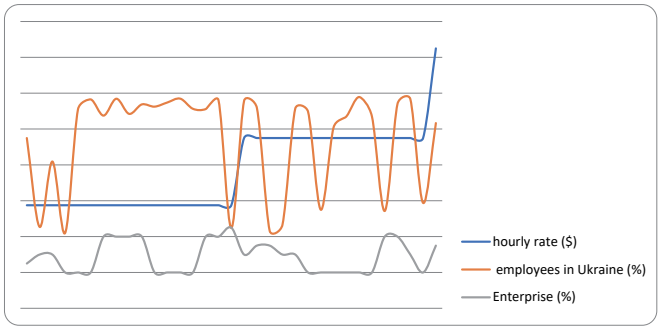


(% of large and medium-sized businesses)

Source: own elaboration

The highest (98.21) average cost of an hour of labour is recorded in the fifth cluster (seven companies) (fig. 29). These are businesses that focus on the Enterprise segment (centroid 78.57), while the Small Business share (centroid 2.14) is the lowest.

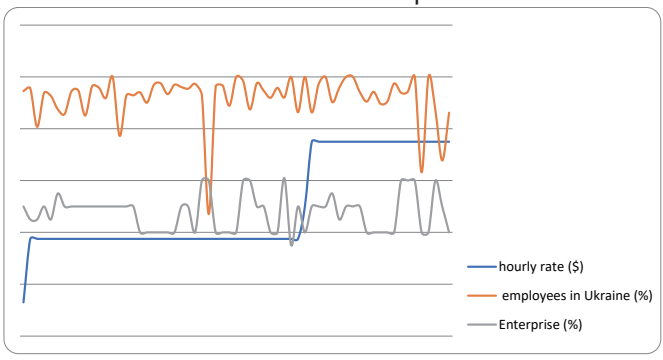
Figure 26. Indicators of companies of cluster 0 based on the amount of annual turnover of client companies



(% of large and medium-sized businesses)

Source: own elaboration

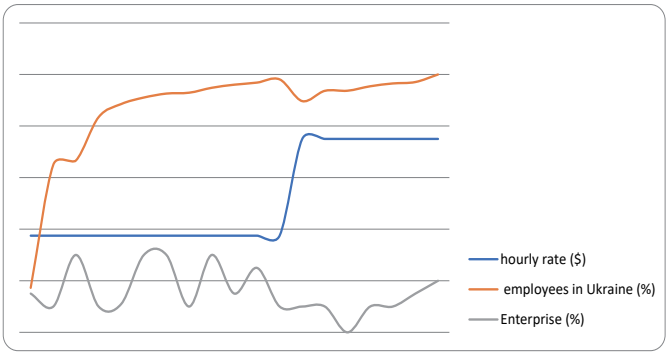
Figure 27. Indicators of companies of cluster 1 based on the amount of annual turnover of client companies



(% of large and medium-sized businesses)

Source: own elaboration

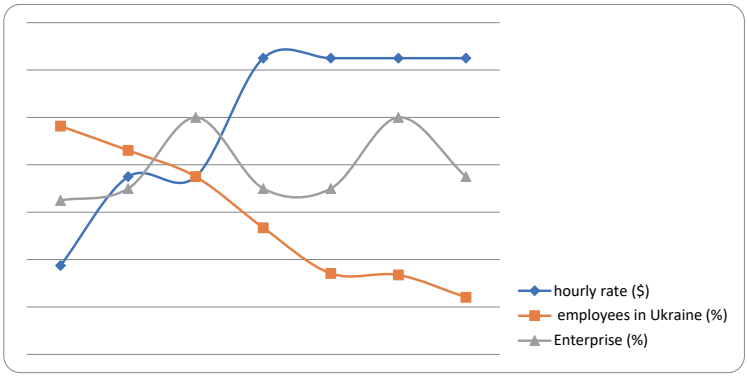
Figure 28. Indicators of companies of cluster 1 based on the annual turnover of client companies



(% of large and medium-sized businesses)

Source: own elaboration

Figure 29. Indicators of companies of cluster 5 based on the annual turnover of client companies



(% of large and medium-sized businesses)

Source: own elaboration

The most important factor in the hourly cost of labour was the percentage of Enterprise scale companies (correlation coefficient 0.921). An even closer relationship was found between the percentage in the client base of companies of this segment and the share of employees registered in Ukraine (correlation coefficient -0.982).

The correlation between the share of medium-sized and small businesses in the client base is insignificant (correlation coefficients -0.367) or medium (correlation coefficients -0.657), respectively. An exception is the small company BINTIME (79 specialists) with 65% of enterprise-scale client companies, 80% of e-commerce services, and 85% of the sector of the economy of the same name. The low average cost of its services ($26-49 per hour) correlates with a high (96%) percentage of Ukrainian employees.

4. Discussion

According to the results of the research (clusters of enterprises designated according to the share of the client base of the corresponding segments and comparison with the cost of an hour of work based on data published by the companies on the Clutch platform), the authors came to the conclusion that enterprises focusing on customers from the Enterprise segment have the highest average cost of an hour of work. These are the majority of companies included in the fifth cluster, namely ImageX, Customertimes Corp, Grid Dynamics, and GlobalLogic, in which the share of Ukrainian employees is 34.2% on average.

This cost is somewhat lower for companies from cluster 2, which focus equally on the Enterprise and Midmarket segments of clients. The share of Ukrainian employees in these companies is 75% on average, which is significantly higher than in the fifth cluster.

This indicator is the lowest for enterprises that focus on customers in the Small Business segment. These companies belong to cluster 0, and their share of Ukrainian workers is 92% on average. This cluster of companies is the largest. Unfortunately, there is a visible trend at play whereby, in order to enter the Enterprise segment, companies with a high proportion of Ukrainian employees need to reduce the prices of their products/services. However, significantly lower prices for the production of a digital product by Ukrainian specialists, due to the lower cost of living and the liberal

taxation system of the individual entrepreneur, make the IT industry the highest paid and one that has resources available for development and growth.

Companies which predominantly deal in services such as custom software development, web development, artificial intelligence, mobile App development or which focus entirely on UX/UI design manage to maintain the average cost of an hour of work. As for the client base, companies at which an hour of work costs approximately the average rate tend to be those which focus on providing services to industries such as financial services, medical, e-commerce, information technology, business services and retail. No dependence between the dispersion of industry branches and the cost per hour of services was found.

Unfortunately, in contrast to the level of digital literacy of the population and the level of digitalisation of state structures, the Ukrainian economy as a whole is developing at an extremely slow pace. With the beginning of Russia's unprovoked full-scale aggression against Ukraine, the situation became even more complicated. Therefore, when promoting their products and services, IT companies must focus more on clients from countries with developed economies and, first of all, on large companies. For this purpose, it is necessary to attract specialists from those countries, involving them in the top management of companies. For companies with a low percentage of Ukrainian employees, it is advisable to focus on increasing this figure, as such a strategy will allow them to provide a high-quality product/service at a lower cost.

SoftServe is a unique company on the Ukrainian IT market, as it is the only company with more than 10,500 employees, 87% of whom are specialists registered in Ukraine. In the remaining three companies of this scale, the percentage of Ukrainian employees does not exceed 34%. However, the top management of the company manages to maintain a high level both in terms of the declared cost of an hour of work ($100-149) and the minimum cost of a project ($50,000). The company's reputation as a reliable partner has been formed over three decades, which of course constitutes a significant success factor. This company provides 12 types of services to four industries, including a group of specific industries under the catch-all category "other industries" (20%). The distribution of the remainder of the industries is as follows: information technology – 45%, medical – 25%, and retail – 10%. The secret of this company's success, in our opinion, is the thorough and total implementation of the slogan "Start your journey with us". The company has followed a unique strategy of attracting the best specialists to the team through close cooperation with universities in the region. Also, as one of the founders of the Lviv IT cluster, SoftServe provides staff with the opportunity to continuously learn and improve their qualifications. However, the satisfaction index in the context of salary and career growth opportunities in the company is somewhat lower than in smaller companies with a similar percentage of Ukrainian employees. We believe that for the further rapid development of the company, more customers from the Enterprise sector should be attracted to the client base (today this share is only 25%).

EPAM also occupies a special place on the Ukrainian IT market. The company has the largest number (11,115) of IT specialists registered in Ukraine (of whom there are 50,304 in total). The top management of these two companies – the largest employers of Ukrainian specialists in the industry – chose the right strategy, occupying non-competing niches providing value both in the range of services and in the range of client industries. However, a higher percentage of the client base in the Enterprise sector does not provide EPAM with a high declared cost per hour of work ($25-49), as well

as a minimum project cost ($10,000). At the same time, smaller projects provide a higher index of satisfaction with career growth. In our opinion, this company should more actively attract specialists with competencies that will allow for the expansion of the range of services provided, creating competition for SoftServe and other companies.

Recommendations for the improvement of business model efficiency for the rest of the IT companies, as assigned to homogeneous groups, are presented in Table 3.

Table 3. Recommendations regarding measures aimed at improving the efficiency of the business model of IT companies categorised in groups of homogeneity

a-b***	Main services provided (the value of the centroid as a percentage of the entire spectrum)	Industries (the value of the centroid as a percentage of the entire spectrum)	Recommendations
0-0 55.5	IT (41.89), BS (11.55)	CSD (34.01), WD (12.32), MaD (8.12)	Establishing cooperation with the Re, MI, and CPS industries
0-1 56.3		AI (70.41), MaD (7.91), BIBD (4.58)	Establishing cooperation with the Re, MI, and CPS industries and increasing the share of BIBD
0-6 50.0		WD (40.13), MaD (33.48),CSD (6,48)	Involvement in the client base of the Ma industry, as well as specific industries
1-0 54.0	MI (29.53), Ed (11.13), E-c (7.81).	CSD (34.01), WD (12.32), MaD (8.12)	Establishing cooperation with the CPS and BS industries
1-1 75.0		AI (70.41), MaD (7.91), BI&BD (4.58)	Establishing cooperation with the Enterprise segment
1-4 60.9		UX/UI (98.66)	Establishing cooperation with the Enterprise segment
1-6 44.1		WD(40.13), MaD (33.48), CSD (6.48)	Expansion of the client base to include the FS, CPS, and BS industries
2-3 81.3	Gaming (86.25)	AR/VR (78), MaD (9)	The optimal combination
2-6 56.2		WD(40.13), MaD (33.48), CSD (6.48)	Adding AR/VR specialists to the team or training one's own specialists
3-0 55.7	FS (52.88), E-c (5.57)	CSD (34.01), WD (12.32), MaD (8.12)	CSD services are the best remunerated in terms of client industries, and so should constitute an increased focus
3-5 45.0		BC (65.38), MaD (4.61)	Establishing cooperation with the Enterprise segment
3-6 45.0		WD (40,13), MaD (33.48), CSD (6,48)	Increasing the share of CSD services

a-b***	Main services provided (the value of the centroid as a percentage of the entire spectrum)	Industries (the value of the centroid as a percentage of the entire spectrum)	Recommendations
4-0 55.5	Re (12.89), FS (9.12), MI (7.7), CPS (6.12)	CSD (34.01), WD (12.32), MaD (8.12)	These select industries pay more for AI services. It is necessary to attract these specialists to the team or to increase the share of CPS clients
4-1 78.1		AI (70.41), MaD (7.91), BIBD (4.58)	Entering the gaming market, as well as increasing the share of AI and BIBD in services
4-2 62.5		WDS (53.66), UX/UI (10.46), E-cD (5.66)	BS, IT industries pay more for similar services. Therefore, attract customers from these industries
4-3 48.2		AR/VR (78), MaD (9)	It is necessary to work at least partially with the gaming industry
4-6 46.9		WD (40.13), MaD (33.48), CSD (6,48)	Attracting the BS industry as well as specific OI industries to the client base
5-0 43.8	OI (36), Ma (10.44), Ed (7.41).	CSD (34.01), WD (12.32, MaD (8.12)	Expand the client base in the FS, BS and CPS industries and attract WD specialists to the team
5-6 64.6		WD (40.13), MaD (33.48), CSD (6.48)	Expand the client base in the FS, BS industries
6-0 75.0	CPS (64), BS (19)	CSD (34.01), WD (12.32), MaD (8.12)	Expand the client base to include FS branches
6-6 75.0		WD (40.13), MaD (33.48), CSD (6.48)	Expand the client base to include FS branches
7-0 56.3	E-c (75) OI (6)	CSD (34.01), WD (12.32), MaD (8.12)	Expand the client base in the fields of FS, CPS, and BS
8-0 46.9	BS (35.69), FS (11.45), IT (8.93), E-c (7.54)	CSD (34.01), WD (12.32), MaD (8.12)	WD services are better remunerated by customers of the same industries. Increasing the share of WD services
8-1 56.3		AI (70.41), MaD (7.91), BIBD (4.58)	Establishing cooperation with the Re, MI, and CPS industries
8-2 75.0		WDS (53.66), UX/UI (10.46), E-cD (5.66)	Establishing cooperation with the Enterprise segment
8-4 37.5		UX/UI (98.66)	Establishing cooperation with the Re and MI industries
8-5 50.0		BC (65.38), MaD (4.61)	The range of services provided is suboptimal, it is necessary to change the emphasis
8-6 51.5		WD (40.13), MaD (33.48), CSD (6.48)	Establishing cooperation with the CPS industry

*a-b – a – cluster number according to industries that form the client base, b – cluster number according to the range of services provided;
** – the average declared cost of an hour of work by the homogeneity groups

Source: calculated by authors

The abbreviations used in Table 3 for industry sectors are as follows: information technology (IT), business services (BS), medical (Ml), education (Ed), e-commerce (E-c), gaming (Ga), financial services (FS), retail (Re), consumer products & services (CPS), other industries (OI), and the media (Ma).

The abbreviations used for the types of services provided: custom software development (CSD), web development (WD), mobile app development (MaD), Artificial Intelligence (AI), business intelligence & Big Data consulting (BIBD), web design (WDS), UX/UI design (UX/UI), e-commerce development (E-cD), AR/VR development (AR/VR), and blockchain technologies (BC).

According to the research, the best remunerated services are artificial intelligence, business intelligence & Big Data consulting, e-commerce development, CRM, ERP consulting and SI, and cloud consulting. These services can only be provided by highly qualified specialists. Therefore, the top management of companies should cooperate closely with universities to create educational programmes, providing technical means of education, as well as promoting the improvement of teaching staff qualifications and setting applied tasks; that is, establishing the process of attracting the best students even in the process of their so-called formal education.

Conclusions

The applied clustering method made it possible to group a large share of Ukrainian IT enterprises according to the similarity of elements of their business models from the point of view of the value creation system. The main indicators that characterise the value of an IT product on the global market are the ability to provide high-quality services (spectrum of provided services); the ability to provide services to certain industries, as well as the ability to form a national or transnational team of specialists that ensure the first two indicators.

The proposed measure of the effectiveness of the applied business models was the average declared cost of an hour of work for the implementation of the project, as well as the spectrum of the scale of the client base (small, medium-sized or large businesses).

The results of the study allowed us to confirm the hypothesis. The study showed that the main factor in the formation of IT product value is the number and quality of employees. Given the present state of the national economy and the predominant transnational nature of a large share of Ukrainian IT companies, the share of employees registered in Ukraine is no less important. The selection of the average hourly cost of work for the assessment of the effectiveness of business models received scientific confirmation.

In the study, the authors found an inexpediency of wide dispersion of the range of services provided. An optimal solution would be to focus on a small number of services, especially custom software development, web development, artificial intelligence, mobile app development, or to devote oneself entirely to UX/UI Design. The breadth of the range of the sectors in which consumers of the services provided operate is insignificant in view of the cost of an hour of work at a given company, but to a certain extent preference should be given to industries such as financial services, medicine, e-commerce, information technology, business services and retail.

Further research can be connected with internal elements of business models, aimed at ensuring the growth of the product value of Ukrainian IT enterprises for external customers, as well as with external factors with the aim of building a vague business model (Zaiats et al., 2019) based on the effects of legislation and the educational environment on the Ukrainian IT industry.

The results of the publication will be useful for the top management of IT companies in order to identify the optimal directions of possible development in relation to more expensive services on the global market. Also, the results of the study can be useful for teaching staff and top management of universities who train budding IT specialists in order to adjust curricula and programmes as well as intensifying cooperation with IT companies and IT clusters.

The results of the study have certain limitations; in particular, only factors influencing the value of an IT product in the context of the client base and the range of services provided were analysed.

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Nestor Shpak, Doctor of Economic Sciences, Professor. Professor of the Department of Management and International Business, Institute of Economics and Management, Lviv Polytechnic National University. Moreover, he is the author of more than 350 scientific publications. Scientific interests: tourism economics, simulation of the business process, strategic management, estimation of the marketing activity, IT- technology, economic systems development management, the Strategys management of Innovative Projects. https://orcid.org/0000-0003-0620-2458

Anastasiya Karpyak, PhD, Investment consultant, director of the "Ne sami" Charitable Foundation. She is the author (co-author) of 25 scientific publications, including 2 monographs. Scientific interests: strategic management, enterprise management, data analysis. https://orcid.org/0000-0001-9920-9944

Olga Rybytska, PhD, Associate Professor in Mathematics, researcher. She is Associate Professor-Researcher at the Department of Higher Mathematics, Institute of Mathematics and Basic Sciences, Lviv Polytechnic National University. Moreover, she is the author (co-author) of more than 120 scientific publications, including 16 textbooks and 8 monographs.

Scientific interests: probability theory and mathematical statistics, mathematical modeling under conditions of uncertainty, fuzzy logic, data analysis, sustainable development. https://orcid.org/0000-0002-2394-355X

Maryana Gvozd, PhD, Associate Professor. She is Associate Professor of the Department of Management of Organizations of Institute of Economics and Management Lviv Polytechnic National University. Moreover, she is the author (co-author) of more than 100 scientific publications. She member of research teams of international scientific projects. Scientific interests: fundamental and applied research into the economic development of organisations and regions, as well as the improvement of organisational development management on an innovative basis business process reengineering, tourism economics, simulation of the business process, risk evaluation. https://orcid.org/0000-0001-7842-694X

Włodzimierz Sroka, PhD, is an associate professor in the Management Department of WSB University, Dąbrowa Górnicza, Poland, and an extraordinary professor at North West University, South Africa. He specialises in theoretical and practical issues relating to management and strategic management. He is the author of numerous scientific papers on strategic alliances, network organisations, strategy, the restructuring of companies, CSR and business ethics, marketing and customer behaviour, public management, as well as innovations and entrepreneurship, published in peer-reviewed international journals. He is also a member of the scientific councils of several journals and conferences organised by different European universities. He holds PhD, M.Sc. and B.Sc. degrees in management and marketing from the Karol Adamiecki University of Economics in Katowice, as well as a D.Sc. degree (habilitation) from the University of Žilina (Slovakia). He combined his scientific activity with his position as CEO of a medium-sized engineering company. He was previously employed in different managerial positions in both the steel and machine industries. https://orcid.org/0000-0002-8701-0716