

Organising in HT Companies: an Example from ICT Sector

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Abstract - This article contains a definition of the essence and characteristics of high technology companies' organizational structure on the basis of experts' research. The following characteristics of the structure were analysed: specialisation, standardisation, configuration, centralisation, formalisation and flexibility in correlation with conceptual variables (strategy, technology, environment, personnel's knowledge and competence, organization culture, etc.). In HT companies, being innovative, knowledge-based and using modern IT technology firms, the organisation structures should be flexible, dynamic, flat, decentralised, with little formalisation, frequently target-oriented and closely integrated in their individual activities. The above is confirmed by the research results presented in the article, implemented in 30 companies from ICT sector, which is recognised as HT industry. Organizational structures of these companies were of the project, process and matrix type, with elements of virtual organisation.

Keywords – high tech enterprise, ICT sector, innovation, knowledge, organizational structure, technology

I. INTRODUCTION

In the developed, post-industrial economies the high technology companies sector is commonly regarded as the area with the largest use of and dependence on the so-called special means of production – knowledge and human resources [1]. Creation of these means is a continuous process which not only allows for competition among individual companies, but also has a positive effect on the environment (traditional industries, level of science, etc.). The high technology sector also requires continuous and intense innovative activities [2] as well as large research and development investments (the latter feature is one of the basic methods used to identify high technology industries all over the world) [3]. Moreover, this sector is characterised by a short life cycle of goods and processes, a fast rate of diffusion of innovation, an increasing demand for highly skilled staff, high capital expenditure, a high investment risk and close scientific and technological cooperation among companies and research centres within particular countries and internationally [4], [5], [6].

The organisational structure is of the key importance to the efficiency and performance of high technology companies. By arranging the elements of the organisation system and coordinating the work of people, the organisational structure reduces uncertainty and streamlines decision-making processes, being at the same time a tool for the implementation of the company's strategy [7]. However, as HT companies are highly innovative and knowledge-intensive, the organisation process is very specific. **This paper** attempts to define the essence and features of high technology companies'

organisational structure on the basis of experts' opinions and conducted research focused on a group of 30 ICT companies from the HT sector.

II. THE CONCEPT AND FEATURES OF THE ORGANISATIONAL STRUCTURE OF HT COMPANIES

According to Harold J. Leavitt [8], organizational structure is inextricably linked to technology and people who perform particular tasks. Charles Handy [9] has shown that it is also directly linked to corporate culture. Organizational structure is the form of an organization that is evident in the way divisions, departments, functions, and people are linked together and interact. It reveals vertical operational responsibilities and horizontal linkages and may be represented by an organization chart. But organizational structure is not a notion that is easily interpreted in an unambiguous manner.

When analyzing the most popular definitions of organizational structure, they may be divided into three categories, i.e.: definitions placing emphasis on the elements of a whole system and their arrangement (e.g. [10], [11], [12]); definitions accentuating relations occurring between the elements of a whole system (e.g. [6], [13], [14]); definitions stressing both the arrangement of the elements of a whole system and relations occurring between them (e.g. [15], [16]).

Despite the multitude of approaches to organizational structure, there are three key components in its definition. First, organizational structure designates formal reporting relationships, including the number of levels in the hierarchy and the span of control of managers and supervisors. Second, it identifies the grouping together of individuals into departments and departments into the whole organization. Third, it includes the design of systems to ensure effective communication, coordination, and integration of efforts across departments [17]. These three elements of structure pertain to both vertical and horizontal aspects of organizing. For example, the first two elements are the structural framework, which is the vertical hierarchy [18]. The third element pertains to the pattern of interactions among an organization's employees [19]. An ideal structure encourages employees to provide horizontal information and coordination where and when it is needed.

In an attempt to define the high technology company organisational structure, an expert survey was used. A panel of 15 experts was selected. These experts were the representatives of universities of economics (11 persons), consulting companies (2 persons) and economic

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practitioners (2 persons). The panel was selected taking into account specialisation. Therefore, persons with considerable theoretical or practical achievements were invited to participate in the survey. The experts were asked to express their opinions on the essence and features of the organisational structure of high-tech companies, as well as on the variables which affect the organisational structure (the so-called conceptual variables).

According to the experts, the specificity with reference to HT companies concerns an attributive approach to the organisational structure, i.e. its features (properties). The experts were most frequently mention these features, making reference mainly to the dimensions proposed by the Aston team [20], modifying some of them and adding new ones. Considering the above, the following dimensions were mentioned [21]:

- specialisation – narrow specialisation of task teams and specialisation of employees making it possible to acquire unique skills is preferred; non-fixed assignment of tasks (teams formed *ad hoc* to carry out a particular task); it is also suggested that the area of production should be separated from the R&D area, as the objective of the former is to minimise costs needed to ensure a production volume of appropriate quality and of the latter – to ensure a product characterised by possibly the highest degree of innovation with frequently limited expenditure;
- standardisation – jointly developed routine cooperation procedures or the lack of such procedures; standardisation of processes with a special focus on the customer, in a way which does not affect the desirable flexibility of the company;
- configuration – the hierarchy should not be strict (flattening of organisational structures, elimination of the hierarchy and implementation of the process organisation). However, the authority of the manager (related to the manager's professional skills and leadership) should be great;
- centralisation – very low centralisation or even decentralisation of the management, limiting the supervision functions, making it possible to independently set tasks and define the way these tasks are to be performed by the employees; making it possible to independently communicate with the environment;
- formalisation – it should be limited to the minimum required to protect resources and copyrights;
- flexibility – the amount of flexibility, which denotes the scope and frequency of changes to the cooperation system and reflects the level of dynamic skills, should be very high, achieved by possibly the greatest decision decentralisation, making it possible to delegate powers;
- proportionally between reflex and synergy – which means maintaining a relevant proportion between the portfolio organisation (not close internal relations, dispersion, autonomous organisation units, reduced and occasional coordination) and the integrated organisation

(close internal relations, interrelated, interdependent organisation units, significant structural coordination) [22]. Maintaining a relevant proportion is decisive to innovation and entrepreneurship. The reflex is concerned with deriving additional benefits related to extraordinary talents of individuals (inventors) and synergy is related to the team work and the effects of this form of work organisation. Some experts suggest that HT companies are characterised by high diversity and strong coordination – diversity in the sense of the quality diversity of component parts and coordination in the sense of using a different cooperation mechanism, in particular the existence of intra-network relations within the organisation and inter-network relations outside the organisation. The number of coordination centres and rotation of coordination authority or the lack of this rotation is very important;

- combination potential – described by the available diversity of knowledge, skills, specialisations, markets, etc.;
- networking and its extent – the system size, characteristics of entities, geographic area of operation, value chain, overlapping of cooperation systems;
- coherence – the strength, scope and direction of cooperative relations, as well as the number of active relations as compared to the number of inactive relations.

Furthermore, some other features of organisational structures of high-tech companies were mentioned, including the following: task orientation, fast and multidirectional flow of information, focus on the protection of intellectual property, focus on projects and multidimensional work, increasing the added value and internal openness.

According to one of the experts, the following features proposed by R. Perich [23] can also be ascribed to organisational features of high technology structures: coexistence (various concepts of the structure of particular parts of the organisation), federalism (a high degree of autonomy of individuals), network communication, minimum organisation in the static sense and the market in the sense of determining priorities and accounting for the results without enquiring into the way tasks are performed (e.g. project groups).

Therefore, it is possible to assume that the organisational structures of HT companies should be flat, lowly formalised, decentralised, rather specialised, flexible and conducive to innovation and transfer of knowledge. However, the features of these structures can be affected by many endogenous and exogenous variables. According to the experts, these variables include mainly the following: the environment in which such companies operate (including in particular technological progress, globalisation, intensity and directions of the development of competition, customers and their needs, support for innovation provided by the government), people within the organisation (their knowledge, attitudes, skills and motivation), technology, financial resources, the size and

life cycle of the company, ownership type, strategy and corporate culture.

The organisational structure understood in this way is usually a hybrid of various types of structural solutions. From the formal and legal point of view, the framework organisational structures are based on the functional structure or line and staff structure (in line with the requirements of the normative pragmatics). From the point of view of fragmentation (configuration), the structural solutions will evolve into more modern and organic forms, such as project/team-based structure [24], matrix structure [25], process structure [26], network structure [27] / boundaryless organisation [28], virtual structure [29], fractal structure [30] and hypertext organisation [31].

The organisational structure of HT companies must on the one hand make it possible to perform creative tasks oriented towards development of new knowledge, and on the other it should allow for efficient performance of routine actions. Moreover, the companies with clearly defined key competences should also be able to explore new market areas and to combine the perfect performance of operational units with development of revolutionary innovations.

III. METHODOLOGY AND FIELD OF RESEARCH

The objective of the research was to determine specific features of organisational structures in HT companies. The research was conducted in 2009 on a sample of 30 SME companies represented ICT trade, which pertain to the high tech sector. ICT are information and communication technologies which convert, process and transmit information in an electronic form. The ICT industry is perceived to be one of the most important powers shaping new forms of knowledge based economies. In 2008, in Poland there were 1605 ICT companies, including mainly small and medium enterprises. These companies were mainly providing IT services and manufacturing ICT equipment (computers and peripherals, consumer electronic goods, software, etc.) [32].

The selection criteria were as follows: running the ICT business and location in the Lodz province. The research was conducted by means of a survey. Respondents included the company owners and management representatives.

As far as the number of employees is concerned, 50% of the analysed entities were small companies (employing from 10 to 49 persons). Eight entities employed from 50 to 99 persons, five – from 100 to 149 persons and two – more than 150 persons (the first one – 167 employees and the second – 209 employees).

A significant number of the analysed companies (16 entities) have been operating for 11-20 years, four of them – for not longer than 5 years, seven – for 6-10 years and three – for over 20 years.

The majority of the analysed companies (73.3%) provide IT services (development of software, the Internet applications, databases, programming services, etc.). 16.7% of these entities are telecommunications companies and 10% of them manufacture ICT equipment.

The analysed companies (70%) are mainly oriented towards development by growth (increasing the production volume, expanding the range of offered products, increasing the number of employees and new investments). In this group there are both, new companies and companies which know the market perfectly thanks to many years of experience in the industry. The remaining companies (30%) make efforts to maintain their current market position. These are mainly companies operating for over 16 years.

Considering the above, it can be concluded that the selected companies are oriented towards development and expansion, which means that their organisational structures will change in the future.

IV. RESULTS AND DISCUSSION

To identify the features of organisational structures of the analysed companies, respondents were asked to determine the way tasks were assigned (fixed, non-fixed) and their grouping within the company (functional, product, customer, place/territory/geographical, process, technological or virtual network departmentalisation), the degree of standardisation by identifying routine organisational procedures limiting randomness of conduct in the organisation, the number of the organisational levels and coordination type (vertical, horizontal, personal, positions of coordinators). Answers provided by the respondents made it possible to determine the degree of specialisation and standardisation of the analysed companies and their configuration. Respondents were also asked to determine the degree of centralisation and formalisation in their companies. The results are shown in Fig. 1.

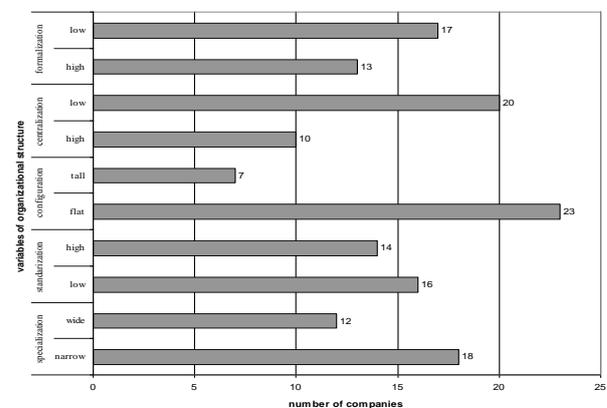


Fig. 1. Features of organisational structures in the analysed companies
Source: Own research

Taking into account the way tasks are assigned, the functional criterion prevailed (23 entities) in the analysed companies. However, the respondents mentioned also other criteria, including the following: process (10

companies), technological (3 companies) and virtual (12 companies). Respondents equally mentioned non-fixed assignment of tasks frequently, which is related to forming different task groups for particular projects. In more than 50% of the analysed companies rather narrow specialisation related to unique employee competence prevails. The degree of standardisation in 14 companies was high, which means that there is a relatively high number of routine organisational procedures (habits, known, repetitive and rarely formalised ways of performing particular operations). On the other hand, standardisation in 16 companies is at a rather low level. It is good that as many as 80% of the analysed companies have a flat organisational structure, which is probably related to the fact that these are medium-size enterprises. A flat configuration means shorter routes and time of information flow, lower risk of distortion of information, greater receptivity to innovations developed at lower levels and better conditions for decentralisation of decisions. It is confirmed in the assessment of the degree of concentration of powers to make decisions in the analysed companies. Decentralisation was reported by as many as 20 of them. Formalisation, i.e. the number of formal documents, rules and procedures, was on the one hand assessed to be at a fairly high level (13 companies), and on the other at a low level (17 companies).

Thus, various types of organisational structures can be identified in the analysed companies. The functional structure prevails. This structure is combined with solutions typical of project and process structures. Respondents quite often reported the existence of virtual teams (19 companies). In several companies, particularly those employing more than 100 persons, the organisational structures are of the matrix type. Therefore, it seems that the organisation of high-tech companies is a hybrid of various structural solutions.

As already mentioned, the organisational structure can be affected by many different variables. Respondents were asked to assess the significance of some of them from the point of view of their impact on the organisational structure. Selected variables were to be assessed using the 1-5 scoring policy, where 1 denoted insignificant variables and 5 denoted the key variables with a significant impact on the organisational structure. The results of provided answers are shown in Table 1.

Data in Table 1 show that according to the respondents the following conceptual variables are the most significant to the organisational structure: customers' requirements, technology, employees' qualifications and strategy. Apart from high average values (exceeding 4), this is also reflected by the value of the median (4), which means that according to 50% of respondents the above-mentioned variables are significant or very significant to the organisational structure. Low values of both, standard deviations and interquartile range ($kr=1$) show a low diversity of the score given by the respondents. The organisational culture and support of innovation by the government (median: 3) were the least significant determinants of the organisational structure.

However, respondents' opinions in the case of these variables varied the most ($Kr=2$). No significant differences were observed in the assessment of particular variables analysed taking into account the number of employees, the period of operation on the market and the type of business.

TABLE I
THE ASSESSMENT OF THE IMPACT OF SELECTED CONCEPTUAL VARIABLES ON THE ORGANISATIONAL STRUCTURE IN THE ANALYSED COMPANIES

Conceptual variables	Total number of companies			
	\bar{X}	Sd	M	Kr
strategy	4,01	1,33	4	1
size	3,68	1,79	4	1
technology	4,18	1,44	4	1
organizational culture	3,12	2,01	3	2
economic and financial conditions	3,85	1,52	4	1
employees' qualifications	4,13	1,21	4	1
support of innovation by government	3,15	1,90	3	2
globalization	3,56	1,85	3	1
customer' requirements	4,24	1,41	4	1

\bar{X} – average S – standard deviation M – median
Q – quantities deviation
Source: Own research

The organisational structure of high-tech companies should be flexible as maintaining excessive additional financial resources, property and human resources is nowadays no longer sufficient. The flexibility of the organisational structure is the result of its efficiency and denotes that this structure changes naturally or that it is possible to quickly change it or adapt to the company's needs. J. Galbraith, D. Downey and A. Kates [33] defined the following features of a flexible reconfigurable organisation: active leadership, knowledge management, learning, integration, employee commitment and change readiness. The flexibility of the organisational structures of the analysed companies was quite high (a high and very high degree according to 60% of respondents). The results are shown in Fig. 2.

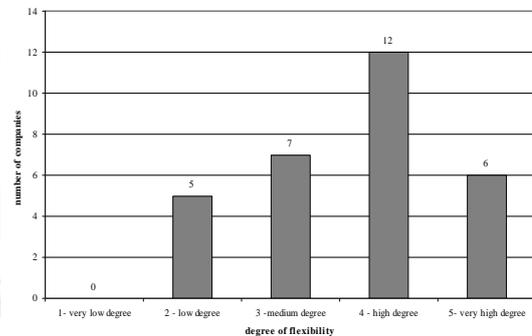


Fig. 2 The assessment of the degree of the organisational structure flexibility in the analysed companies

Source: Own research

None of the respondents assessed the flexibility of the organisational structure as the one of a very low degree, meaning a mechanical (fixed) solution where it is difficult to make any changes.

A low and medium degree of flexibility was reported by 12 respondents who represented mainly the companies with a large number of employees (more than 70). The project, process and virtual structures were the most frequently reported as the flexible structural solutions.

V. CONCLUSION

Organising is a process of the creation of people and other resources for the purpose of cooperation in order to achieve a common objective. The process result is an organisational structure which, while regulating internal operations of the company and minimising randomness and unpredictability of behaviour, it influences the efficiency and effectiveness of the company. Despite the fact that an organisational structure of a given company is unique and original, it should mainly support personnel's creativity of new knowledge and innovation in HT companies. Therefore, it is necessary to make the organisational structures less bureaucratic and more flexible, vital and dynamic. Such organisational solutions include the following: project structures, process structures, matrix structures, virtual structures, etc. These organisational structures are characterised by a lean hierarchy and a low degree of centralisation, specialisation, formalisation and standardisation of actions. The degree of the above-mentioned features in the analysed high technology companies representing the ICT sector is quite high. However, some of them continue to function in traditional functional organisational structures which are highly centralised and formalised. Therefore, it seems that if these companies wish to further develop, be creative and open to innovation, changes to their organisational structures are necessary.

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