Folia Oeconomica
Acta Universitatis Lodziensis
ISSN 0208-6018 e-ISSN 2353-7663

https://www.czasopisma.uni.lodz.pl/foe/
2(367) 2024
DOI: https://doi.org/10.18778/0208-6018.367.01

Anna Brzozowska https://orcid.org/0000-0002-0227-9493

Faculty of Management, Czestochowa University of Technology, Czestochowa, Poland
annabrzozowskapcz@gmail.com

Information Management in a Dynamic Business Environment – A Case Study of Fractal Organisations

Abstract: In today's organisations, faced with constant changes in the economic environment, information management plays an important role. Greater possibilities for obtaining financial and material resources have made the implementation of economic processes less of a challenge than it used to be. Currently, the key issue is the ability to quickly acquire, effectively collect, properly process and rationally use economic information, which can bring a competitive advantage. Modern enterprises, operating in a rapidly changing environment, can use fractal theory to understand their behaviour. The concept of a fractal organisation that perfectly meets the requirements of operating in a turbulent and competitive environment can also be useful in building effective information management systems within the organisation capable of coping with the increasing volatility of the business environment. The aim of the article is to explore and explain how fractal theory and the concept of fractal organisation can help modern organisations manage information in a dynamically changing economic environment. The subject of the article is the analysis of the role of information management in the current conditions of constant changes in the economic environment in view of the ways in which organisations can use fractal theory to effectively manage information and build a competitive advantage. This article suggests descriptive and comparative analytical methods and synthetic methods of exploring and comparing different approaches to information management. In the study, statistics of measured variables as well as the Shapiro–Wilk test and Pearson's r correlations were used to develop a multiple regression model for the dependent variable: Quality of information management.

Keywords:	information management, management of knowledge, fractal organisation
JEL:	L23, M15, O32

1. Introduction

The dynamism of the global economic scene has a profound impact on how organisations function. In this context, information management has become an essential element that organisations must master in order to maintain and develop their competitiveness (Schwalbe, 2015). The modern business climate, characterised by constant change, requires them to be able to effectively collect, process and use economic information (Kallinikos, 2006, Webber, Dunbar, 2020). In the era of extensive possibilities of obtaining financial and material resources, the implementation of economic processes is no longer such a big challenge (Carr, 2003). However, the fractality principle proposed by Haken (2006) indicates a new, innovative approach to information management that is adapted to the conditions of a dynamic environment. Fractals can serve as a tool for better understanding of how organisations function and behave, and thus assist in adapting to a changing environment (Frame, 2017).

In the era of accelerated digital transformation, adaptation to unpredictable changes in the environment is becoming a key success factor for modern organisations (Schwab, 2017). In this context, traditional hierarchical structures seem increasingly inadequate, and are being replaced by new models that are characterised by greater flexibility and the ability to adapt quickly to changing conditions (McCord, 2018). Among these innovative approaches, the concept of a fractal organisational structure is gaining ground as a vision of the future of the company (Hock, 2005). This modern structure, inspired by fractal mathematics, is characterised by autonomous, repeating individuals who are able to make decisions independently and adapt to their specific context, while maintaining the coherence and purposefulness of the entire organisation (Brafman, Beckstrom, 2006). This complex, yet simplified structure, is reminiscent of fractals observed in nature, where small-scale simplicity and repeatability creates complex and beautiful forms on a larger scale (Mandelbrot, 1982). This article examines the fractal organisational structure, discusses its advantages and challenges, and shows how it can create space for unlimited innovation and adaptation in the dynamic business world (Tapscott, Tapscott, 2016).

In light of existing research on the fractal organisational structure and information management, there is a research gap regarding the practical application and impact of such a structure on decision-making processes and knowledge management in a dynamically changing business environment (Accou, Carpinelli, 2022). Although the concept of fractality is widely applied in various scientific fields, its practical implications in managing organisations, especially in the context of information management, have not been fully explored. This study aims to address this gap, focusing on the following key research questions:

2. How does the fractal organisational structure impact the effectiveness of information management in a dynamically changing business environment?

What are the key factors determining the success of information management in fractal organisations?

How does the fractal structure influence decision-making processes and knowledge management within the organisation?

The article has been enriched with the current literature and theories concerning fractal organisations, and the literature review distinctly indicates a publication gap in the field of information management within the context of fractal organisations, thereby emphasising the significant contribution of this study in expanding the existing discussions and research in this domain. The aim of the article is to investigate the impact of the fractal organisational structure on information management in dynamic business conditions, showcasing the innovation of the study through an analysis of the practical application of this structure in the context of information management and decision-making.

3. Literature Review

The relevant literature treats fractals as a kind of geometry that describes figures with a complex structure, consisting of smaller fragments that look the same as the whole figure. They have features such as isomorphism of part and whole, holographic, self-similarity, mathematical repeatability, and the ability to infinitely zoom in and out. Fractals are used to describe modern organisations characterised by a multiplicity of branches, self-similarity of parts, chaotic dynamics, and irregularity (Perechuda, 2000a: 25; Singh, Mishra, Gupta, 2023: 115–126).

A fractal enterprise, as defined by Hans Jürgen Warnecke, is an entrepreneurial unit with an independent activity in which goals and performance can be clearly described (Warnecke, 1999: 109). It can be both an entire enterprise (macrofractal) and a single organisational unit (microfractal). Both the company and its organisational units are characterised by structural similarity, freedom of decision making, independence, self-optimisation, common goals, dynamics, and orientation towards bringing added value to the customer (Perechuda, 2000a: 26; Warnecke, 1999: 109–110).

A fractal enterprise is characterised by specific features, classified and summarised in the figure presented below (Binsztok, 2005: 138; Krawczyk, 2001: 18–19).

The effectiveness of fractal enterprises depends on many factors, such as an appropriately designed process network, awareness of creating added value, elimination of non-value-creating activities, etc. (Bider et al., 2017: 663–689).

Network organisations, also known as fractal organisations (Raye, 2014: 50–68), are an alternative to traditional hierarchical structures. Because these organisations are networked by nature, they are changing the way we do business. By creating network organisations, traditional restrictions related to geographical location or barriers between economic sectors are removed. The transition to new markets no longer depends only on capital, but mainly on access to knowledge and the use of network effects (Kelly, 2001: 70). Fractal enterprises (Sandkuhl, Kirikova, 2011: 193–207) therefore play an important role in building an economy based on the exchange of intangible assets, such as intellectual capital, key competences, knowledge and skills. It is therefore important to effectively manage the flow of information and knowledge in fractal organisations (Kelly, 2001: 70).

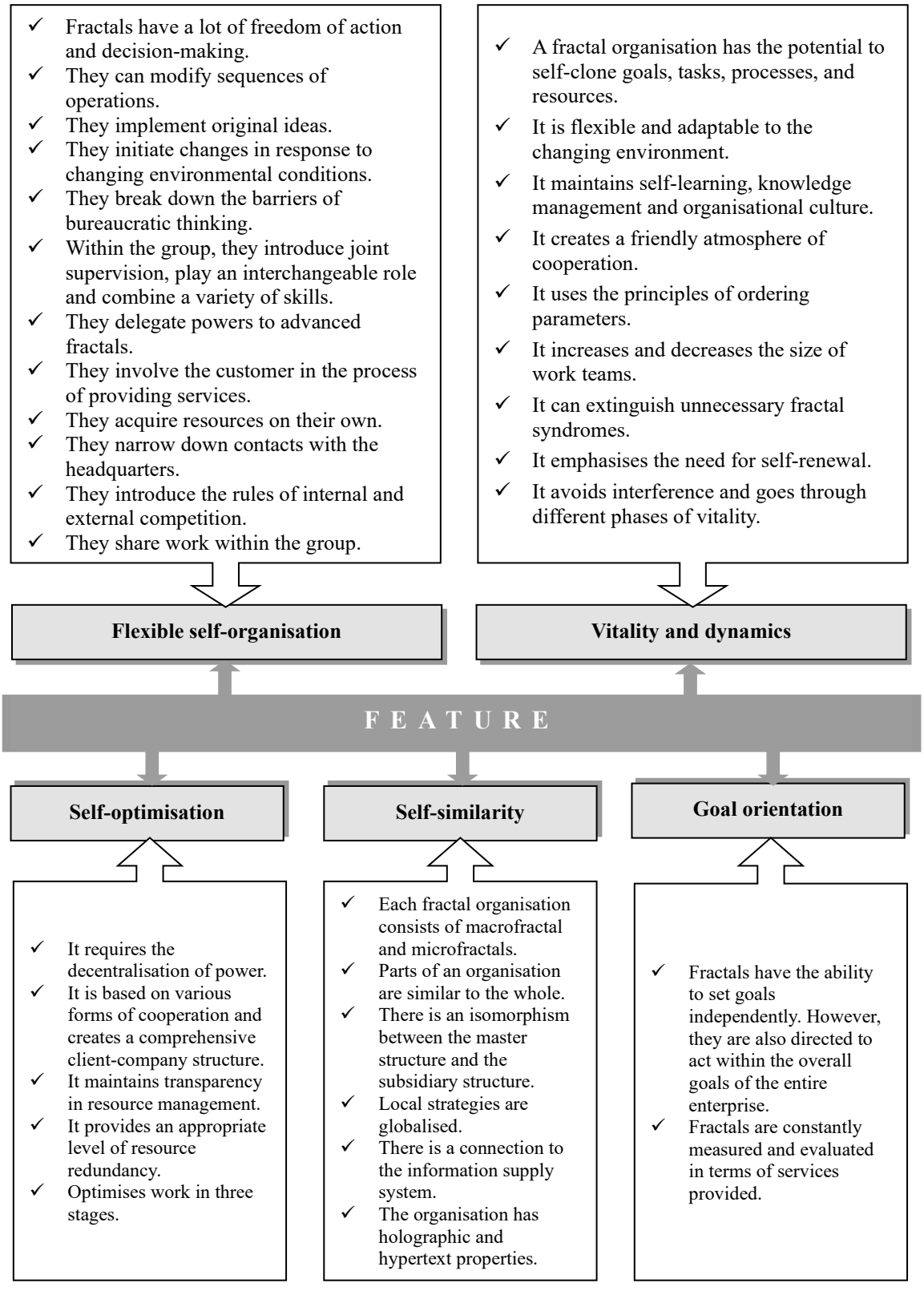

Figure 1. Four basic characteristics of a fractal organisation with a description of activities

Source: own elaboration based on: Krawczyk, 2001: 18–19; Binsztok, 2005: 138

The basic structure of fractal organisations is a network consisting of nodes and connections between them. Nodes perform various roles, such as operations, administration and management, procurement and integration. Connections determine the composition of elements and their activation (Warner, Witzel, 1998: 1–18).

Network organisations (Szerb, 2003: 81–95), on the other hand, consist of smaller and smaller units that have specialised knowledge and skills. Each enterprise in the fractal network is specialised in the implementation of specific tasks, which brings a competitive advantage. The purpose of the network structure of fractal organisations is to connect and harmonise different entrepreneurial centres and also to achieve full integration, flexibility and efficiency. Simplifying the transfer of information between fractals and their structuring leads to optimisation of organisational control processes (Warnecke, 1999: 133).

With its flexibility, a fractal company (Warnecke, 1993: 1–220) is able to maintain organisational order, which enables it to continue to function and develop. The continuous process of searching for innovations is conducive to the rapid development of knowledge within the enterprise, which is obtained from both customers and employees (Warnecke, 1999: 133; Makowiec, 2007: 67–68).

According to the literature, the most effective model of knowledge creation (Choi, Lee, 2002: 173–187) within an enterprise is one that enables the preservation of key competences, controlled flow of basic knowledge, avoidance of dispersion of classified knowledge and direct control of research and development teams (Perechuda, 2005: 124). The process of knowledge creation in classic and fractal enterprises can be divided into four phases: phase I – gradual business learning, typical of small businesses; phase II – applies to large enterprises, where organisational learning is the result of a strategic game with the environment; phase III – reflects the globalisation and networking of transnational enterprises, where classified knowledge is protected, and only part of explicit knowledge is made available; phase IV – the network-fractal model (Leego, Bider, 2021: 107–116) preferred by medium-sized companies in advanced technology sectors (Perechuda, 2005: 124–125).

According to researcher K. Zahender, a fractal organisation is based on activating and using motivation, creativity and competence at every stage. The 'motivational-creative-competency' level allows a fractal company to effectively solve problems (Zehender, 1998: 59). A fractal company (Ryu, Son, Jung, 2003: 720–733) can meet customer expectations and react quickly to changing market conditions. Competitiveness also results from the competition between autonomous fractals, which has a positive effect on the position of the entire company. Not only does creating organisations based on IT networks enable companies to function and compete in a changing environment but it also fosters the emergence of new forms of activity, such as virtual organisations.

When dealing with effective information management in fractal enterprises, it is important to take into account several key aspects (Perechuda, 2000a: 25–27; 2000b: 53–54; Warnecke, 1999: 109–110): Fractal enterprises are characterised by a complex structure, consisting of many autonomous organisational units. It is imperative to design flexible structures that will enable an effective flow of information between individual parts of the organisation. You

can take a networked approach to information management that enables rapid data exchange and collaboration between different entities. Communication plays a key role in information management in fractal enterprises (Klyukina, Bider, Perjons, 2021a: 613–624; 2021b: 445–464). It is necessary to create effective communication processes that will enable a smooth flow of information within the organisation. Various tools and technologies, such as content management systems, communication platforms and discussion groups, etc., can be used to facilitate communication between employees. Modern information technologies play a key role in information management. Fractal enterprises can use information systems to collect, process, analyse and share information within the organisation. It is important to use appropriate tools and systems, such as databases, customer relationship management (CRM) systems, knowledge management systems (KM) and decision support systems, etc., that will enable effective information management. In fractal enterprises, it is vital to build an information culture that promotes effective information management at all levels of the organisation (Bider, Chalak, 2019: 359–373). Employees should be aware of the importance of information and be able to collect, process and use it to make effective decisions. It is also important to promote cooperation and information sharing between different organisational units. Fractal enterprises should strive for continuous improvement of their information management processes (Henkel et al., 2019: 56–69). Monitoring the effectiveness of activities, analysing results and making improvements are crucial for optimising information management. Organisations should be open to new trends and innovations in the area of information management and adapt to changing market conditions. In the case of fractal companies (Bider, 2020: 95–111), where there are many separate organisational units, information security is extremely important. Appropriate data security measures, such as authentication systems, encryption, network security and permission management, are essential to protect the confidentiality, integrity and availability of information. It is also worth conducting training for employees to increase awareness of data protection and cybersecurity. Fractal enterprises generate huge amounts of data from different organisational units. For effective information management, it is crucial to perform data analysis to obtain valuable insights and guidance for decision-making. The use of data analysis tools, such as Business Intelligence (BI) and artificial intelligence (AI), enables you to discover hidden patterns, trends and opportunities for optimising processes. Regular monitoring of the effectiveness of information management and the creation of reports is an important element in the improvement process. Fractal companies should use appropriate indicators and measures to assess the results of information management and identify areas for improvement. Reporting should be transparent, accessible to relevant stakeholders and used to make strategic decisions. The business and technological environment is constantly evolving, so fractal enterprises must be flexible and ready to adapt. Information management should take into account dynamic changes and be able to respond quickly to new challenges and opportunities. Constant study of trends, innovations and future business needs allows you to adapt your information management strategy and maintain competitiveness.

According to M. Wochner, a fractal organisation is a lean enterprise, which means it can operate flexibly in a turbulent environment. The management of such an organisation is less centralised, and power is mainly derived from knowledge, experience and skills, rather than hierarchy. Employees act as independent fractal units, cooperating with other employees as part of a team. For a better understanding of the 'lean' enterprise, comparative differences between fractal and traditional models should be presented. Fractal teams are independent teams of an enterprise that have a great influence on their own activities, work well in turbulent environments, organise themselves, perform a variety of services, and are subject to constant change. Whereas traditional teams operate in accordance with directives issued by top managers and their internal organisation is mainly shaped by those top managers, they work well in a stable environment, perform certain functions, and are hardly ever subject to change (Hopej, 2001: 9).

Fractal organisations are permanent groupings of autonomous, specialised units or enterprises that cooperate on market terms. The network may include both subsidiaries and capital-independent undertakings retaining decision-making autonomy.

Accordingly, effective information management in fractal enterprises requires a holistic approach that takes into account organisational structures, processes, technologies, information culture, and data security. Continuous improvement, monitoring of results and adapting to changing conditions are also crucial. Correct information management is the basis for efficient fractal enterprises and contributes to their success in a dynamic business environment (Khawla, Molnár, 2019: 556–563).

Fractal organisations are characterised by a clear structure, consisting of a main unit (macrofractal) and a network of sub-units (microfractals) that act as autonomous organisational units. Due to constant changes in the environment, the structures of the organisation are flexible, and resource optimisation means that microfractals join the structure only for the duration of specific tasks, according to the needs of customers. In fractal organisations, it is important for them to only perform a part of the tasks typical of traditional enterprises. Other activities that can be done better or cheaper are outsourced. The units in the network have autonomy in making commercial, financial and organisational decisions, while a central unit of recognised reputation and standing performs a coordinating function (Hopej, 2001: 9). Its tasks include creating the concept of a joint venture, identifying the necessary competences, designing a process map, selecting business partners, assigning tasks to companies, coordinating, monitoring, controlling and providing products and services for customers, both internal and external. In addition, fractal organisations use internal and external billing (Hopej, 2001: 9).

The existence of a central institution enables the development of network partnerships, but the connection with other market participants means that the organisation is perceived through the prism of other network links. Accordingly, in the network form of fractal organisation, the trust, commitment and reputation of internal individuals are all extremely vital. Network organisations are of particular importance because new rules and ways of exchanging information often achieve breakthroughs and revolutionary results. Decentralised fractal structures, in which individual units have a high level of autonomy, place greater demands on information systems in enterprises (Koumas, Dossou, Didier, 2021: 607–630). Regardless of specific tasks,

these systems should support the diagnosis of business needs by selecting, filtering and acquiring information and knowledge from various sources, processing information into tasks according to priorities, generating solutions, making decisions according to objectives, processing solution options, and transferring information to other entities (Morgan, 1986). Treating the structure of the organisation in a fractal form, it is important to create transparent units of the company that determine success and enable a quick response to market changes. The integration of various elements is an important task that requires looking at the whole. Simplification plays a crucial role here, as it reduces the effort needed for learning by limiting the amount of information that needs to be assimilated, processed and remembered (Morgan, 1986). Employees in fractal organisations have greater autonomy and responsibility for the decisions they make. This requires strong communication skills, cooperation and the ability to make decisions in conditions of uncertainty (Perechuda, 2000a: 315–317). In fractal organisations, it is important to create an open and flexible environment where innovation and experimentation are welcome. Employees are free to use their skills and creativity to contribute to the development of the organisation (Perechuda, 2000a: 315–317). Another important aspect of management in fractal organisations is continuous learning and development. Employees are encouraged to expand their knowledge and skills, and the organisation supports them in this process through training, mentoring and other forms of development (Perechuda, 2000a: 315). Moving from a traditional management model to a fractal organisation can be challenging for both employees and managers (Lartey, 2020: 44–51). It requires a change of mentality and approach to work and openness to new ways of organising and managing. Accordingly, fractal organisations have a greater ability to adapt to a changing environment and are more flexible and innovative. However, due to their specific nature, they are not suitable for every industry or situation. When deciding whether to implement such a governance model, you should carefully examine the context and understand whether it is the right solution for your organisation. Nevertheless, fractal organisations provide the opportunity to create a more dynamic and effective work environment in which employees are more engaged and have a greater opportunity to reach their own potential.

4. Research Methodology

The aim of the study is to comprehend the role of information management in contemporary organisations, particularly within the context of fractal organisations operating in a dynamically changing economic environment. In response to the research gap identified in the existing literature, the study endeavours to examine how fractal theory and the concept of a fractal organisation can bolster effective information management.

The research objectives are directly linked to the applied methods.

To understand the impact of the fractal organisational structure on the effectiveness of information management, a combination of descriptive and comparative analytical methods was employed. These methods facilitate the examination and comparison of various approaches to information management within the fractal structure framework, providing insights into how these structures might enhance or impede information flow and processing.

To identify key factors determining the success of information management in fractal organisations, synthetic methods were utilised. This approach allows for the integration of various types of data and perspectives into a cohesive understanding of the complex dynamics involved in information management within fractal structures.

To investigate the influence of a fractal structure on decision-making processes and knowledge management, statistical tools including the Shapiro–Wilk test and Pearson's r correlations were used. These tools are instrumental in developing a multiple regression model for the dependent variable: Quality of information management. This model provides quantitative evidence on the relationships between fractal structures and various aspects of information and knowledge management.

The aim of the study is to comprehend the role of information management in contemporary organisations, particularly within the context of fractal organisations operating in a dynamically changing economic environment. In response to the research gap identified in the existing literature, the study endeavours to examine how fractal theory and the concept of a fractal organisation can facilitate effective information management. The empirical component of this study was bolstered by a carefully selected research sample. A total of 382 respondents from 19 large fractal organisations in Poland were included. To ensure a comprehensive and representative sample, a stratified sampling method was employed. This method involved dividing the population of interest into distinct subgroups or strata and then randomly selecting respondents from each stratum. The stratification was based on the respondents' roles within their organisations, ensuring an even distribution across various hierarchical levels. The stratification criteria focused on job roles within the organisations, categorising respondents into managers, supervisors, department directors, and knowledge workers. This approach guaranteed a diverse range of perspectives regarding information management in fractal structures. Among the respondents, 61% were women and 39% men, with 72% living in urban areas and 28% in rural areas. The participants included 31% managers, 27% supervisors, 13% department directors, and the remaining group comprised knowledge workers from different departments of fractal organisations. Key features related to information management were measured using a Likert scale, ranging from awareness of the value of knowledge.

This methodological approach ensures a thorough exploration of the identified research gap, directly linking the study's objectives with the applied methods, to provide a deeper understanding of the role of fractal theory in information management in contemporary organisations.

As previously mentioned, the methodology of this study was meticulously designed to address the identified research gap, focusing on the impact of fractal organisational structures on information management in dynamically changing business environments. Special attention was devoted to the procedures for sample selection, testing the reliability of responses,

the duration of the study, and the applied quality control measures. As indicated earlier, the study involved 382 respondents from 19 large fractal organisations in Poland. A stratified sampling method was employed to ensure representativeness across various levels of the organisational hierarchy, including managers, supervisors, department directors, and knowledge workers. The selection criteria were based on the respondents' engagement in decision-making processes and their direct experiences with information management systems in their organisations. To ensure the reliability of responses, a pilot test was conducted with a smaller subset of the target population. Based on feedback from the pilot test, the survey questions were refined for clarity and relevance. Cronbach's alpha coefficient was calculated for the survey instrument to assess internal consistency, setting a threshold of 0.7 as acceptable reliability. The study was conducted over a period of six months, allowing ample time for comprehensive data collection and analysis. This duration included the initial pilot testing phase, the main data collection phase, as well as the final analysis and interpretation of the data. Quality control was maintained throughout the study by regularly reviewing the data collection process for consistency and accuracy. This methodological framework provided a robust examination of the posed research questions, enabling the generation of valuable insights into the role of fractal theory in information management in contemporary organisations.

5. Research Results

In Table 1, statistics for measured variables and the Shapiro–Wilk W test, which was used to verify the normal distribution of the measured features, are presented. Because $p > 0.05$, it was assumed that the probability density distributions do not differ statistically significantly from the normal distribution and, on this basis, Pearson's r correlation coefficient was adopted for the correlation assessment.

Table 1. Descriptive statistics

	Average	***N***	**Deviation standard**	**median**	**Kurtosis**	**Skewness**	**W Shapiro Wilk**	***p***
Awareness of the value of knowledge	3.51	382	0.18	3.57	– 1.147	0.023	0.987	0.425
Innovations	4.02	382	0.26	4.12	– 0.526	0.072	0.978	0.372
Efficiency	3.49	382	0.21	3.57	– 0.494	0.009	0.976	0.388
Competitiveness	2.50	382	0.28	2.54	– 0.598	0.006	0.969	0.351
Systematic accumulation of knowledge	2.54	382	0.28	2.57	– 0.454	0.014	0.964	0.392
Tests	3.13	382	0.28	3.22	– 0.777	– 0.021	0.983	0.401

	Average	*N*	Deviation standard	median	Kurtosis	Skewness	W Shapiro Wilk	*p*
Data analysis	4.33	382	0.29	4.36	– 0.639	0.113	0.972	0.333
Observation	2.96	382	0.26	2.97	– 0.591	0.032	0.967	0.335
Organisation and structure of knowledge	4.37	382	0.22	4.38	– 0.682	0.059	0.966	0.344
Sharing and sharing knowledge	2.87	382	0.28	2.93	– 0.764	0.088	0.977	0.404
Using knowledge to make decisions	3.11	382	0.26	3.15	– 0.347	0.141	0.977	0.363
Continuous improvement and learning	2.73	382	0.27	2.80	– 0.739	– 0.025	0.966	0.328
Technology supporting knowledge management	3.34	382	0.29	3.42	– 0.397	0.049	0.964	0.336
Quality of information management	3.00	382	0.28	3.07	– 0.688	– 0.004	0.985	0.426

Source: own elaboration

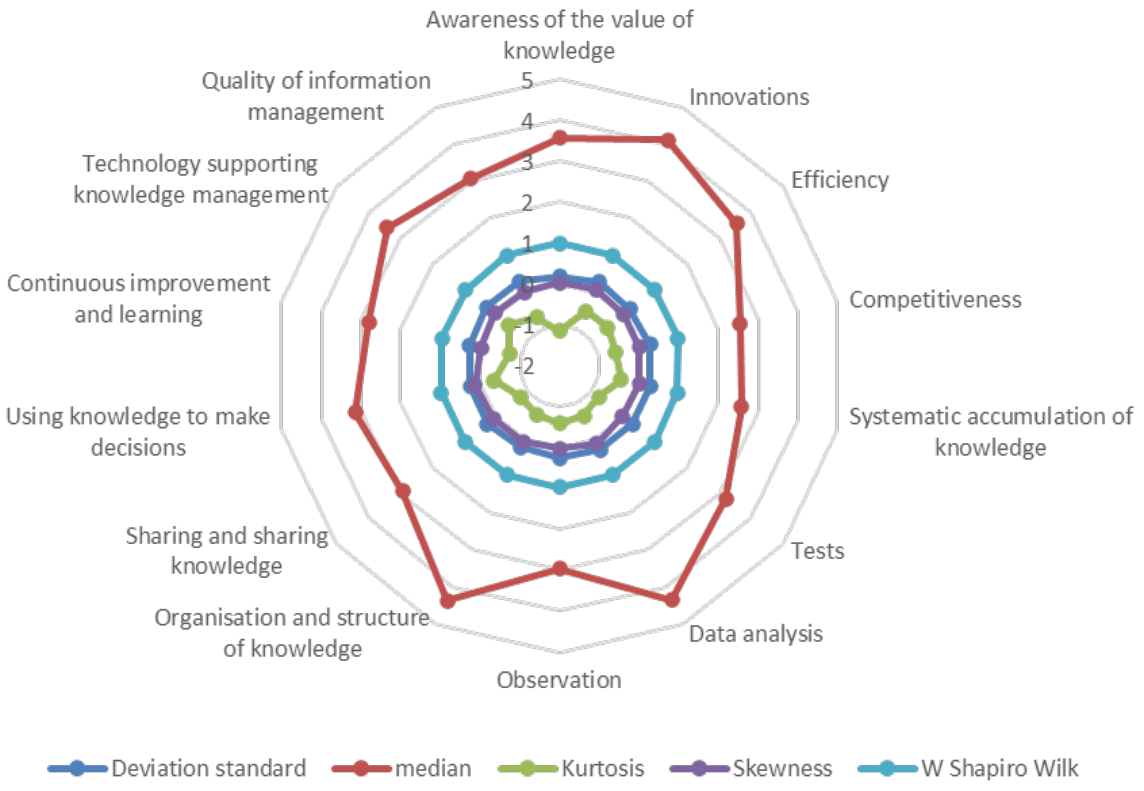

Figure 2. Descriptive statistics
Source: own elaboration

Based on the correlation analysis conducted (Table 2), it can be inferred that all variables are significantly statistically related at a fairly high level with the quality of information management in a fractal organisation. The strongest association with the dependent variable occurs in the awareness of the value of knowledge ($r = 0.782$; $p < 0.001$), in research ($r = 0.630$; $p < 0.001$), and in the organisation and structure of knowledge ($r = 0.620$; $p < 0.001$).

Table 2. Pearson *r* correlations

		Quality of information management
Awareness of the value of knowledge	Pearson *r* correlations	0.782
	Significant (*p*)	< 0.001
	N	382
Innovations	Pearson *r* correlations	0.574
	Significant (*p*)	< 0.001
	N	382
Efficiency	Pearson *r* correlations	0.602
	Significant (*p*)	< 0.001
	N	382
Competitiveness	Pearson *r* correlations	0.609
	Significant (*p*)	< 0.001
	N	382
Systematic accumulation of knowledge	Pearson *r* correlations	0.588
	Significant (*p*)	< 0.001
	N	382
Tests	Pearson *r* correlations	0.633
	Significant (*p*)	< 0.001
	N	382
Data analysis	Pearson *r* correlations	0.591
	Significant (*p*)	< 0,001
	N	382
Observation	Pearson *r* correlations	0.577
	Significant (*p*)	< 0.001
	N	382
Organisation and structure of knowledge	Pearson *r* correlations	0.620
	Significant (*p*)	< 0.001
	N	382

		Quality of information management
Sharing and sharing knowledge	Pearson *r* correlations	0.618
	Significant (*p*)	< 0.001
	N	382
Using knowledge to make decisions	Pearson *r* correlations	0.580
	Significant (*p*)	< 0.001
	N	382
Continuous improvement and learning	Pearson *r* correlations	0.585
	Significant (*p*)	< 0.001
	N	382
Technology supporting knowledge management	Pearson *r* correlations	0.574
	Significant (*p*)	< 0.001
	N	382

Source: own elaboration

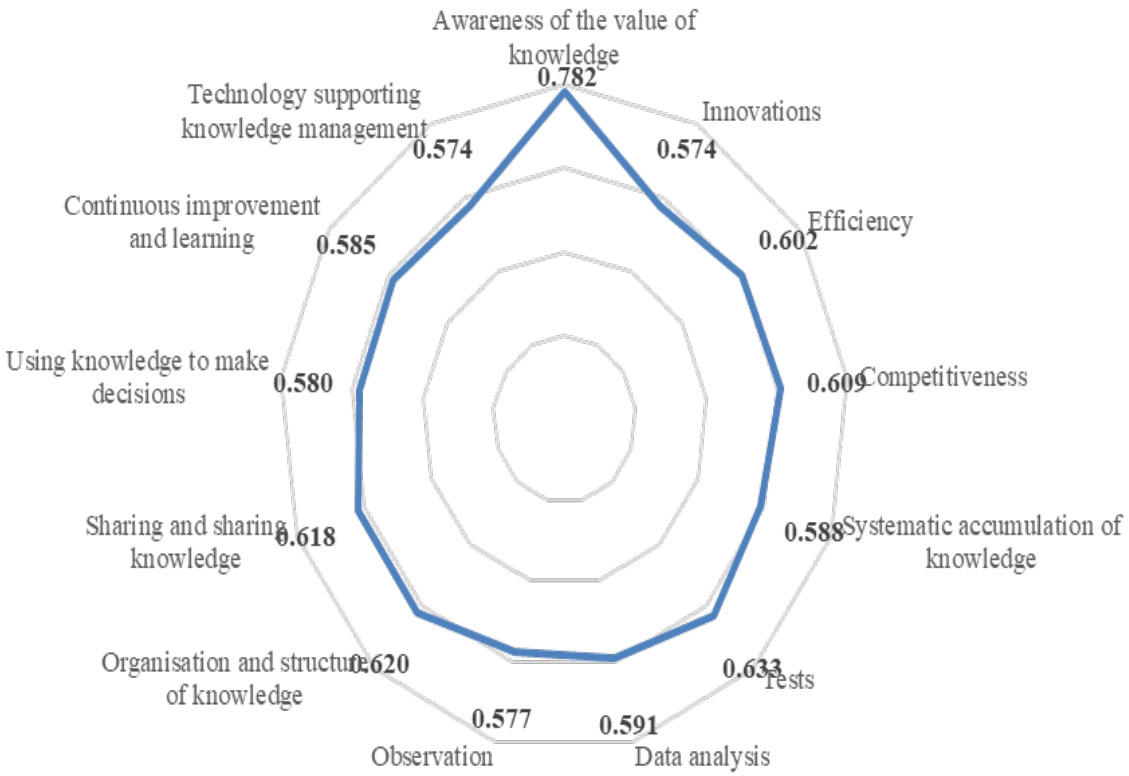

Figure 3. Pearson *r* correlations
Source: own elaboration

Table 3 presents the results of stepwise multiple regression, where statistically significant variables entering into interaction with each other are isolated. The model explains 61.1% of the total variance of the quality of information management. The higher the Beta

parameter in the model, the more strongly a given variable affects the dependent variable. The higher the awareness of the value of knowledge (Beta = 0.782; $p < 0.001$), the greater the innovativeness of implementation in fractal organisations (Beta = 0.676; $p < 0.001$), the greater the effectiveness of making various decisions (Beta = 0.433; $p < 0.001$), the better the results in the systematic gathering of knowledge (Beta = 0.322; $p < 0.001$), the better the management of the organisation and structure of knowledge (Beta = 0.199; $p < 0.001$), the better the sharing and dissemination of knowledge (Beta = 0.188; $p < 0.001$), the better knowledge is used for decision-making (Beta = 0.185; $p < 0.001$), the more emphasis is placed on continuous improvement and learning (Beta = 0.174; $p < 0.001$), the more is invested in technologies supporting knowledge management (Beta = 0.166; $p < 0.001$), and the higher the quality of information management in the fractal organisation.

Table 3. Multiple regression model – dependent variable: Quality of information management

	beta v model	***t***	**Significant**
(constant)	–	– 0.277	0.782
Awareness of the value of knowledge	0.782	24.426	< 0.001
Innovations	0.676	23.356	< 0.001
Efficiency	0.433	22.212	< 0.001
Systematic accumulation of knowledge	0.322	19.944	< 0.001
Organisation and structure of knowledge	0.199	14.133	< 0.001
Sharing and sharing knowledge	0.188	12.274	< 0.001
Using knowledge to make decisions	0.185	11.039	< 0.001
Continuous improvement and learning	0.174	10.893	< 0.001
Technology supporting knowledge management	0.166	9.579	<0.001
$R = 0.782$; $R^2 = 0.611$; The standard error =1.165; F = 587.321; $p < 0.001$			

Source: own elaboration

6. Discussions

Therefore, effective information management in fractal enterprises requires a holistic approach that considers organisational structures, processes, technologies, information culture, and data security. Continuous improvement, results monitoring, and adaptation to changing conditions are also crucial. Proper information management forms the basis of the efficiency of fractal enterprises and contributes to achieving success in a dynamic business environment.

A fractal organisational structure, being an expression of dynamism, autonomy, and self-organisation, seems to be an ideal place for effective knowledge management. In the context of increasing complexity and volatility of the business environment, both knowledge management and information management become key to the survival and development of enterprises.

We see that fractality as an organisational paradigm serves to create a flexible environment capable of collecting, organising, sharing, and utilising knowledge in a systematic and integrated way. From the perspective of knowledge management, fractality helps to realise the idea that knowledge is a valuable resource with the potential to influence innovation, efficiency, and competitiveness.

Information management is inherently linked to the process of knowledge management but focuses more on structuring, sharing, and securing data. In a fractal organisation, the application of a holistic approach to information management, which takes into account organisational structures, processes, technologies, information culture, and data security, is not only beneficial but indeed necessary.

Let us emphasise that technology plays a key role in fractal organisations, not only in the context of information management but also as a catalyst for learning and innovation capabilities. Fractal enterprises use advanced IT tools to create and share knowledge bases, as well as to promote a culture of knowledge sharing, which is extremely important for the effective functioning of such an organisation.

In the whole process, one cannot overlook the role of people. The human element is crucial for knowledge management in a fractal organisation, as it is the employees who are the carriers of knowledge, sharing their experience and ideas. The fractal structure promotes greater autonomy, which in turn can lead to greater innovation and efficiency.

In conclusion, in the era of digitisation and rapid technological changes, companies need to adapt their organisational structures along with knowledge and information management processes. The fractal organisational structure, with its dynamism, self-organisation and scalability, facilitates a more agile response to market demands and enhances the ability to innovate within the company.

7. Conclusions

The study of economic and social life leads to the conclusion that there are factors conducive to the management of the flow of knowledge and information in organisations and the fractalisation of enterprises. These factors are primarily the spontaneity of employees, spontaneity of action, creative chaos, individualism, short projects, short life cycles of products and services, and openness to risk. It is also essential to remember factors inhibiting the development of the concept of fractal organisations. These include corporate debt, the lack of willingness of employees to share information and knowledge, and outdated thinking patterns of business owners and managers, especially those of small and medium-sized enterprises.

Fractal organisations constitute a new quality in the theory and practice of management, effectively fitting into atomised concepts of economic and social life. However, despite the expectations, their practical application is not developing as rapidly as one might think. Today, organisations that are constantly renewing and modernising are indispensable, and fractal enterprises

meet these requirements. With their advantages, they simplify the organisational structure of the company by increasing its level of flexibility and enabling it to cope with the various challenges of a heterogeneous environment.

In the era of digitisation and growing business environment complexity, the fractal organisational structure and effective knowledge and information management seem to be crucial for companies' survival and success. In research conducted on a group of 382 respondents from 19 large companies in Poland, we sought to assess the impact of specific variables on the quality of information management in the context of the fractal organisational structure.

These variables encompass aspects such as awareness of the value of knowledge, innovation, efficiency, competitiveness, systematic knowledge gathering, the application of various research methods (data analysis, observation), the organisation and structure of knowledge, sharing and disseminating knowledge, the use of knowledge in decision-making, continuous improvement and learning, and the use of technology to support knowledge management.

The study focused on a group of employees in various positions: from managers, through heads and directors of various departments, to knowledge workers from various company divisions. Using a Likert scale (0–5), we measured how important knowledge is to them in the context of each of the aforementioned variables.

The results suggest that all these variables have an impact on the quality of information management, which confirms the importance of implementing and maintaining the fractal organisational structure. It is capable of creating a flexible environment, promoting systematic gathering and sharing of knowledge, supported by modern technologies.

The study, while comprehensive, has certain limitations. Foremost, it was confined to a specific geographic region – Poland, which may influence the ability to generalise the findings to other contexts. Additionally, the focus was primarily on large organisations, which potentially overlooks the nuances of fractal structures in smaller enterprises. Future research could be expanded to include a broader range of geographic locations and a wider spectrum of organisational sizes, which would allow for the verification and expansion of the results.

Based on the study's findings, it is recommended that organisations, particularly those operating in dynamic sectors, consider adopting fractal structures to enhance information management. Key practices include fostering an environment conducive to knowledge sharing, utilising technology for efficient information flow, and promoting autonomy and flexibility among employees. For effective implementation, investment in training programs is advised to familiarise employees with the concept of fractality and its application in their daily tasks.

Future research may focus on longitudinal studies to observe the long-term impact of fractal structures on information management. Investigating the application of these structures in different industries and cultural contexts could provide deeper insights. Furthermore, exploring the role of technology, especially artificial intelligence and machine learning, in optimising information management within fractal organisations presents a promising avenue for further research.

In summary, the study confirms the effectiveness of fractal structures in improving information management, yet continuous exploration in this field is essential to adapt to the evolving business landscape. The fractal organisational structure, in tandem with effective knowledge and information management, seems to be key to the future of businesses. It responds to the challenges of the modern, dynamic business environment, creating a foundation for effective operation and achieving success. The research results confirm the significance of introducing and maintaining this type of structure in business management practice.

References

Accou B., Carpinelli F. (2022), *Systematically investigating human and organisational factors in complex socio-technical systems by using the "SAfety FRactal ANalysis" method*, "Applied Ergonomics", Vol. 100, 103662.

Bider I . (2020), *Structural coupling, strategy and fractal enterprise modelling*, [in:] F. Dalpiaz, J. Zdravkovic, P. Loucopoulos (eds.), *Research Challenges in Information Science. 14th International Conference, RCIS 2020, Limassol, Cyprus, September 23–25, 2020, Proceedings*, Springer International Publishing, Cham, pp. 95–111, https://link.springer.com/chapter/10.1007/978-3-030-20618-5_24 [accessed: 23.03.2024].

Bider I., Chalak A. (2019), *Evaluating Usefulness of a Fractal Enterprise Model Experience Report*, [in:] I. Reinhartz-Berger, J. Zdravkovic, J. Gulden, R. Schmidt (eds.), *Enterprise, Business-Process and Information Systems Modeling. 20th International Conference, BPMDS 2019, 24th International Conference, EMMSAD 2019, Held at CAiSE 2019, Rome, Italy, June 3–4, 2019, Proceedings*, Springer International Publishing, Cham, pp. 359–373, https://link.springer.com/chapter/10.1007/978-3-030-20618-5_24 [accessed: 23.03.2024].

Bider I., Perjons E., Elias M., Johannesson P. (2017), *A fractal enterprise model and its application for business development*, "Software & Systems Modeling", Vol. 16, pp. 663–689.

Binsztok A. (2005), *Organizacja fraktalna*, [in:] R. Krupski (ed.), *Zarządzanie przedsiębiorstwem w turbulentnym otoczeniu*, Polskie Wydawnictwo Ekonomiczne, Warszawa, pp. 138–151.

Brafman O., Beckstrom R.A. (2006), *The Starfish and the Spider: The Unstoppable Power of Leaderless Organizations*, Portfolio, New York.

Carr N.G. (2003), *IT doesn't matter*, "Educause Review", Vol. 38, pp. 24–38.

Choi B., Lee H. (2002), *Knowledge management strategy and its link to knowledge creation process*, "Expert Systems with Applications", Vol. 23(3), pp. 173–187.

Frame M. (2017), *Fractals: A Very Short Introduction*, Oxford University Press, Oxford.

Haken H. (2006), *Information and Self-Organization: A Macroscopic Approach to Complex Systems*, Springer, Berlin.

Henkel M., Koutsopoulos G., Bider I., Perjons E. (2019), *Using the Fractal Enterprise Model for Inter-organizational Business Processes*, [in:] *Conference: ER Forum and Poster & Demos Session 2019, co-located with 38th International Conference on Conceptual Modeling (ER 2019)*, Salvador, Brazil, pp. 56–69, https://www.researchgate.net/publication/337787324_Using_the_Fractal_Enterprise_Model_for_Inter-organizational_Business_Processes [accessed: 23.03.2024].

Hock D. (2005), *One from Many: VISA and the Rise of Chaordic Organization*, Berrett-Koehler Publishers, San Francisco.

Hopej M., *Struktura organizacyjna fraktalnego przedsiębiorstwa*, „Ekonomika i Organizacja Przedsiębiorstwa", No. 3, pp. 9–12.

Kallinikos J. (2006), *The Consequences of Information: Institutional Implications of Technological Change*, Edward Elgar Publishing, Cheltenham.

Kelly K. (2001), *Nowe reguły gospodarki*, WIG-Press, Warszawa.

Khawla B., Molnár B. (2019), *A Survey on Dynamic Business Processes and Dynamic Business Processes Modelling*, [in:] *The international Conference ICEIS*, *SCITEPRESS*, pp. 556–563, https://www.scitepress.org/Papers/2019/76271/76271.pdf [accessed: 23.03.2024].

Klyukina V., Bider I., Perjons E. (2021a), *Does Fractal Enterprise Model Fit Operational Decision Making?*, [in:] *23rd International Conference on Enterprise Information Systems, SCITEPRESS*, pp. 613–624, https://www.scitepress.org/PublishedPapers/2021/104073/104073.pdf [accessed: 23.03.2024].

Klyukina V., Bider I., Perjons E. (2021b), *Patterns for Using Fractal Enterprise Modelling in Operational Decision-Making*, [in:] *Enterprise Information Systems*, Springer International Publishing, Cham, pp. 445–464, https://www.researchgate.net/publication/361829572_Patterns_for_Using_Fractal_Enterprise_Modelling_in_Operational_Decision-Making [accessed: 23.03.2024].

Koumas M., Dossou P.-E., Didier J.-Y. (2021), *Digital transformation of small and medium sized enterprises production manufacturing*, "Journal of Software Engineering and Applications", Vol. 14(12), pp. 607–630.

Krawczyk A. (2001), *Geometria fraktalna jako instrument opisu organizacji*, „Przegląd Organizacji", No. 4, pp. 18–19.

Lartey F.M. (2020), *Chaos, complexity, and contingency theories: a comparative analysis and application to the 21st century organization*, "Journal of Business Administration Research", Vol. 9(1), pp. 44–51.

Leego S., Bider I . (2021), *Using Fractal Enterprise Model in Technology-Driven Organisational Change Projects: A Case of a Water Utility Company*, [in:] *The 23rd IEEE International Conference on Business Informatics (IEEE CBI 2021), Bolzano*, Vol. 2, pp. 107–116, https://www.researchgate.net/publication/355874726_Using_Fractal_Enterprise_Model_in_Technology-Driven_Organisational_Change_Projects_A_Case_of_a_Water_Utility_Company [accessed: 23.11.2023].

Makowiec M. (2007), *Organizacja fraktalna*, [in:] B. Mikuła, A. Pietruszka-Ortyl, A. Potocki (eds.), *Podstawy zarządzania przedsiębiorstwami w gospodarce opartej na wiedzy*, Difin, Warszawa, pp. 67–68.

Mandelbrot B. (1982), *The Fractal Geometry of Nature*, W.H. Freeman and Company, New York.

McCord P. (2018), *Powerful: Building a Culture of Freedom and Responsibility*, Goodreads, Silicon Valley.

Morgan G. (1986), *Images of Organization*, Sage, Newbury Park.

Perechuda K. (2000a), *Kierowanie w organizacji fraktalnej*, [in:] K. Zimniewicz (ed.), *Instrumenty zarządzania we współczesnym przedsiębiorstwie*, vol. II, Wydawnictwo Akademii Ekonomicznej, Poznań, pp. 25–27.

Perechuda K. (2000b), *Organizacja fraktalna*, [in:] K. Perechuda (ed.), *Zarządzanie przedsiębiorstwem przyszłości. Koncepcje, modele, metody*, Placet, Warszawa, pp. 53–54.

Perechuda K. (2005), *Procesy kreowania wiedzy w organizacjach sieciowych*, [in:] K. Perechuda (ed.), *Zarządzanie wiedzą w przedsiębiorstwie*, Wydawnictwo Naukowe PWN, Warszawa, pp. 121–126.

Raye J. (2014), *Fractal organisation theory*, "Journal of Organisational Transformation & Social Change", Vol. 11(1), pp. 50–68.

Ryu K., Son Y.-J., Jung M. (2003), *Framework for fractal-based supply chain management of e-Biz companies*, "Production Planning & Control", Vol. 14(8), pp. 720–733.

Sandkuhl K., Kirikova M. (2011), *Analysing Enterprise Models from a Fractal Organisation Perspective – Potentials and Limitations*, [in:] *The Practice of Enterprise Modeling: 4th IFIP WG 8.1 Working Conference, PoEM 2011 Oslo, Norway, November 2–3, 2011 Proceedings 4*, Springer, Berlin–Heidelberg, pp. 193–207.

Schwab K. (2017), *Czwarta rewolucja przemysłowa*, World Economic Forum, Geneva.

Schwalbe K. (2015), *Information Technology Project Management*, Cengage Learning, Boston.

Singh R., Mishra J., Gupta V .K. (2023), *Dynamical analysis of a Tumor Growth model under the effect of fractal fractional Caputo-Fabrizio derivative*, "International Journal of Mathematics and Computer in Engineering", Vol. 1(1), pp. 115–126.

Szerb L. (2003), *The Changing Role of Entrepreneur and Entrepreneurship in Network Organisations*, [in:] I. Lengyel (ed.), *Knowledge Transfer, Small and Medium-Sized Enterprises, and Regional Development in Hungary*, JATEPress, Szeged, pp. 81–95, https://www.researchgate.net/publication/259532002_The_Changing_Role_of_Entrepreneurship_in_Network_Organization [accessed: 23.03.2024].

Tapscott D., Tapscott A. (2016), *Blockchain revolution: how the technology behind bitcoin is changing money, business, and the world*, Penguin, New York.

Warnecke H.J. (1993), *Fractal Company – A Revolution in Corporate Culture*, Springer, Berlin–Heidelberg.

Warnecke H.J. (1999), *Rewolucja kultury przedsiębiorstwa. Przedsiębiorstwo fraktalne*, Wydawnictwo Naukowe PWN, Warszawa.

Warner M., Witzel M. (1998), *General Management Revisited*, "Journal of General Management", Vol. 23(4), pp. 1–18.

Webber E., Dunbar R. (2020), *The fractal structure of communities of practice: Implications for business organization*, "PloS one", Vol. 15(4), e0232204.

Zehender K. (1998), *Unternehmensführung in fraktalen Unternehmen. Aufgaben, Architektur und Funktionsweise*, Peter Lang Verlag, Frankfurt.

Zarządzanie informacją w dynamicznym środowisku biznesowym – studium przypadku organizacji fraktalnych

Streszczenie: W dzisiejszych organizacjach zarządzanie informacją w warunkach ciągłych zmian otoczenia gospodarczego odgrywa istotną rolę. Rozszerzone możliwości pozyskiwania zasobów finansowych i materialnych sprawiły, że przeprowadzenie procesów gospodarczych nie jest już takim wyzwaniem jak wcześniej. Obecnie kluczowymi kwestiami są umiejętności szybkiego pozyskiwania, efektywnego gromadzenia, odpowiedniego przetwarzania i racjonalnego wykorzystywania informacji gospodarczej, co może przynieść przewagę konkurencyjną. Współczesne przedsiębiorstwa, funkcjonujące w dynamicznie zmieniającym się otoczeniu, mogą skorzystać z teorii fraktali, aby zrozumieć swoje zachowanie. Koncepcja organizacji fraktalnej, która doskonale odpowiada wymaganiom działania w turbulentnym i konkurencyjnym środowisku, może być również przydatna w budowaniu skutecznych systemów zarządzania informacją w organizacji, które są w stanie sprostać rosnącej zmienności otoczenia. Przedmiotem artykułu jest analiza roli zarządzania informacją

w warunkach ciągłych zmian otoczenia gospodarczego, z uwzględnieniem sposobów, w jakie organizacje mogą wykorzystać teorię fraktali do skutecznego zarządzania informacją i budowania przewagi konkurencyjnej. Artykuł zawiera opisowe i porównawcze metody analityczne oraz metody syntetyczne w celu zbadania i porównania różnych podejść do zarządzania informacjami. W badaniu wykorzystano statystyki mierzonych zmiennych testu W Shapiro Wilka oraz korelacje *r* Pearsona do opracowania modelu regresji wielokrotnej dla zmiennej zależnej.

Słowa kluczowe: zarządzanie informacją, zarządzanie wiedzą, organizacja fraktalna

JEL: L23, M15, O32

Received: 2023-10-05; revised: 2024-04-02. Accepted: 2024-06-21