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DYNAMIC MODEL OF THE EFFICIENCY OF SMALL ENTERPRISES

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Abstract. Previous considerations on the theory of the efficiency of small enterprises in the literature have not led to the creation of a comprehensive model. This is due to the ambiguity of the concept of efficiency and the lack of consistency in the subject matter. In the traditional approach, the efficiency measures needed to be improved for managing small organisations that compete in a turbulent environment. The measures included in the literature mainly refer to financial issues, whereas to a minimal extent, they refer to the future efficiency of the organisation. Therefore, the need to organise the problems raised in theoretical and research areas was indicated. This study aims to create a dynamic model of efficiency in a small enterprise. Quantitative analysis based on a representative sample of 455 organisations allowed the verification of the hypotheses, resulting in a comprehensive model of the efficiency of small enterprises. The empirical model coincided with the conceptual model. The model was validated on a sample of 336 service companies. On this basis, the company's efficiency occurs in a continuous cycle of its elements: economic efficiency, manufacturing efficiency, and effectiveness.

Keywords: Small and medium enterprises (SME); economic efficiency; effectiveness; manufacturing efficiency

1. Introduction

In a hyperdynamic environment (Freeman and Reed 1983) (Ashkenas et al. 2002) (Schumpeter 2017), characterised by phenomena of the black swan type (Beliaeva et al. 2020), the effectiveness of small enterprises is determined by the prompt adaptation to changes (Ștefănescu 2018). These should ensure the organisation's anticipatory response to the environment's requirements (Perechuda 2018), (Bonnet and Lehtimaki 2020). *"Creative Destruction"* is now (McKnight et al. 2001; Mohr et al. 2010) the driving force behind the small and medium-sized enterprises (Lerner 2006), (van Stamm and Trifilova 2009), (Metcalfe 2004). Thanks to this rotation, the economy is still "reincarnated" (Kalvet and Kattel 2006). Remarkable changes in today's world go beyond supply and demand imbalances or technological advances (Ryfkin 2001), (Vavrecka et al. 2021).

Micro and small enterprises assimilate relatively quickly to the changing environment, but their mortality rate is high (Kortelainen et al. 2012). Understandably, small entrepreneurs struggle with finding a reliable recipe for high efficiency in the conditions of internationalisation and globalisation (Kazlauskaitė et al. 2015). The very specificity of the operation of small enterprises conditioned by limited resources (Owusu et al. 2019), (Bretherton and Chaston 2005), (Wach 2008), (Wang and Clegg 2018), (Wasiuzzaman 2019), (Alshami 2019) and no cash reserves (Ghalke et al. 2022) it is a barrier in itself that is difficult to overcome in the pursuit of high efficiency. However, many examples in the business practice of SMEs focus solely on short-term financial performance, overlooking essential needs that determine long-term success (Rubio-Andrés et al. 2022).

The SME sector is perceived as an absolute stimulus of the economy (Eyre and Smallman 1998), (Berger and Udell 1998), (Audretsch and Thurik 2000), (Jamali et al. 2009) and a reason to build the economic potential of countries. The literature studies confirm the recognition of its crucial role in creating stability and growth of the economy (Wijewardena et al. 2008), (Komkov et al. 2011), particularly in countries where the share of small enterprises in the total GDP is relatively high (Kotey and Meredith 1997). Therefore, the problem of the efficiency of enterprises in the SME sector becomes essential, which may be related to the factors determining the activity in a single country (Sajnóg 2015).

The unambiguous concept of organisational effectiveness and methods of its assessment has long been an unresolved subject of interest for both theoreticians and practitioners. Theorists made attempts to develop generalised models (or sets of criteria) based on different paradigms, enabling the description of the organisation in terms of its effectiveness and conditions for shaping it (Argyris and Schön 1974), (Cherns 1976), (Quinn and Rohrbaugh 1983), (Quinn 1988), (Kaplan and Norton 1992), (Kaplan and Norton 1993, 1996), (Argyris 1994) (Cilliers 2005), (Gatarik and Born Rainer 2012). Managers conducting diagnostic and intervention activities in organisations face the problem of the multiplicity of such models (taking into account sets of criteria) (Carton and Hofer 2010). It means continuously monitoring activities to ensure high efficiency in using resources and all business processes (Skowronek-Mielczarek and Bojewska 2017).

The analysis of the literature shows that many authors typology efficiency, defining it from different perspectives (Pasour 1981), (Drucker 2005), (Harrington 1926), (Cunningham 1977), (Hamrol 2001), (Samuelson and Nordhaus 2005), (Yarnada 1972), (Campbell 1977), (Clark et al. 1980), (Romani, John et al. 1981), (Xenophon and Holden 2010). It can be concluded that the vector of the organisation's success is the solution to the practical problem of measuring and evaluating its efficiency (Holcomb and Holmes 2005), (Beer 2009).

This literature analysis shows a methodological gap in the research on the efficiency of small enterprises. This is due to the equivocal understanding of the concept of efficiency and how an efficiency model is constructed. Current achievements in this area are characterised by inconsistency in the subject matter, research is selective, and does not cover the entirety of issues of organisational efficiency. The aim is to suggest a grounded methodology to construct the dynamic model of efficiency. The article is an attempt to fill the research gap in theoretical and practical dimensions.

2. Literature review and theoretical background

The results of the literature research presented in the table confirm that the efficiency problem is still relevant, and a comprehensive model must be developed. The table shows the areas related to the study of SMEs' efficiency and the scope of research in these areas. The adopted layout of the literature research presentation was the background to create the grounded methodology allowing the construction of the dynamic model of efficiency.

Table 1. Literature review

Areas of Efficiency	Scope and content of the study
economic efficiency	• an attempt to specify and determine which of the success factors is particularly important for the effectiveness measured by the results of enterprises (Wu and Wu 1994; Wu 1996) • economic efficiency indicator measured by the financial result using series of interviews (Hudson et al. 2001) • relationship between the economic results of SME enterprises and the variables including quality, time, flexibility, the level of financial result, customer satisfaction, human resources and gender of the owner (Glancey 1993; Davies et al. 2002; De Zoysa and Herath, Siriyama 2007) • total sales and profitability of enterprises (O'Cass and Weerawardena 2009) • resources processing into products and revenues research conducted on the domestic market (Szymańska 2010) • the interaction between an SME's profitability and the owner's personality (Steinerowska-Streb 2012); the manager's influence as a determinant of the company's profits. (Steinerowska-Streb 2012) • methods of supporting effective management of the most significant importance for the development of entrepreneurship and identify the most frequently used methods by business owners (Siemieniak 2014) • the impact of the family (or non-family) nature of the firm on the relationship between environmental and financial performance of the firm (Garcés-Ayerbe et al. 2022) • the socio-emotional benefits of appointing women as family directors, and how some of these specific female characteristics (desire to pass the business on to future generations, long-term commitment and willingness to protect the family's reputation) prove beneficial to the performance of the family business (García-Meca and Santana-Martín 2022) • links between a company's internal Corporate Social Responsibility and its implementation. The results of this study showed that two internal activities, employee behaviour related to strategic renewal and behaviour related to new business ventures, partially mediate the link between internal CSR practices and company performance (Giang and Dung 2022) • Corporate Social Responsibility (CSR) and knowledge-based resources, i.e. intellectual capital (IC), improve financial results. (Mutuc and Cabrilo 2022) • The impact of family ownership on the performance of small and medium enterprises (SMEs) in the context of internal and external governance mechanisms. On their basis, a positive bidirectional relationship was claimed between performance and promoter ownership without the moderating effect of internal governance (Ghalke et al. 2023)
the organisation's manufacturing efficiency	• the relationship between the goals achieved and the need to adopt a new management strategy (Baruk 2006) • Polish authors attempted to investigate critical factors of scalability of enterprises in the SME sector (Parkitna and Galus 2017) • the impact of international experience on the efficiency of small and medium enterprises measured by company results was confirmed (Camisón and Villar-López 2010; Franz et al. 2018). • digital technologies are employed to increase the efficiency and effectiveness of the relationship of digital communication (Salo et al. 2020) which is the result of following the changing world in which the role of social media and the development of e-commerce is increasing (Kmecová et al. 2021) • high managerial dominance does not guarantee success; other factors are needed to promote innovation in small businesses and ensure their growth (Harel et al. 2021) • the pursuit of goals is associated with less formal practices, carried out on privately owned small and medium-sized family businesses (Michiels et al. 2022) • strategic agility positively influences performance in both developed and emerging markets (Vrontis et al. 2022) • a close relationship between innovation, entrepreneurship and productivity growth in the high-tech sector (Haltiwanger 2022; Piccinetti et al. 2023) • the attempts to establish single measures of organisational effectiveness were unsuccessful; the researchers examined the relationship between overconfidence as a character trait of owners/managers and organisational resilience in terms of the effectiveness of the organisation's business processes carried out

	(Kunz and Sonnenholzner 2023)
external factors	• lack of unambiguous results in the area of exploration of companies' reactions to changes in the environment and the impact of SME development and obtaining external business advice while controlling the impact of SME characteristics on age, production/services, advanced technology, the level of innovative skills of the workforce, exports and the number of competitors (Robson and Bennett 2000) • context of internationalisation and the impact of economic transformations on the development of SME enterprises (Bateman et al. 2002) • efficiency barriers included external and internal obstacles; research studies have verified the degree of survival of the company by selecting and taking into account characteristics, context and the degree of inclusion in the entrepreneurial network in France (Abdesselam et al. 2004); the research has shown a relationship between the effectiveness measured by the development of enterprises such as SMEs and innovation in areas related to ecology (Roy et al. 2016; Ebrahimi and Mirbargkar 2017) • exploration of firms' responses to environmental changes significantly dependent on internal factors that are fundamental to achieving efficiency and success (Ashkenas et al. 2002; Bretherton and Chaston 2005), such as: speed of action, flexibility, trust, integration of activities, innovation and e-business (Salder et al. 2020); research conducted in Malaysia confirms the relationship between innovative capacity and operational efficiency (Iranmanesh et al. 2021) • the success of enterprises depends on a combination of the following conditions of institutional quality: accountability of the voice, political stability, quality of regulation and the rule of law (Lv et al. 2021).
effectiveness	• factors influencing the development of small and medium enterprises on the market in the region; in a situation of economic and technical difficulties and intense competition, the ability to maintain the company's operations and, ensure its survival and avoid liquidation plays an important role (Lachiewicz 2013; Nowicki 2013) • impact of a creative strategy on efficiency; the result only partially confirmed the existence of a positive relationship between the dimensions of creative strategy and the efficiency of assessing using subjective measures and contradicted (Dyduch 2013) • relationships between such factors as entrepreneurial characteristics, product and financial issues, social ties and human capital, and the market success of the company have been demonstrated (Nishantha and Pathirana 2013; Umar et al. 2022); additionally, the relationship between age (and size) and export intensity (and performance) is moderated by the type of management in a given type of SME, given an SME-type (Dubey and Das 2021) • the impact of the national research and development (R&D) programme in the field of technological innovations on the effectiveness of small and medium-sized enterprises (Park 2014) • the relationship between gender and the growth objectives of companies, i.e. turnover, profit professional level and new markets (Cabeza-García et al. 2021; Ting et al. 2021); when organisations are focused on increasing sales, profits, employees and new markets, they are more likely to face difficulties when the managers are women. On the other hand, when company goals are linked to increasing innovation, brand reputation and relationships with other companies, companies are more orientated towards resilience when they are not led by women (Casprini et al. 2022)
efficiency	• no empirical results have been identified that would suggest which factors are most strongly correlated with critical performance dimensions (Ha-Brookshire, Jung 2009) • in "high-performance enterprises", belonging to the SME sector, the level of efficiency is monitored using a wide range of efficiency indicators; however, the study described in the literature lacked a detailed description of the research tool, evaluation model and a set of indicators measuring efficiency (Zbierowski 2013) • the relationship between the efficiency measurement and the accuracy of the performance measurement has been recognised by scientists around the world (Koźmiński 2008; Koźmiński and Latusek-Jurczak 2017) • system and the development efficiency of small and medium-sized enterprises was confirmed (Gębczyńska, 2017)

Source: Own elaboration

Concluding the above considerations, the main research question is as follows: ***What is efficiency, and how do the individual components of efficiency create its model?*** Moreover, a group of detailed questions was developed, based on which supplementary questions were formulated:

*Question 1. **Does efficiency depend on the type of business?***

*Question 2. **Does efficiency depend on the number of people in the enterprise?***

The hypotheses formulated complement the proposed research questions:

H_{P0}: A statistically significant reciprocal relationship exists between the model elements and the efficiency.

H_{P1}: The efficiency between the distinguished types of activity differs significantly.

H_{P2}: The efficiency between distinguished groups by the number of people in an enterprise is significantly different.

In the traditional approach, the efficiency measures turned out to be insufficient for managing small organisations (Gębczyńska 2017). A mere increase in economic efficiency is not enough to change the overall use of resources. Certain principles should be applied in planning to achieve cost-effectiveness, which is challenging in small enterprises (Burchard-Dziubińska et al. 2014). Excellence in managing parts of an organisation's operations is not enough to ensure a dynamic balance of operational efficiency. In the management of fragmentary areas of the enterprise, there is a tendency to emphasise the effectiveness of the performance of a given function at the expense of losing the overall efficiency- the effectiveness of the level of achieved goals of the entire organisation (Oleksiuk 2014).

The search for opportunities to increase the efficiency of a modern organisation to ensure its competitiveness considers management processes (Osbert-Pociecha 2013). In managing the company's efficiency, time must be regarded as one of the resources. The time analysis of processes is used to assess the efficiency of the company's operations. It is sometimes a determinant of readiness and the ability to take on challenges and take advantage of emerging opportunities. The very reduction of the processing time leads to increased market competitiveness (Sarnowski 2013).

3. Methodology

3.1. Concept of a theoretical mathematical model

The performance paradox refers to the weak correlation between the efficiency indicators and the effectiveness itself, understood as a performance measurement (Meyer and O'Shaughnessy 1993; Meyer, M and Gupta 1994). Over time, performance indicators tend to lose the ability to measure efficiency, making it impossible to distinguish between effective and ineffective actions (behaviours).

As a result, the relationship between actual and reported activities is reduced, often resulting in an overly optimistic assessment of reality. Therefore, this paradox does not refer to the activity itself but to the effects of its measurement (van Thiel and Leeuw 2002).

In summary, the construction of such a model that can be used to measure efficiency reliably is significant in the aspect of the organisation's limited resources (Nieplowicz 2014). Therefore, considering the importance of small business performance management, our goal was to solve the research problem. The present study has attempted to cover the missing links and find research gaps on the subject matter.

Managing the efficiency of a small enterprise is a process, and knowledge of the dimensions of efficiency will build the right background for development (Li and Hu 2002).

The efficiency of an SME we define as the entirety of the activities of its owners in the area of economic and manufacturing efficiency (performance), the effectiveness of a small organisation aimed at achieving success (reflecting the ability to create a success of the enterprise at a specific moment in time when certain external factors operate).

Based on the stages of research proceedings in empirical sciences (Bunge 2017), our analysis of the literature concluded that:
- efficiency is a subject of science that can be measured and acted on in a specific direction as a controlled entity,
- enterprises from the SME sector, due to their specificity, are not subject to the rules for large enterprises
- there needs to be a comprehensive model of the efficiency of a small organisation in the literature on the subject.

To carry out a practical verification of the research problem, we conducted qualitative research with owners of small businesses. The interviews were based on the goal grid and the SMART method. (Specific, Measurable, Ambitious, Realistic, Time-bound). The stages of the research procedure we adopted allowed us to formulate the main goal and set unequivocal research goals, which are:
- organising the concepts of the efficiency of a small organisation,
- developing a small business efficiency model.

As a starting point for creating the model, changing how it is understood is necessary. Therefore, we assumed that the main objective of an enterprise's activity is to maximise the value for the owners. This general objective consists of specific objectives, which can be grouped as follows:
- growth of the enterprise - understood as an increase in the volume of production and, consequently, sales, i.e., manufacturing efficiency,
- development of the enterprise - understood as the introduction of new products and expansion of operations into new markets, i.e., effectiveness of market activities,
- making profits - understood as gaining funds for both the growth and development of the enterprise, i.e., economic efficiency.

We assumed that important aspects influencing efficiency are:
- correct estimation of future expenditures - economic efficiency,
- performance of previously planned tasks - manufacturing efficiency
- the expediency of outlays; outlays incurred are adequate for implementation, and the objective achieved determines the effectiveness.

Therefore, from the perspective of management theory and business practice in the case of micro and small enterprises, it seems justified to modify organisation objectives from the perspectives of efficiency and market success (Table 2).

Table 2. Objectives of the enterprise

The overarching objective of the business	Levels of efficiency	Main objectives	Specific objectives	Management objectives
Maximising the owner's wealth, increase in the value of the SME company	Economic efficiency	Result	Profitability = Maximise profit	Cost optimisation
				Maximising revenue
			Liquidity = Optimisation of the operating cash level in circulation	Receivables
				Liabilities
				Stock
	Manufacturing efficiency	Growth	Productivity = ability to make use of resources	New products
				Investment in development
	Effectiveness	Development	Optimisation of market positioning strategy = Strengthening market position	Satisfying customer requirements and needs
				Advertising and marketing

Source: Own elaboration

The efficiency management process will be divided into three areas: results, growth and development. The efficiency of SMEs should be considered together as a triad of relationships between the three components: economic efficiency, manufacturing efficiency and effectiveness of operations, which are defined as follows:

- economic efficiency (E_e) - an action where the result obtained exceeds the expenditure incurred to obtain it (Kotarbiński 1974; Kazlauskaite and Buciuniene 2008; Szudy 2013; Górski and Parkitna 2017; Griffin 2017) in the case of SMEs perceived as operating cash in circulation = result with because it is less susceptible to manipulation than the financial result,

- the organisation's manufacturing efficiency (M_e), (Barasa et al. 2019) (Guinee et al. 2007) (Sarmiento et al. 2007) (Mullen et al. 1996), i.e. performance (Knedler 2002), in the context of the original meaning of the term as a feature of the operation – the proper performance of something in the given time (Harrington 1926), in relation to the original paradox of efficiency understood as productivity (Meyer and O'Shaughnessy 1993; Meyer and Gupta 1994) and not the meaning of efficiency as an evaluation of good work. In this sense, a firm is efficient if, making full use of its resources, it produces goods for which there is market demand without unnecessary stockpiling (Sulmicki 1978). In general, productivity could be defined as the efficiency changes between periods (Jubilee et al. 2021a), (Jubilee et al. 2021b). Productivity results from technological progress, which emerges from the capacity of (new and incumbent) economic agents to generate and commercialise innovations (Lafuente et al. 2020).

- effectiveness (E_n) - an action that leads to the market effect intended as an objective (Henri 2004), (Cameron 1986), (Gaertner and Ramnarayan 1983), (Pearce 2000), (Pasetta 2005).

Considering the importance of the efficiency of small enterprises, the paper attempts to solve the research problem of creating a model of efficiency.
The efficiency of an enterprise is a continuous cycle of its components.

$$Ee_0 \rightarrow Me_0 \rightarrow En_0 \rightarrow Ee_1 \rightarrow Me_1 \rightarrow En_1 \rightarrow Ee_2 \rightarrow \cdots$$

The moment of entry in the business register is the beginning of business activity. At the outset, an enterprise generally has some initial capital, determining its economic efficiency. This capital leads to the accumulation of

resources, the consumption of which determines manufacturing efficiency. The growth of the organisation determines its effectiveness in the market. The return from the market determines the economic efficiency of the new cycle, etc (Figure 1).
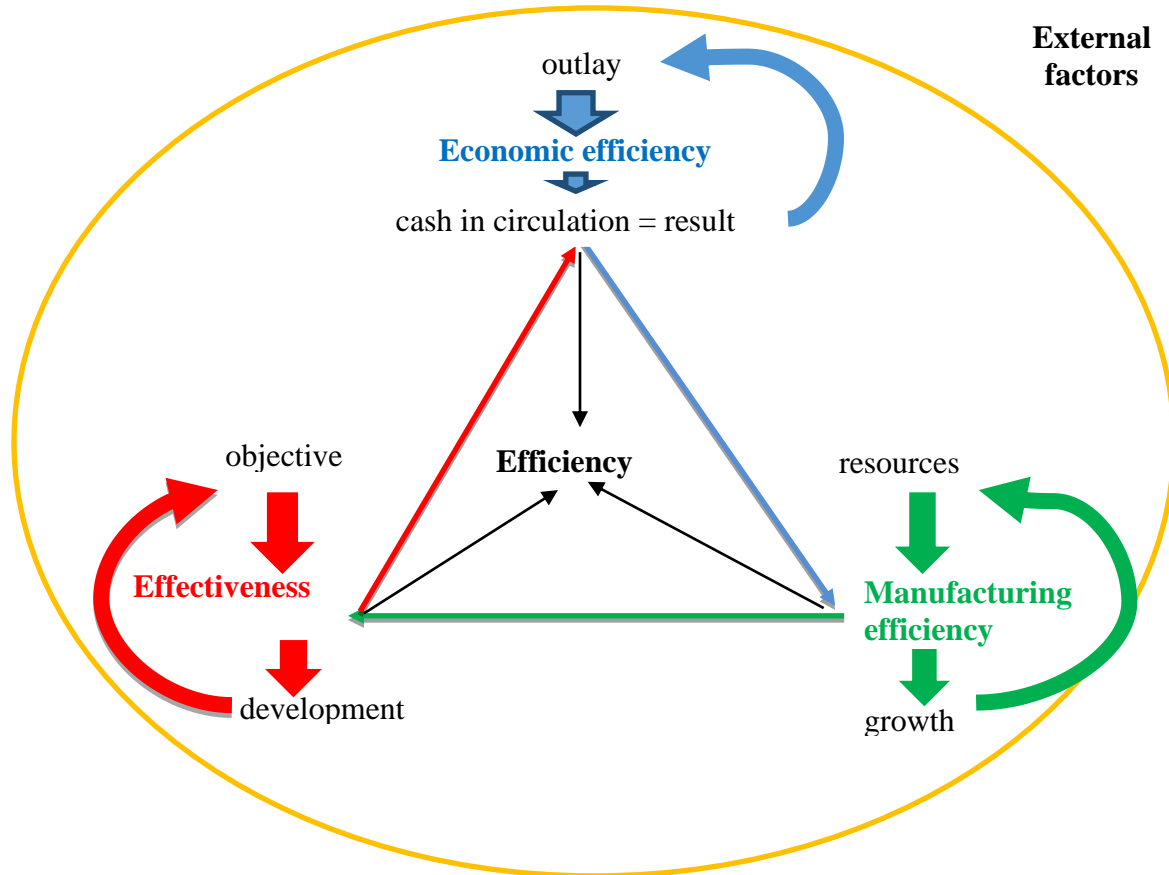

Figure 1. Model of the efficiency triangle in time t

The enterprise is set up to exist indefinitely, so there is no possibility of a time limit here. The efficiency triangle cycle runs from when the enterprise is established - moment 0, to the subsequent cycles in time $- t = 1,..., n$. The efficiency triangle is exposed to external factors determining the efficiency at a specific point in time t. The model's basic assumption is to present each company's efficiency at moment t as a point $E_f = (E_e, M_e, E_n)$ in the Cartesian reference system (three-dimensional space).

A set of ordered components determines the position in dimension R^3 of each efficiency point:

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A set of ordered components determines the position in dimension R^3 of each efficiency point:

$$R^3 = \{(E_e, M_e, E_n): E_e, M_e, E_n \in R\}$$

The efficiency measure can be defined as the length of the vector determined based on the previously discussed parameters (E_e, E_n, M_e). The length of the efficiency vector is expressed as:

$$\|E_f\| = \sqrt{e_e + m_e + e_n}$$

$\|E_f\|$ - the length of the vector (non-negative value),

e_e - square of the length of the economic efficiency component at moment/time t, determined as a positive change in the economic efficiency value:

$$e_e = (\max(E_{et} - E_{et-1}, 0))^2$$

m_e - square of the length of the manufacturing efficiency component at moment/time t, determined as a positive change in the economic efficiency value:

$$m_e = (\max(M_{et} - M_{et-1}, 0))^2$$

e_n - square of the length of the effectiveness component at moment/time t, determined as a positive change in the economic efficiency value:

$$e_n = (\max(E_{nt} - E_{nt-1}, 0))^2$$

Therefore, for the first step/cycle/run, assuming negative change is not plausible a simplified form of the length of the vector determining the efficiency value can be presented as:

$$\|E_f\| = \sqrt{(E_{e_1} - E_{e_0})^2 + (M_{e_1} - M_{e_0})^2 + (E_{n_1} - E_{n_0})^2}$$

$E_{e_0} E_{n_0} M_{e_0}$ the initial values are 0.

At $t = 0$ the company has no value yet; this is the moment of initiation of business activity, equal to the moment of entry in the register, therefore:

$$\|E_f\| = \sqrt{E_{e_1}^2 + M_{e_1}^2 + E_{n_1}^2}$$

Such a description of an enterprise's efficiency is accurate since statistical evidence in the literature generalises the characteristics of vectors for a multidimensional case and the presentation of their selected properties.
Assumptions:
1)   All the components of efficiency are interconnected.

2)   Economic efficiency, effectiveness, and manufacturing efficiency vectors are linearly independent.

3)   At t = 0 the efficiency vector components are equal to 0.

3.2. Sample and data collection

To verify the model, a questionnaire was constructed according to the methodology (Babbie 2004; Glasow 2005; Taherdoost 2016; Hair et al. 2013). Successive iterations determined the accuracy of the survey with 76 long-term owners, entrepreneurs and employees of organisations supporting the development of entrepreneurship in Poland. The Polish market was selected as an appropriate one because the Index agency FTSE Russell (LSEG Business 2022) has reclassified Poland from "emerging markets" to "developed markets" in 2018. Poland is the first country to be promoted to developed markets and the first time a country from Central and Eastern Europe has been qualified for this group. Evidence from the literature suggests that entrepreneurs in developing economies develop informal platforms for cooperation and financing, thus strengthening their entrepreneurial ecosystem (Guerrero et al. 2021).

We estimated the size of a representative research sample for a finite population of 2,150,000 enterprises, which is 384 complete answers with a significance level of 0.05 and an error of 5%. Using traditional and electronic distribution channels, 10,000 questionnaires were delivered to the owners of micro and small entities throughout Poland, of which 455 fully completed forms were obtained (4.55% of the total). The sample is representative of the total population of small enterprises in Poland.

According to the APA standards, the concept of validity is homogeneous and should be used to define the research tool as a whole (Pitts and Naumenko 2016). The questionnaire begins with the part concerning the external factors of the environment, which determine the efficiency of enterprises measured by its success (Scale 1. External determinants). The second part concerns economic efficiency assessment (Scale 2. Economic efficiency). The third part concerned manufactory efficiency, that is, the company skills and the assessment of the impact of its factors on the level of efficiency measured by performance (Scale 3. Manufacturing efficiency). The fourth part concerned effectiveness, achieving a market position, and assessing the impact of its factors on the level of efficiency measured by effectiveness (Scale 4. Effectiveness). Parts 5 to 7 are dedicated to efficiency management. The fifth part concerned the presentation of efficiency in terms of economic efficiency management at time t, which is the result of past actions at time t - 1 (Scale 5 - Past). The sixth part concerned the recognition of efficiency in terms of manufacturing efficiency management in the current operational activity at time t (Scale 6 - Present). The seventh part concerned the efficiency of managing the effectiveness at time t in planning future market operations at time t + 1 (Scale 7 - Future). A measurement was created using a five-point Likert scale.

3.3. Research Framework

To answer the research questions, we have created a conceptual mathematical model along with detailed hypotheses resulting from the research questions posed. Measurement reliability analysis was completed using Cronbach's alpha coefficient. The hypotheses were formalised and then statistically verified. Afterwards, algorithms for the hierarchical grouping of data were used. The procedure was performed using SPSS IBM Statistic and MATLAB software. The model was validated using the same tools.

4. Research findings

4.1. Reliability analysis

Based on the performed calculations, we validated the reliability of all 7 scales related to the questionnaire question areas. The research tool should be considered reliable and appropriate for further data analysis. The statistical characteristics of the research sample confirmed the accuracy of the survey structure and individual descriptive statistics.

At the stage of operationalisation of the research model, we formulated hypotheses. Verification of research hypotheses is done by verifying the statistical hypothesis (Rószkiewicz et al. 2013).

4.2. Verification of the main hypothesis

$$H_{P0}: \mu_{Ee} \Leftrightarrow \mu_{Me} \Leftrightarrow \mu_{En} \Leftrightarrow \mu_{Ef}$$

$$H0_{P0}: \mu_{Ee} \not\Leftrightarrow \mu_{Me} \not\Leftrightarrow \mu_{En} \not\Leftrightarrow \mu_{Ef}$$

H_{P0}: A statistically significant reciprocal relationship exists between the model elements in the triangle and efficiency.
$H0_{P0}$: There is no statistically significant reciprocal relationship between the model elements in the triangle and efficiency.

Variables do not have a normal distribution. To verify the hypotheses, we used Spearman's rank correlation (Kendall, Maurice 1948), one of the non-parametric measures of monotonic statistical dependence between random variables for independent samples.

Because the correlation coefficient between

- Economic efficiency (E_e) and Manufacturing efficiency (M_e): R = 0,391, p = 0 < 0,01,
- Manufacturing efficiency (M_e) and Effectiveness (E_n): R = 0,441, p = 0 < 0,01,
- Effectiveness (E_n) and Economic efficiency (E_e): R = 0,467, p = 0 < 0,01,
- Effectiveness (E_n) and Efficiency (E_f): R = 0841, p = 0 < 0,01,
- Manufacturing efficiency (M_e) and Efficiency (E_f): R = 0,712, p = 0 < 0,01,
- Economic efficiency (E_e) and Efficiency (E_f): R = 0,779, p = 0 < 0,01,

We reject hypothesis **$H0_{P0}$** in favour of **H_{P0}**. Therefore, it should be assumed that a statistically significant mutual relationship exists between particular elements of the model.

The analysis of the significance of the correlation coefficients should be supplemented with the direction and strength of the relationship. All correlations between the analysed variables have a positive coefficient, meaning that the other increases along with increasing one feature. There is a weak relationship between elements of the model: E_n and M_e, E_n and E_e, E_e and M_e. There is a strong relationship between the individual components of the model and efficiency.

4.3. Verification of specific hypotheses

Does efficiency depend on the type of business you run?

$$H_{P1}: \mu Ef_{trade} \neq \mu Ef_{service} \neq \mu Ef_{production} \neq \mu Ef_{mixed}$$
$$H0_{P1}: \mu Ef_{trade} = \mu Ef_{service} = \mu Ef_{production} = \mu Ef_{mixed}$$

H_{P1}: The efficiency between the distinguished types of activity differs significantly.
$H0_{P1}$: The efficiency between the distinguished types of activity is not significantly different.

The Kruskal Wallis test result χ^2 = 9,412, p = 0,024 < 0,05 indicates the necessity to reject hypothesis **$H0_{P1}$** and adopt **H_{P1}**, which means that the efficiency level in trade, service, production and mixed enterprises differs significantly.

Does efficiency depend on the number of people in an enterprise?

$$H_{P2}: \mu_{Ef1person} \neq \mu_{Ef2-4people} \neq \mu_{Ef5-10people} \neq \mu_{Ef11-24people} \neq \mu_{Ef25-49people} \neq \mu_{Ef50people}$$
$$H0_{P2}: \mu_{Ef1person} = \mu_{Ef2-4people} = \mu_{Ef5-10people} = \mu_{Ef11-24people} = \mu_{Ef25-49people} = \mu_{Ef50people}$$

H_{P2}: The efficiency between distinguished groups by the number of people in an enterprise is significantly different.
$H0_{P2}$: The efficiency between distinguished groups by the number of people in an enterprise is not significantly different.

The Kruskal Wallis test result χ^2 = 30,165, p = 0 < 0,05allows the rejection of hypothesis **$H0_{P2}$**. The hypothesis **H_{P2}** is accepted, which means that the efficiency level in enterprises with 1 person, 2-4, 5-10, 11-24, 25-49, and 50 people differ significantly in the groups distinguished in this way. Therefore, it is necessary to test the detailed hypotheses regarding the efficiency components in the studied group.

$$H_{P21}: \mu_{Ee1person} \neq \mu_{Ee2-4people} \neq \mu_{Ee5-10people} \neq \mu_{Ee11-24people} \neq \mu_{Ee25-49people} \neq \mu_{Ee50people}$$
$$H0_{P21}: \mu_{Ee1person} = \mu_{Ee2-4people} = \mu_{Ee5-10people} = \mu_{Ee11-24people} = \mu_{Ee25-49people} = \mu_{Ee50people}$$

H_{P21}: The economic efficiency between distinguished groups by the number of people in an enterprise is significantly different.
$H0_{P21}$: The economic efficiency between distinguished groups by the number of people in an enterprise is not significantly different.

Kruskal Wallis test result χ^2 = 12,684, p = 0,027 < 0,05, the **$H0_{P21}$** hypothesis is rejected. The hypothesis **H_{P21}** is accepted, which means that the level of economic efficiency in enterprises with 1 person, 2-4, 5-10, 11-24, 25-49 and 50 people differ substantially.

$$H_{P22}: \mu_{Me1person} \neq \mu_{Me2-4people} \neq \mu_{Me5-10people} \neq \mu_{Me11-24people} \neq \mu_{Me25-49people} \neq \mu_{Me50people}$$
$$H0_{P22}: \mu_{Me1person} = \mu_{Me2-4people} = \mu_{Me5-10people} = \mu_{Me11-24people} = \mu_{Me25-49people} = \mu_{Me50people}$$

H_{P22}: The manufacturing efficiency between distinguished groups by the number of people in an enterprise is significantly different.
$H0_{P22}$: The manufacturing efficiency between distinguished groups by the number of people in an enterprise is not significantly different.

Kruskal Wallis test result χ2 = 25,202, p = 0 < 0,05, the hypothesis **H0P22** is rejected **and** the hypothesis **H$_{P22}$** is accepted. There are statistically significant differences in the average levels of manufacturing efficiency between groups distinguished by the number of people in an enterprise.

$$H_{P23}: \mu_{En1person} \neq \mu_{En2-4people} \neq \mu_{En5-10people} \neq \mu_{En11-24people} \neq \mu_{En25-49people} \neq \mu_{En50people}$$

$$H0_{P23}: \mu_{En1person} = \mu_{En2-4people} = \mu_{En5-10people} = \mu_{En11-24people} = \mu_{En25-49people} = \mu_{En50people}$$

H_{P23}: The effectiveness between distinguished groups by the number of people in an enterprise is significantly different.
$H0_{P23}$: The effectiveness between distinguished groups by the number of people in an enterprise is not significantly different.

Kruskal Wallis test result $\chi^2 = 30,815$, p = 0 < 0,05, the hypothesis **H0P23** is rejected. The hypothesis **H_{P23}** is accepted, which means that the level of effectiveness in enterprises with 1, 2-4, 5-10, 11-24, 25-49 and equal to 50 people differs substantially.

4.4. Efficiency Triangle Empirical Model in Multidimensional Space

The result of the research is presented in a diagram as the Efficiency Triangle Model (Figure 2) in a multidimensional space for enterprises grouped by their size.

Figure 2. Diagram as Efficiency Triangle Model
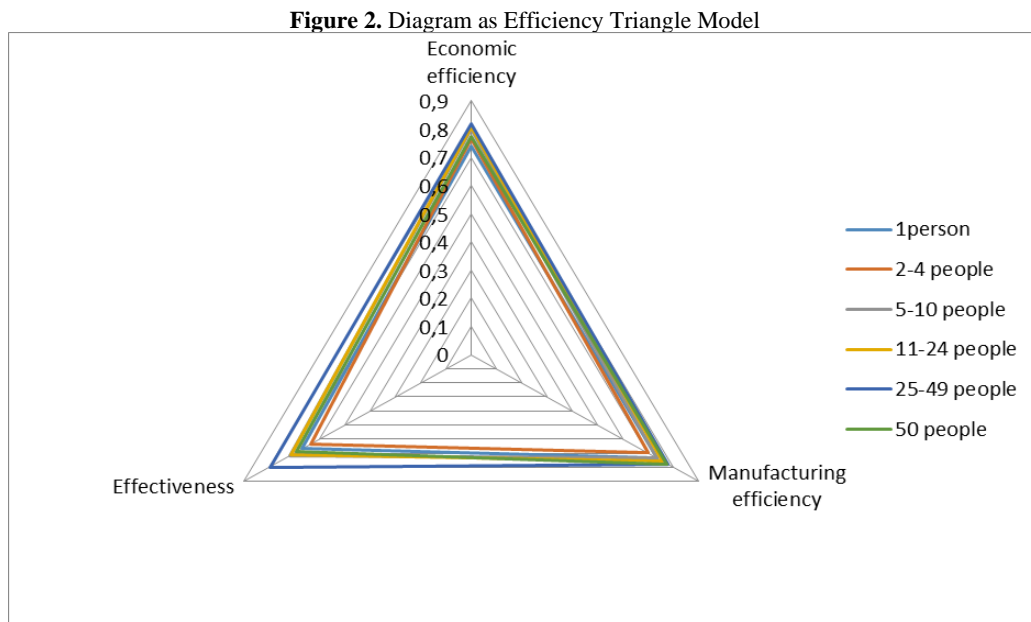
Source: Own elaboration.

To analyse the survey results, we used the hierarchical bottom-up grouping agglomeration algorithm (Table 3). As a result of successive iterations, coordinates were obtained, which are also vertices coordinates of the model elements. The obtained result is presented in the table.

Table 3. Agglomeration algorithm of hierarchical bottom-up grouping

	1 person	2-4 people	5-10 people	11-24 people	25-49 people	50 people
Economic efficiency	0,740814	0,76609	0,80135	0,806159	0,820437	0,775362
Manufacturing efficiency	0,735482	0,69806	0,73528	0,757473	0,777344	0,775136
Effectiveness	0,668504	0,63551	0,71860	0,711413	0,798214	0,691304

Source: Own elaboration.

To accurately interpret the model, we have decomposed its structure. As shown in Figure 3, it is possible to show the spread in position by the size of an enterprise.
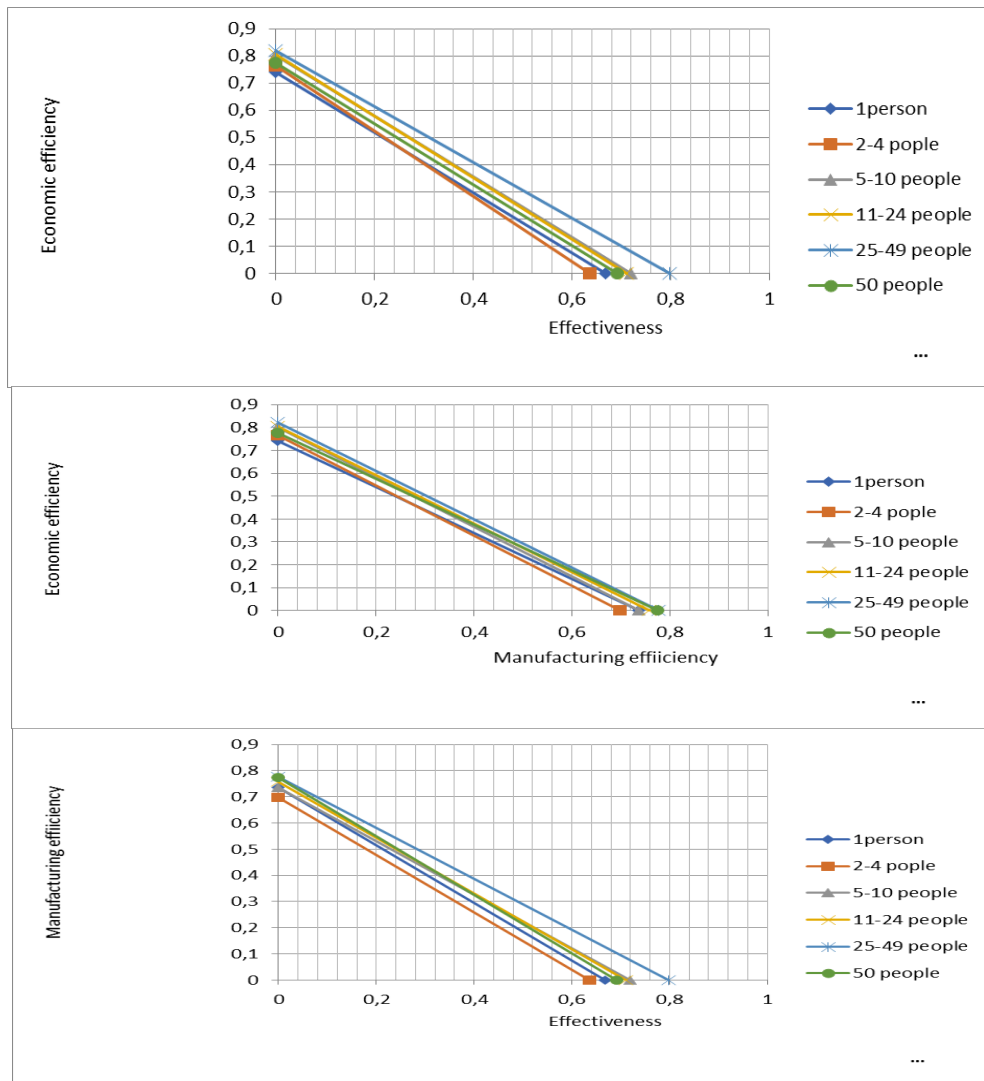

Figure 3. The distance between the selected model vertices for the distinguished groups of enterprises
Source: Own elaboration

4.5. Model validation under pandemic conditions

The literature suggests that, on average, small businesses had less ability to quickly adjust to changes in regulations and demand when the pandemic hit. However, the fragility of small businesses compared to large companies outweighs their higher flexibility (Fairlie et al. 2022). For this reason, we decided to look at the behaviour of small service businesses as a specific market barometer to validate the model. Polish Agency for Enterprise Development, in publication 2020, reports the total number of service sector as 1 047 800 (Polish Agency for Enterprise Development 2020) in 2019, representing 52% of the 2.15 million of the whole business population in Poland. Therefore, determined by the number of 336 returns obtained and the population size, the maximum error of the study was set at 5% with a confidence level of 95% and a fraction size of 0.5.

The research was conducted on entities operating in the first half of 2021. The central hypothesis of the model was re-validated. The variables do not have a normal distribution; Spearman rank correlation was used.

The following correlation coefficient is given between:
- Economic efficiency (E_e) and Manufacturing efficiency (M_e): R = 0,710, p = 0 < 0,01,
- Manufacturing efficiency (M_e) and Effectiveness (E_n): R = 0,432, p = 0 < 0,01,
- Effectiveness (E_n) and Economic efficiency (E_e): R = 0,444, p = 0 < 0,01,
- Effectiveness (E_n) and Efficiency (E_f): R = 0835, p = 0 < 0,01,
- Manufacturing efficiency (M_e) and Efficiency (E_f): R = 0,710, p = 0 < 0,01,
- Economic efficiency (E_e) and Efficiency (E_f): R = 0,762, p = 0 < 0,01,

The hypothesis **H0$_{P0}$** should be rejected in favour of **H$_{P0}$.** Hence, it should be assumed that **there is a statistically significant mutual relationship between the elements of the model: economy, efficiency and efficiency**. The result obtained confirms the validity of the model.

5. Discussion

The deductive approach allowed us to create a theoretical model of efficiency based on the construct of a mathematical model. The research showed that the survey questionnaire was accurate and reliable, and the research sample was representative. The scope of the study was consistent with the purpose of the article. Selected enterprises carried out various activities and represented multiple industries and profiles according to the classification of activities. The respondents were assumed to be only owners of small and medium enterprises whose organisations have been operating on the market for more than four years.

The methodological value of this work includes the development of the model itself and its validation utilising quantitative research and the use of the hierarchical clustering algorithm. The construction of the model is based on a comprehensive approach, consisting of three elements, and it should be emphasised that it has yet to exist in literature. Model validation was performed in a turbulent pandemic environment. As other researchers have shown (Zhang et al. 2022), the development of work-from-home as a positive outcome and 'creative destruction' during the pandemic helped small businesses perform better through industry change and continue to shine after the end of stay-at-home orders. Research shows that the surrounding environment can determine the effectiveness of an SME's approach to less common types of change, such as a global economic recession triggered by a worldwide public health problem (Dejardin et al. 2022).

Our work meets the needs of business practice by proposing a theoretical model that has been tested in a turbulent environment.

Our empirical findings are consistent with our initial expectations and support the hypotheses drawn from our theoretical framework. Our analysis shows critical conclusions. Firstly, verification of the research hypotheses concerning the assumptions of the Efficiency Triangle Model showed that the empirical model coincided with the conceptual model. Secondly, the research's conclusion indicates that the Efficiency Triangle Model is correct, and the study proved that it is a verified model. Thirdly, it can be presumed that the efficiency of an enterprise takes place in a continuous cycle of its elements. Fourthly, research has shown that the efficiency level in commercial, service, production and mixed micro and small enterprises differs. Fifth, from the point of view of manufacturing efficiency, the size of an enterprise is also irrelevant because, from a general point of view, the efficiency of resource utilisation is essential.

5.1. Limitations

The aim of the study was achieved, but there were numerous limitations, mainly due to the methodological approach adopted and the data analysis techniques used. The detailed limitations are listed below.

The first limitation is a limited area of coverage. We conducted preliminary qualitative research throughout Poland on 76 business entities. The quantitative analysis covers 455 enterprises. In the case of approximately 2 million enterprises in Poland, this is a representative but still a tiny percentage. Therefore, the authors presented an extended study based on an additional sample of 336 service companies in a pandemic. The result confirms assumptions made at the stage of selecting the research sample. It allows for formulating a thesis about the broader universality of confirmed regularities in a changing environment.

The second limitation is subjectivism inherent in the specificity of research conducted in all fields of social sciences. The deductive and hybrid of naturalistic and anti-naturalistic approaches only eliminate some shortcomings. Qualitative and quantitative research has created a wide area of subjectivism for both subjects and researchers. The interviews with entrepreneurs provided a particular image of a subjective assessment of their experiences specific to the Polish market. Measurement scales allowed one to examine the foundations of entrepreneurs for specific areas, but the interpretation of point values was based on their subjective feelings. However, the negative impact has been minimised by strictly adhering to the stages of research proceedings in empirical sciences. The purpose of conducting quantitative research as a supplement to truncated qualitative study was to eliminate the disadvantages related to subjectivity.

5.2. Future research

To increase the universality, the model could be checked on other types of enterprises in post-pandemic reality. Therefore, the dynamic approach to efficiency could be applied in the future.
Despite the diligence and scope of the study presented in this article, issues of universal measures of the efficiency and method of their measurement in four sectors: micro, small, medium and large enterprises were not discussed. After verifying this model in the large enterprise sector, it will be possible to propose efficiency measures. Further research will concern the measurement of efficiency at time t as point.

$E_f = (E_e, M_e, E_n)$t   in the Cartesian frame of reference (three-dimensional space).

Considering the replication of the result, it is advisable to repeat the quantitative research using the same measurement tools in other world economies. Repetition check is significant for generating a new theory. It would be worth conducting research at a higher significance level of a representative random sample.

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