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OPTIMIZING ORGANIZATIONAL RESILIENCE POTENTIAL BASED ON PREDEFINED ATTRIBUTES: A CASE STUDY OF THE POLISH FOUNDRY INDUSTRY DURING THE COVID-19 PANDEMIC

Introduction

The COVID-19 pandemic underscored the importance of organizational resilience in companies, a trait vital for weathering crises such as natural disasters, economic downturns, and operational disruptions. Consequently, organizational resilience, along with business continuity management and crisis management, is a significant component within a comprehensive recovery management system. Companies strive to manage in a manner that facilitates crisis survival, adaptation to new circumstances, stability, and safety [Ma et al., 2018]. Thus, top management have to devise new decision-making strategies. In high-risk environments, the most effective strategies are those that combine exploratory and exploitative actions, often employing ambidexterity [Zakrzewska-Bielawska, Piotrowska, 2022]. The literature on the subject contains relatively numerous definitions, tools, and methods for modeling and assessing organizational resilience. However, a review of these works indicates a lack of agreement and does not provide fully satisfactory answers to these problems

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[Ingram, 2023]. This was the authors' inspiration to conduct the research, and by achieving the goals contribute to the existing literature.

This study aimed to identify latent variables that could better characterize an organization's resilience potential, and also to assess the possibility of optimizing organizational resilience potential, predefined by 9 attributes to construct its new, optimal model. To achieve this, empirical research was conducted in Polish foundry companies during the COVID-19 crisis. A questionnaire consisting of 38 questions was designed to examine these characteristics. Additionally, the study included questions about situational awareness and proactive attitude as important indicators closely related to organizational resilience [Rahi, 2018].

In this study, it is assumed that the potential for organizational resilience is a latent variable described by indicators of 9 attributes based on the ISO 22316:2017 standard [ISO 22316, 2017]. The first research hypothesis aims to examine which indicators of organizational resilience potential are the most correlated with the latent variable. The second research hypothesis explores the relationship between organizational resilience potential and two variables: situational awareness and proactive attitude. Finally, the third resulting research hypothesis examines the possibility of optimizing organizational resilience indicators.

1. Organizational resilience – theoretical background

The term " organizational resilience" has many definitions. For instance Zhang defines it as an organization's ability to withstand dynamic risks from an endogenous perspective, which in turn enables organizations to cope with unpredictable risks [Zhang et al., 2022]. Even international standards describe the concept of resilience, particularly organizational resilience [Zabłocka-Kluczka, 2012]. However, a common approach to organizational resilience has not yet emerged. To address this lack of clarity, the article adopts ISO 22316:2017's definition of organizational resilience. As per this standard, organizational resilience is defined as "The organization's ability to absorb and adapt to a changing environment". This ISO definition serves as a foundational reference point for comprehending and discussing organizational resilience within the study's context.

The concept of organizational resilience comprises nine attributes, each contributing to the organization's ability to adapt and thrive in a changing environment:

1) Shared Vision and Clarity of Purpose (C1): The purpose, vision, and values at each organizational level should be clear and easily understood [Schutte, Mberi, 2020].
2) Understanding and Influencing Context (C2): A comprehensive understanding of both internal and external environments is crucial for making effective decisions [Howard, Irving, 2021].

3) Effective and Empowered Leadership (C3): Resilience is bolstered by leadership that not only empowers the workforce but also encourages their development [Howard, Irving, 2021].
4) A Culture Supportive of Organizational Resilience (C4): This is reflected in active involvement and shared beliefs and values [Howard, Irving, 2021].
5) Shared Information and Knowledge (C5): Encouraging learning through shared experiences and mutual learning among colleagues [Joshi, Gupta, 2021].
6) Availability of Resources (C6): The organization should allocate the necessary resources to adapt to changing circumstances [Paeffgen, 2023].
7) Development and Coordination of Management Disciplines (C7): Ensuring that management practices align with defined objectives significantly enhances organizational resilience [Paeffgen, 2023].
8) Supporting Continuous Improvement (C8): Monitoring results against predetermined criteria and leveraging experiences gained for ongoing enhancement [Hollnagel et al., 2006].
9) Ability to Anticipate and Manage Changes (C9): The organization's capacity to foresee and effectively manage changes [Hollnagel et al., 2006].

The concept's implementation allows companies to adapt to changing situations while operating on the edge of chaos; on the one hand, they remain stable enough to survive, and on the other hand, they are immersed enough in chaos to be creative and generate new ideas [Świerczek, 2020].

Factors closely linked with organizational resilience encompass situational awareness (variables A) and proactivity (variables B) [Rahi, 2018]. Situational awareness holds a special place in the research of human activity within complex and dynamic systems. It plays a pivotal role in decision-making processes by perceiving environmental elements, comprehending their significance, and predicting their future states. In the literature, one can find a definition of organizational resilience, according to which resilience is a function of situation awareness, management of keystone vulnerabilities, and adaptive capacity in a complex, dynamic, and connected environment [Rzegocki, Grucza, 2015].

Organizations respond differently to challenging situations and crises, depending on their organizational culture and resource potential. Adopting a proactive strategy, as an alternative to a reactive approach, is desirable in modern organizations. Proactivity involves forecasting and preparing solutions for impending challenges. This proactive approach entails identifying threats in advance and suggesting constructive changes. It is believed that an organization's strategy for coping with a crisis ultimately relies on proactive actions derived from a proactive attitude [Piórkowska, 2015]. Proactivity offers numerous business advantages, enabling rational forecasts and strategic planning even in unpredictable scenarios.

The authors intentionally selected situational awareness and proactive attitude as factors related to organizational resilience, taking into account the existing literature and research context. The first characteristic refers to respondents' perception of the current situation related to the coronavirus pandemic during the research period. The second characteristic concerns the involvement and activity of employees in the context of working during a crisis.

2. Materials and Methods

2.1. Construction and Validation of questionnaire

The authors had previously used the set of data to a larger extent in another study [Ewertowski et al, 2023]. They developed a questionnaire consisting of 38 questions, aligned with the nine attributes of organizational resilience. Each attribute was represented by 4 to 6 questions. Additionally, for assessing situational awareness and proactive attitude, five questions were designed for each characteristic. Respondents were required to respond to the questions using a 5-degree Likert scale, where 1 indicated 'I definitely don't agree' and 5 signified 'I definitely agree'. Given the complex nature of organizational management phenomena [Czakon, 2015], there isn't a single definitive measure for describing organizational resilience, or rather the potential for resilience, and there is a clear gap when it comes to assessing resilience using quantitative methods [Tew et al., 2008]. This quality classifies it as a latent (hidden) variable, unmeasurable directly. It was assumed that the levels of the listed 38 indicators with prefix "C" are a measure of the potential for organizational resilience. The questionnaire also included social-demographic questions about respondents, with answers given on an ordinal or nominal scale.

The validation of the questionnaire design occurred in three stages. The first stage utilized the Delphi method, which involves structuring group communication to tackle complex problems involving independent individuals. A panel of seven experts, consisting of researchers in safety and quality management, as well as workers from an iron foundry, provided comments and guidance. Their input led to an improved version of the research tool with verified questions.

The second step encompassed a pilot study involving 50 respondents from an iron foundry in Greater Poland. This stage aimed to rectify any procedural flaws and verify the refined research tool. After analyzing the pilot study's results and pre-validating the questionnaire, the third step, the main study, was conducted. This phase focused on manufacturing plants within the foundry industry in Poland.

Sample selection was based on data from the CEIDG, a Polish government database of companies, using criteria such as legal form, current email addresses, and business

sector. The authors opted for purposive sampling, guided by their own judgment and research objectives. Out of 233 firms, the authors narrowed the selection down to medium and large firms, totaling 47 enterprises. This selection criterion was met as these firms were believed to better represent the target group's characteristics. This choice was further supported by historical evidence that larger enterprises have demonstrated a better ability to manage previous crises owing to the scope of their operations [Romanowska, Mierzejewska, 2016].

Using a fixed interval, the authors selected respondents from the firms listed in the sampling frame, collecting data from 10 units, which represents 21.3% of the selected foundries. With an estimated average of around 200 employees across all 47 companies, the authors derived a total population of approximately 9,400 employees. Utilizing a sample size calculator, the authors determined that an appropriate sample size for the survey would be 350 respondents. This calculation considered a 95% confidence level and a 5% margin of error.

Table 1. The characteristics of the examined workers

Characteristics	Answers	Frequency	%
Sex	Woman	84	23
	Man	278	77
Age	<26	31	9
	26–40	150	41
	41–60	136	38
	> 60	45	12
Education	Basic	29	8
	Professional	80	22
	Medium	105	29
	Higher	148	41
Experience	<1	20	6
	1–3	31	9
	3–4	66	18
	5–6	69	19
	> 6	176	49
Position	Production worker	175	48
	Specialist	107	30
	Assistant	20	6
	Manager	50	14
	Director	10	3

Source: own study.

The study was conducted from January 27, 2021, to April 30, 2021 (in the time of the peak of the second wave of COVID-19 in Poland), during which the authors collected 362 valid questionnaires. Respondents completed the form via email. The structure of the respondents who participated in the questionnaire is presented in Table 1.

The questions within the questionnaire, along with the item-total correlation achieved by specific variables, are detailed in Table 2. Analyzing the correlation of each item helps identify questions that possess distinct characteristics and could potentially be removed from the questionnaire.

Table 2. The questionnaire with questions and their item-total correlation

Variable			Question	Item-total correlation
SITUATIONAL AWARNESS (A)	A1		The current epidemiological situation is very serious.	0.29
	A2		The crisis always surprises.	0.50
	A3		We need a long time to recover from the coronavirus pandemic.	0.35
	A4		Our company monitors the level of acceptable risk associated with a pandemic crisis.	0.33
	A5		Crises will always happen.	0.22
PROACTIVITY (B)	B1		I like my job even when I face difficulties	0.41
	B2		When I encounter a difficult situation, I actively seek help from others.	0.38
	B3		I am committed to my work.	0.45
	B4		I have the courage to overcome difficulties and problems.	0.32
	B5		The current pandemic situation is stressful.	0.29
POTENTIAL OF AN ORGANIZATIONAL RESILIENCE (C)	Shared vision and clarity of purpose (C1)	C11	I have clear goals and precise responsibilities.	0.38
		C12	My personal development goals align with the company goals.	0.61
		C13	Production is always my supervisor's first and most valuable priority.	0.26
		C14	My goals and the company's goals are monitored and reviewed periodically for possible discrepancies and adjusted to changes.	0.58
	Understanding and influencing context (C2)	C21	In my company, all initiatives are promoted in the field of innovation, consisting in the development and achievement of the strategic goals of the organization.	0.62
		C22	In my workplace, employees can influence the decisions of their superiors.	0.53
		C23	The company has identified all stakeholders and tries to maintain strong relationships with them.	0.56
		C24	The company supports all activities at all levels in accordance with its goals and vision.	0.70
	Effective and empowered leadership (C3)	C31	My supervisor appreciates my work.	0.60
		C32	My supervisor is always aware of the organizational, human, and technological risks that can threaten the company's operations.	0.71
		C33	If I have concerns about my safety and work, I can consult with my manager.	0.60
		C34	My supervisor tolerates any news, including bad ones.	0.50

Variable		Question		Item-total correlation
POTENTIAL OF AN ORGANIZATIONAL RESILIENCE (C)	A culture supportive of organizational resilience (C4)	C41	Safety issues are continuously raised and investigated at the senior management level (not just as a single case or only after accidents have occurred).	0.65
		C42	If I have concerns about the safety of my task, I don't have to do it.	0.54
		C43	Our safety meetings or workshops are a great way to better anticipate potential problems in the future.	0.67
		C44	The company expects me to perform several tasks simultaneously, and most of these tasks have conflicting goals.	0.27
		C45	If there is a conflict between safety and production, safety comes first.	0.58
		C46	I look for a learning opportunity to improve or gain new professional skills.	0.40
	Shared information and knowledge (C5)	C51	I have completed the training necessary for the proper and safe performance of my work	0.49
		C52	Information on nonconformities and shortcomings of the system must be reported to the appropriate persons in our company.	0.59
		C53	Incidents occurring in the company should be thoroughly analyzed and their causes should be explained to other employees in order to learn from them and prevent their recurrence.	0.44
		C54	In our company, communication is developed and resources are provided in order to quickly respond to emergency situations.	0.69
	Availability of resources (C6)	C61	My supervisor provides sufficient resources and facilities to maintain and increase the safety level of the company.	0.60
		C62	My access to resources (equipment, time, etc.) is perfect for dealing with unexpected events.	0.68
		C63	In my workplace, training and additional courses are held regularly and on time.	0.50
		C64	If at a given moment an employee in the company is absent, there is always a substitute.	0.49
	Development and coordination of management disciplines (C7)	C71	Employees from various departments and levels participate in occupational health and safety (OHS) meetings.	0.52
		C72	In our company, the managers of individual departments exchange information on changes that take place in the functioning of these departments.	0.62
		C73	In our company, all departments develop ways to deal with undesirable changes in order to overcome them.	0.62
		C74	In our company, all departments develop ways to deal with undesirable changes by adapting to them.	0.64
	Supporting continual improvement (C8)	C81	Workplace safety instructions and procedures are updated regularly.	0.66
		C82	Employees who are able to detect nonconformities or threats (sixth sense) are supported and encouraged to express their observations and comments.	0.66
		C83	The discussion and exchange of views on the risks at work are very important to me.	0.55
		C84	The company's continuous improvement mechanisms are monitored and assessed.	0.68

cont. Table 2

Variable		Question		Item-total correlation
POTENTIAL OF AN ORGANIZATIONAL RESILIENCE (C)	Ability to anticipate and managing change (C9)	C91	The company where I work has the necessary facilities and procedures to respond to unexpected changes and disruptions.	0.63
		C92	The company I work for has the ability to adapt to stressful situations caused by internal and external pressure.	0.54
		C93	If the system collapses, the company has the ability to quickly return to its original (stable) state.	0.59
		C94	The company has mechanisms to predict threats and changes and reacts appropriately to them.	0.69

Source: own study.

The subsequent step involved conducting a reliability analysis of the questionnaire using the Cronbach's alpha index. The computed result for the entire questionnaire yielded $\alpha = 0.91$, surpassing the threshold of 0.70, thereby confirming the questionnaire's reliability. The item-total correlation ranged from 0.22 to 0.71, indicating varying strengths of correlation from weak (0.2–0.29) to strong (0.6–0.79), with most values falling within the middle to strong range. In subsequent analysis, the authors decided to exclude questions A1, A5, B5, C13, and C44, as their results were below 0.3. These questions were deemed divergent from others in terms of their correlation.

2.2. Methods of analysis

Given the latent nature of the variables – organizational resilience potential, situational awareness, and proactive attitude – a SEM model was constructed. Structural Equation Modeling (SEM), also known as path analysis, aims to unveil cause-and-effect relationships between latent variables [Cwalina, 2000]. Within SEM, variables can be categorized into exogenous (not explained by the model) and endogenous (responses to other variables in the model). An important component of SEM analysis is Confirmatory Factor Analysis (CFA). It assesses the strength of relationships between observable indicators and latent variables, known as constructs, by isolating the variance of specific indicators from the variance of the overall latent variable. This process confirms the factor structure of the theoretical concept under study. CFA is often used in questionnaire validation [Tomé-Fernández et al., 2020], facilitating the selection of indicators that are strongly correlated with latent variables while describing less significant ones. The strength of the association between an indicator and the latent variable it describes is measured using factor loadings, where the correlation coefficient serves as a measure of this association. To simplify interpretation, values are scaled so that the highest factor loading equals 1, with the remaining loadings expressed proportionally. This approach aids in identifying the most relevant factor related to the variable and in understanding the relative

strength of other relationships. However, such scaling prevents direct comparison of coefficient strengths across different variables. For these comparisons, standardized coefficients, which can be interpreted as correlation coefficients, are more appropriate.

The accuracy of the SEM model is measured based on indicators, including the ratio of the chi-square statistic χ^2 to the number of degrees of freedom (df), CFI (Confirmatory Factor Index), TLI (Tucker Lewis index) and RMSEA (Root Mean Square Error of Approximation).

The presence of negative variance estimates in the model indicates its incorrectness, as variance – being the square of the standard deviation. Such anomalies, including negative changes in model indicators or correlation coefficients exceeding 1, are referred to as the Heywood case. This phenomenon may result from an insufficient number of observations or from correlations between indicators that are either too high or too low.

In some cases, it is necessary to examine the factor structure to identify indicators that exhibit similar variability. Exploratory Factor Analysis (EFA) is employed for this purpose, as it helps to group variables with similar variation patterns of variation – a process that can be open to subjective interpretation. Before conducting factor analysis, it is essential to ensure that the data meet the assumption of significant correlations among variables. Bartlett's test of sphericity is commonly used to assesses whether the correlation matrix significantly deviates from an identity matrix, while the Kaiser-Meyer-Olkin KMO (KMO) coefficient, which ranges from 0 to 1, measures sampling adequacy. A value closer to 1 indicates a stronger justification for using factor analysis.

3. Results

At the outset of the analysis, the aim was to determine which attributes of organizational resilience had the most significant influence on the variability of this characteristic. Utilizing the 9 attributes as a foundation, a hierarchical Confirmatory Factor Analysis (CFA) model was constructed. This model described the organizational resilience characteristic (C), which was delineated by the 9 attributes (C1–C9) and defined by 36 indicators (C13 and C44 were excluded). However, the result of this analysis was negative variances, which indicates that the model is incorrect – a Heywood case occurred. The possibility of a small sample size was considered but rejected because the number of observations exceeded the recommended threshold (over 200). Nevertheless, the complexity of having a considerable number of factors (9) and indicators (36) might result in elevated correlations among indicators.

It was decided to analyze the factor structure of indicators describing the organizational resilience potential using EFA to remove the least important indicators, and the assumption of significant correlations between indicators was checked by conducting Bartlett's Test of Sphericity and computing the Kaiser-Meyer-Olkin (KMO) measure

at a significance level of $\alpha = 0.05$; the Bartlett's test indicated that the correlated matrix between the 36 indicators significantly deviated from the identity matrix ($p = 0.000 < 0.05$), and the KMO index was calculated to be 0.88, indicating substantial correlations among the questionnaire items and thus validating the appropriateness of conducting factor analysis.

Prior to commencing factor analysis, the dataset was divided into two segments: the first part was utilized to generate new factors in EFA, while the second part was dedicated to conducting Structural Equation Modeling (SEM) analysis based on the derived factors; similarly, data splitting was used in the study to check the results obtained by EFA using CFA [Tomé-Fernández et al., 2020]. The new data collections contained 150 and 212 observations for the EFA and SEM methods, respectively, and the categorization is outlined in Table 3.

Table 3. Data classification

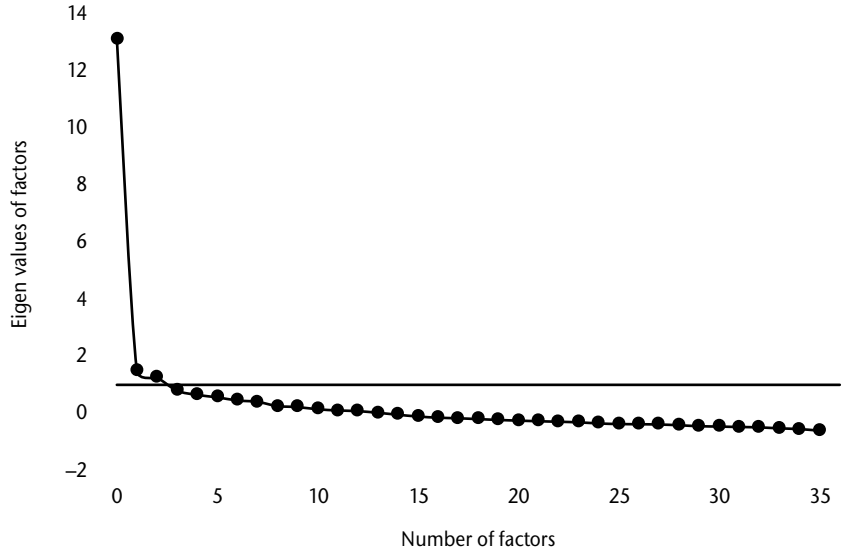
	Dataset for EFA	Dataset for SEM
Company 1	22	21
Company 2	16	32
Company 3	12	15
Company 4	9	16
Company 5	5	15
Company 6	26	38
Company 7	6	11
Company 8	14	10
Company 9	25	41
Company 10	15	13

Source: own study.

Subsequently, an Exploratory Factor Analysis (EFA) was executed using the maximum likelihood method with oblique (Oblimin) rotation to account for correlations between factors; employing the Kaiser criterion, three factors with eigenvalues greater than 1 were identified, collectively elucidated 45% of the total variations in the data, and the results are visually depicted in the scree plot presented in Figure 1.

The identified factor loadings are presented in Table 4, where loadings greater than 0.5 were highlighted and subsequently used in the SEM model, by examining the content of the questions associated with each factor, meaningful interpretations were made that led to the identification of attributes for the new organizational resilience potential model F (as an alternative to C), categorized as follows: F1 – Adaptation and resourcefulness, F2 – Leadership and anticipation, and F3 – Partnership and communication, with the Pearson's correlations between these new attributes presented in Table 5.

Figure 1. Scree plot



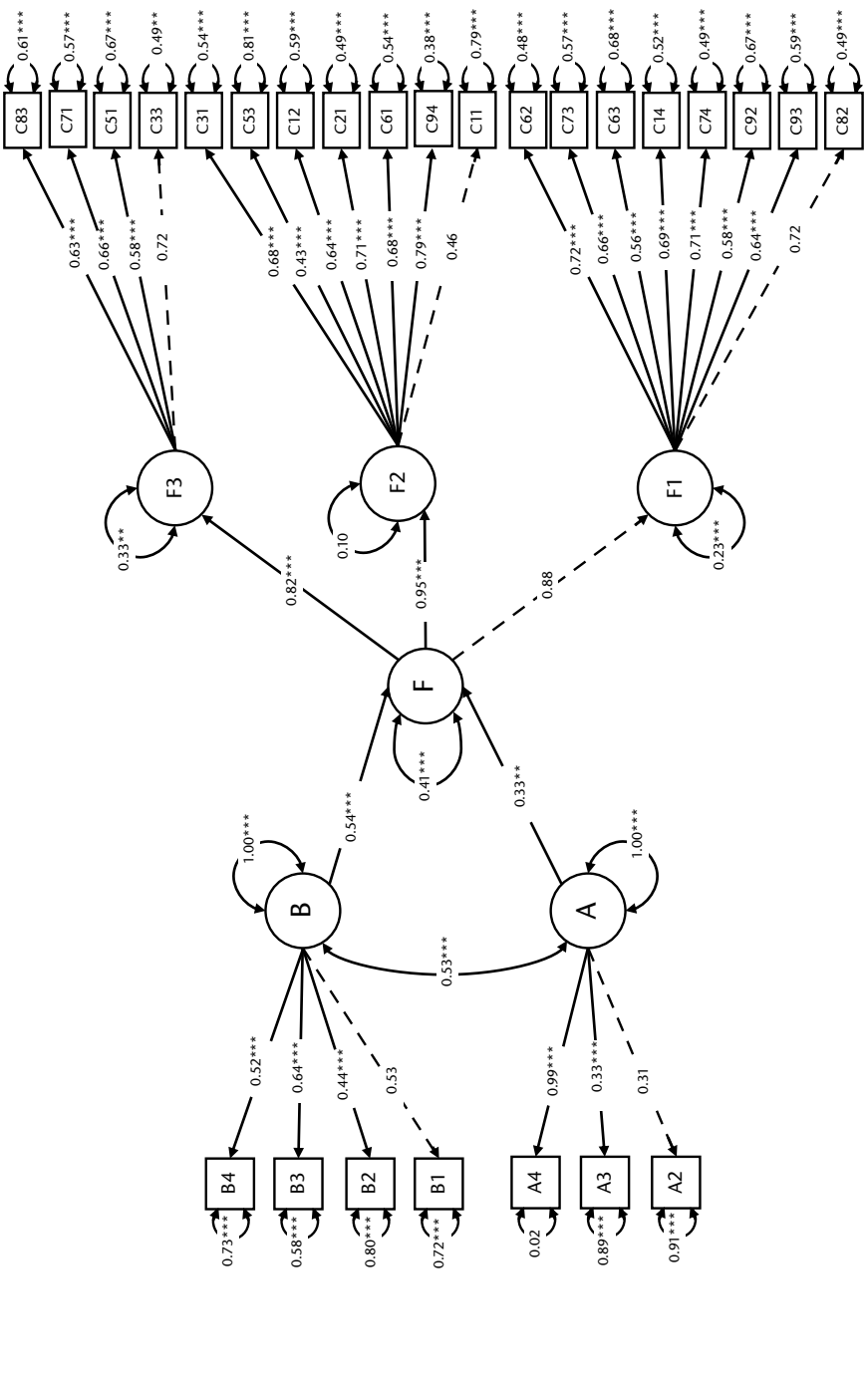
Source: own study.

Table 4. Factor loadings identified in EFA

Question	F1	F2	F3	Question	F1	F2	F3
C82	**0.85**	–0.13	0.17	C12	0.02	**0.57**	0.18
C93	**0.63**	–0.02	0.15	C53	0.23	**0.56**	–0.13
C92	**0.63**	0.2	–0.22	C31	–0.08	**0.55**	0.27
C74	**0.62**	0.14	–0.06	**C32**	0.12	0.47	0.33
C14	**0.62**	0.07	0.07	**C84**	0.34	0.47	0.01
C63	**0.54**	0.00	0.14	**C43**	0.31	0.45	0.09
C73	**0.53**	0.34	–0.22	**C72**	0.33	0.44	0.02
C62	**0.52**	0.04	0.39	**C41**	0.19	0.39	0.20
C64	0.49	0.00	0.13	**C81**	0.10	0.39	0.32
C54	0.48	0.22	0.13	**C23**	0.08	0.36	0.23
C24	0.46	0.33	0.05	**C33**	0.23	–0.03	**0.66**
C91	0.42	0.15	0.22	**C51**	–0.10	0.22	**0.64**
C22	0.39	0.29	–0.02	**C71**	0.10	0.12	**0.53**
C46	0.37	0.13	–0.01	**C83**	0.34	0.02	**0.52**
C11	–0.18	**0.73**	0.00	**C52**	0.17	0.24	0.39
C94	0.31	**0.63**	–0.19	**C45**	0.23	0.18	0.38
C61	–0.12	**0.62**	0.21	**C42**	0.15	0.27	0.30
C21	0.11	**0.58**	0.08	**C34**	0.27	0.10	0.29

Source: own study.

Figure 2. The structural model of the organizational resilience potential with elements of proactive attitude and situational awareness



* Result significantly different from zero at the $\alpha = 0.05$ level
** Result significantly different from zero at the $\alpha = 0.01$ level
*** Result significantly different from zero at the $\alpha = 0.001$ level

Source: own study.

Table 5. Pearson's correlation between new attributes

Factor	F1	F2	F3
F1	1.00	0.58	0.40
F2	0.58	1.00	0.33
F3	0.40	0.33	1.00

Source: own study.

The F1 attribute exhibits a moderate correlation with the F2 attribute, indicating a significant link between issues related to adaptation/resourcefulness and leadership/anticipation. The study then proceeded to assess the accuracy of the organizational resilience assessment classification based on the new attributes F1, F2, and F3.

Afterward, using the second dataset and new factors (F1, F2, F3), a SEM model with diagonally weighted least squares (DWLS) was built. DWLS method is employed when the data do not conform to a multidimensional normal distribution [Mîndrilă, 2010]. In Figure 2, the relationships between variables and the standardized factor loadings are depicted. A is situational awareness and B is proactive attitude. Latent variables are represented by ovals, while observable indicators are shown as rectangles. An arrow whose beginning and end are located at the same variable symbolize the variance of that variable. However, arrows connecting two variables show correlations. Before interpreting the results, an index of model assessment was determined to evaluate the model's appropriateness. The model specification is presented in Table 7. The index $\chi^2/df = 1.13 < 2$, even with a conservative approach, indicates that the model is well-suited, which is further confirmed by the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), both exceeding 0.95.

Table 6. The specification of the model

Coefficient	Measured value	Appropriate fit
χ^2	330.673	-
Df	293	-
χ^2/df	1.13	< 2
RMSEA	0.025	< 0.05
TLI	0.992	> 0.95
CFI	0.993	> 0.95

Source: own study.

The root mean square error of approximation (RMSEA) also met the requirements of a correct model, with a value less than 0.05. The model specification is presented in Table 6.

The three attributes (F1, F2, and F3) are strongly correlated with the variable F, with correlation coefficients above 0.82. The outcomes of the Confirmatory Factor

Analysis (CFA) for the newly defined organizational resilience potential F are provided in Table 7.

Table 7. The results of CFA analysis for factor F

Attribute	Index	Estimate	Standard error	z-value	p-value	Standardized factor loadings
F1	C82	1.00	-	-	-	0.72
	C93	0.77	0.05	15.51	0.0000	0.64
	C92	0.72	0.05	14.68	0.0000	0.58
	C74	0.72	0.05	16.23	0.0000	0.71
	C14	0.89	0.06	15.77	0.0000	0.69
	C63	0.76	0.05	14.51	0.0000	0.56
	C73	0.75	0.05	15.64	0.0000	0.66
	C62	0.85	0.05	16.75	0.0000	0.72
F2	C11	1.00	-	-	-	0.46
	C94	2.36	0.19	12.68	0.0000	0.79
	C61	2.30	0.19	12.01	0.0000	0.68
	C21	2.33	0.19	12.34	0.0000	0.71
	C12	2.06	0.17	11.94	0.0000	0.64
	C53	1.08	0.10	10.91	0.0000	0.43
	C31	2.39	0.20	12.24	0.0000	0.68
F3	C33	1.00	-	-	-	0.72
	C51	0.71	0.06	12.25	0.0000	0.58
	C71	1.06	0.08	13.59	0.0000	0.66
	C83	0.96	0.07	13.14	0.0000	0.63

Source: own study.

The standardized factor loadings for the second data group exceed the threshold of 0.46, indicating that all factor loadings are statistically significant. This validates the appropriateness of the factor division obtained through Exploratory Factor Analysis (EFA). The regression indices between the latent variables A and B are displayed in Table 8.

Table 8. The regression indices between latent variables A and B

Factor	Regression coefficient	Standard error	z-value	p-value	Correlation
A	0.72	0.23	3.14	0.00	0.33
B	0.72	0.14	5.04	0.00	0.54

Source: own study.

The analysis of relationships between latent variables revealed significant regression indicators between situational awareness, proactive attitude, and organizational resilience potential. The positive estimators indicate that an increase in the characteristics of situational awareness and proactive attitude contributes to an increase in the organizational resilience potential (F characteristic). Moreover, comparing variable A and B, proactive attitude is more strongly correlated with organizational resilience – as defined by factors F1, F2, F3 – than situational awareness.

Conclusion

This study confirmed the first hypothesis about indicators of organizational resilience potential that are the most correlated with the latent variable. There are as many as 29 factors that have a total item correlation higher than 0.5 (see Table 2).

The second hypothesis, which posited the existence of correlations between the potential of organizational resilience, situational awareness, and proactive attitude, was indeed confirmed by the study's findings. The structural model constructed on the basis of the identified latent variables (F1-F3) and additional variables (A and B) provided a comprehensive framework for assessing an organization's resilience. The analysis of the SEM results indicated that the model was adequate. This offers a holistic view of the organization's current resilience level, enabling the identification of strengths, weaknesses, and readiness levels. By understanding the interplay between organizational resilience, situational awareness, and proactive attitude, organizations can make informed decisions to enhance their ability to navigate disruptions and crises effectively.

This study also effectively confirmed the third hypothesis regarding the possibility of optimizing the examination of organizational resilience potential. Initially defined by nine attributes and 38 associated factors, the organizational resilience potential (C) was refined through subsequent optimization into a streamlined structural model, now known as organizational resilience potential (F). This optimization process resulted in a reduction of attributes from 9 to 3, and a decrease of factors/questions from 38 to 19.

The analysis revealed three primary latent variables that encapsulated the essence of the original nine attributes:

F1 – Adaptation and Resourcefulness: This dimension encompasses factors related to the organization's adaptive capacity and its ability to creatively navigate challenges, emphasizing that effective utilization of resources is a cornerstone for building resilience, requiring strategic changes in resource management [Sopińska, 2014].

F2 – Leadership and Anticipation: Centered around effective crisis leadership and anticipation capabilities, including sound decision-making during disruptions and

the ability to predict potential issues, thereby contributing to improved organizational resilience [Krzakiewicz and Cyfert, 2013].
F3 – Partnership and Communication: This dimension involves factors associated with understanding relationships, communication requirements, and both internal and external communication methods, highlighting that clear and effective communication is crucial for minimizing errors and barriers during crises and enhancing overall resilience [Zapłata, Kaźmierczak, 2011].

The standardized factor loadings for the indicators within each of these dimensions were significant, further affirming the relevance of these attributes in measuring organizational resilience potential. The study highlighted the critical role of adaptation, resourcefulness, leadership, anticipation, partnership, and communication in enhancing an organization's capacity to absorb and adapt to a changing environment, as defined by ISO 22316:2017. These findings offer valuable insights for organizations aiming to enhance their resilience by indicating specific areas of focus that can lead to improved performance disruptions – such as those experienced during the COVID-19 pandemic – and ensuring sustainable development.

From a managerial perspective, the outcomes carry significant implications across various levels of management. The research emphasized the attributes that exert the most substantial influence on its variability. As a result, management teams, ranging from top-level executives to operational and line management, are encouraged to prioritize these attributes when devising strategies to foster organizational, with top management playing a pivotal role in incorporating them into decision-making processes.

However, it's important to note that the study has certain limitations. The survey was conducted during the second wave of COVID-19, which was considerably more severe than the first, and as a result, the tool could not be applied to companies in some industries. The use of a non-probabilistic sampling method focusing on larger companies within a specific sector might limit the generalizability of the results, rendering the findings potentially incomplete due to this restricted sample. Nonetheless, the presented model provides valuable insights for managing foundry companies during the COVID-19 crisis by indicating specific aspects of organizational resilience that warrant improvement. While the current sample is considered sufficiently representative for preliminary conclusions, future research should broaden the scope by including companies from various sectors and sizes to enhance the generalizability.

Future research initiatives could explore the optimization of these attributes to improve management practices in other production or service industries, thereby examining potential differences and further assessing the possibility of generalizing results.

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OPTIMIZING ORGANIZATIONAL RESILIENCE POTENTIAL BASED ON PREDEFINED ATTRIBUTES: A CASE STUDY OF THE POLISH FOUNDRY INDUSTRY DURING THE COVID-19 PANDEMIC

Abstract

This study aimed to identify latent variables that could better characterize an organization's resilience potential within a sample predefined by nine attributes based on the ISO 22316:2017 standard, and to assess the possibility of optimizing it. To achieve this, empirical research was conducted among Polish foundry companies during the COVID-19 crisis. A questionnaire,

consisting of 48 questions was designed to investigate these attributes. Each organizational resilience attribute was examined using 4–6 questions (38 questions in total). Additionally, the research included questions about situational awareness and proactive attitude as important characteristics closely related to organizational resilience, with five questions per factor (10 questions in total). The study employed both exploratory and confirmatory factor analysis (EFA, CFA), along with structural equation modeling (SEM). The analysis outcomes allowed the authors to construct a structural model of organizational resilience potential based on three principal latent variables corresponding to the thematic areas of resilience potential: Variable F1 – Adaptation and Resourcefulness, Variable F2 – Leadership and Anticipation, and Variable F3 – Partnership and Communication. Through optimization, the number of attributes was streamlined from nine to three, and the number of questions describing these attributes was reduced from 38 to 19. Moreover, a substantial correlation was identified between proactive attitude, situational awareness, and organizational resilience potential. This study provides management personnel with valuable insights to formulate new decision-making strategies by focusing on the attributes of organizational resilience potential that exert the most significant influence on its variability. Ultimately, these findings could enhance organizational performance during disruptions and foster the sustainable development of enterprises.

Keywords: organizational resilience, optimization, factor analysis, structural equations, crisis management, sustainable development

JEL Classification Codes: M110, L 200, L610

OPTYMALIZACJA POTENCJAŁU ODPORNOŚCI ORGANIZACYJNEJ NA PODSTAWIE ZDEFINIOWANYCH ATRYBUTÓW: STUDIUM PRZYPADKU POLSKIEGO PRZEMYSŁU ODLEWNICZEGO W CZASIE PANDEMII COVID-19

Streszczenie

Celem tego badania było zidentyfikowanie zmiennych ukrytych, które mogłyby lepiej scharakteryzować potencjał odporności organizacji w badanej próbie, zdefiniowany za pomocą dziewięciu atrybutów w oparciu o normę ISO 22316:2017, oraz w przypadku potwierdzenia – ocena możliwości jego optymalizacji. W tym celu przeprowadzono badania empiryczne w polskich odlewniach podczas kryzysu COVID-19. Stworzono kwestionariusz składający się z 48 pytań. Każdy z atrybutów odporności organizacyjnej był badany za pomocą 4–6 pytań (łącznie 38 pytań). Dodatkowo w badaniu znalazły się pytania dotyczące świadomości sytuacyjnej

i postawy proaktywnej jako ważnych cech ściśle związanych z odpornością organizacji, z pięcioma pytaniami na każdy czynnik (w sumie dziesięć pytań). W badaniu wykorzystano zarówno eksploracyjną, jak i konfirmacyjną analizę czynnikową (EFA, CFA), wraz z modelowaniem równań strukturalnych (SEM). Wyniki analiz pozwoliły autorom skonstruować model strukturalny potencjału odporności organizacyjnej. Ten model opierał się na trzech głównych zmiennych ukrytych, związanych z obszarami tematycznymi potencjału odporności organizacyjnej: Zmienna F1 – Adaptacja i Zaradność, Zmienna F2 – Przywództwo i Antycypacja oraz Zmienna F3 – Partnerstwo i Komunikacja. Dzięki optymalizacji liczba atrybutów została zmniejszona z 9 do 3, a pytania opisujące te atrybuty zostały zredukowane z 38 do 19. Ponadto zidentyfikowano istotną korelację między postawą proaktywną, świadomością sytuacyjną a potencjałem odporności organizacyjnej. Badanie to powinno być inspiracją kadry zarządzającej do tworzenia nowych strategii podejmowania decyzji, skupiając wysiłki na cechach potencjału odporności organizacyjnej, które wywierają największy wpływ na jego zmienność. W rezultacie może to zwiększyć wydajność organizacyjną w okresach zakłóceń i sprzyjać zrównoważonemu rozwojowi przedsiębiorstw.

Słowa kluczowe: odporność organizacyjna, optymalizacja, analiza czynnikowa, równania strukturalne, zarządzanie kryzysowe, zrównoważony rozwój

Kody klasyfikacji JEL: M110, L200, L610