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Creating Organizational Resilience through Digital Transformation and Dynamic Capabilities: Findings from fs/QCA Analysis on the Example of Polish CHP Plants

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Abstract: Digital transformation, organizational resilience, and agility are now becoming key to meeting the competitive challenges of modern organizations. It is no surprise that digital transformation and digital technologies have also begun to significantly impact the energy industry, moving towards improving the sector's profitability and efficiency. However, to move the difficult process of digital transformation in today's dynamically changing environment, organizations, including those in the energy sector, need to build organizational resilience. Nevertheless, the relationship between digital transformation and organizational resilience has not yet been explained in a satisfactory and sufficient manner. Focusing on the level of digital transformation, and more precisely within the two dimensions of digital maturity, i.e., digital intensity and transformation management intensity, as well as based on the perspective of dynamic capabilities, this study developed a configurational framework and proposed a theoretical model to study the equifinal paths through which digital transformation and dynamic capabilities influence organizational resilience in energy sector companies. Based on a fuzzy set qualitative comparative analysis (fs/QCA) conducted on selected companies in the energy sector, i.e., Polish CHP plants, the relationship among digital transformation, dynamic capabilities, and organizational resilience was investigated. The results show that a high level of organizational resilience is possible to achieve through two main paths based on the dominance of dynamic capabilities and the dominance of digital maturity. The results show that a high level of organizational resilience is possible to achieve through two main paths based on the dominance of dynamic capabilities and the dominance of digital maturity. The study found that digital maturity can significantly influence CHP resilience. Moreover, the transformation management intensity is strongly related to high organizational resilience. The paper concludes by describing theoretical and practical implications, as well as research limitations and prospects for future research.

Keywords: digital transformation; organizational resilience; dynamic; capabilities; CHP plants; fuzzy-set qualitative comparative analysis (fs/QCA)



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1. Introduction

We are currently witnessing continuous changes related to the progressive introduction of new digital technologies such as cloud computing, Internet of Things (IoT), blockchain, big data, artificial intelligence (AI), industrial internet, turning traditional economies into smart ones, and the resulting transformative change market and enterprises. On the other hand, due to the currently observed unfavorable phenomena that carry a huge risk for the world economy, such as the Russian invasion, the global crisis due to the COVID-19 pandemic, efficiency improvement, resource allocation, or social coordination caused by digitization, they gain particular importance for the survival and further development of the organizations. It should be emphasized that one of the best-known and consistent views is that digitization is a proven way of achieving organizational resilience by organizations [1]. Organizational resilience can be referred to as a company's ability to effectively assimilate,

implement responses according to the situation, and engage in transformational activities to achieve specific benefits from unexpected events [2,3]. It should be emphasized that the definition of resilience is still not clearly defined due to various approaches and views [3], which result from its multidimensional and multi-level nature [4,5]. An important symptom of resilience is that organizations have the ability to adapt to strategic processes in order to discover other solutions to the new reality [6].

It is important that companies wishing to maximize their innovative capacity to achieve organizational resilience are also concerned about the outcomes of digital transformation, which could adversely affect existing processes or structures. In the energy sector, issues relating to the implementation of innovative solutions and digital transformation are also quite intensively analyzed. Among other things, surveys were carried out on the use of solutions based on the Industry 4.0 paradigm in the energy sector [7], the role of Industry 4.0 in energy sustainability [8], and the use of modern digital technologies, such as artificial intelligence (AI), big data, Internet of Things (IoT), blockchain in energy industries that facilitate the development of smarter energy grids and offer a more efficient and innovative approach to energy use [9–12]. Given the nature of digital transformation, which is uncertain and highly complex, it is invariably difficult for entrepreneurs to fully appreciate the results and implications of digital transformation. Therefore, it is of great importance to address topics related to the digital transformation process itself, as well as improving the organizational resilience of enterprises.

There is a significant gap in the literature in the field of empirical verification of the impact of digital transformation on the resilience of organizations, especially companies from the energy sector. As regards the factors influencing organizational resilience, the conducted research shows that in a crisis caused, for example, by the COVID-19 pandemic, enterprises must be able to reconfigure themselves to minimize the risk [13], and digitization significantly facilitates understanding and adapting to changing environmental contexts. For example, artificial intelligence and other digital technologies help enterprises make smart decisions in crisis situations and promote supply chain resilience [14] and the resilience of the platform ecosystem [15]. In addition, in the process of digital transformation, enterprises rebuild organizational capabilities and formulate dynamic capabilities as part of an innovative reconstruction of internal and external resources, processes, and structures [16]. Therefore, the possessed resources and capabilities are often effectively used by enterprises to build new opportunities in line with the adopted development paths. Consequently, the dynamic capability theory allows for a deeper exploration of the relationship between digital transformation and organizational resilience.

Dynamic capabilities are the keys to digital transformation, enabling more sustainable development, greater competitiveness, and increasing the organization's resilience. However, it should be noted that both of these variables have been analyzed together to a limited extent. Based on existing literature relating to digital business strategies and dynamic capabilities, considering combined heat and power plants (CHP plants) in Poland as research objects, this study examines the mechanisms of influence between digital transformation and organizational resilience. The following research question was posed: What are the possible combinations of dynamic capabilities, or more precisely, sensing capability, seizing capability, reconfiguring capability, and digital transformation, that affect organizational resilience?

This study analyzed data using fuzzy set qualitative comparative analysis (fs/QCA) to determine sets of relationships between digital transformation, dynamic capability, and organizational resilience. The study shows that digital transformation leads to high organizational resilience, which involves high sensing capability or high seizing capability. There is a substitution relationship between sensing capability and seizing capability. Moreover, high dynamic capabilities also lead to high organizational resilience, together with high transformation management intensity. This study deepens the knowledge and understanding of CHP plants that are trying to achieve organizational resilience through

digital transformation and also provides guidance for appropriate management practices of the analyzed enterprises.

An undoubted advantage of this study is the application of a configurational approach and the use of the fs/QCA method as a tool to explain organizational resilience, a high level of which can be achieved simultaneously through multiple paths. Proposing and presenting a research model, following the adopted algorithm of the research procedure, and conducting the research in a specific context (selected Polish CHP plants) provides valuable knowledge and enriches scientific research on the impact of digital transformation and dynamic capabilities on organizational resilience. The paper's noteworthy points are, firstly, a comprehensive theoretical framework that can be used to explore how combinations of dynamic capabilities and digital transformation are linked to organizational resilience. Second, the research on organizational resilience was extended by analyzing dynamic capabilities in conjunction with digital transformation. Thirdly, three equifinal configurations that lead to high organizational resilience and two associated with low organizational resilience were discovered.

The paper was organized as follows: after the introduction, the theoretical background is described, then the research model is developed, the research methods and results are presented, and finally, the discussions and conclusions.

2. Theoretical Background

Resilience has been studied from the perspective of many disciplines. Pioneering works by Staw et al. [17] and Meyer [18] regarding the organization's response to external threats introduced resilience as a research area in organizational management, creating a space for research on organizational resilience. Despite the lack of consensus on organizational resilience, it can be assumed by most researchers that organizational resilience refers to "the ability of an organization to withstand significant business disruptions caused by unpredictable, unexpected or catastrophic events, driving organizational systems beyond planned service limits without serious losses" [19], p. 383. Therefore, given the high uncertainty and rapid changes that organizations face, the concept of organizational resilience is becoming increasingly important [20]. The literature contains at least three different perspectives on the interpretation of organizational resilience: reactive, adaptive, and transformational (Table 1). They all point to the various capabilities of an organization to anticipate, respond to, and adapt to external disruptions.

Table 1. Interpretive perspectives on organizational resilience.

Perspective	Overview
The reactive perspective	Organizational resilience is perceived as the ability of an organization to turn back to an earlier state—a state of "normality", after experiencing unforeseen and unfavorable situations [21]
The adaptive perspective	Organizational resilience is the ability not only to survive but also to emerge from the crisis, thanks to various adaptation interventions, such as rescuing enterprises, rebuilding infrastructure, or rebuilding the market, resulting in new business models [21]
The transformational perspective	Organizational resilience refers to taking preventive steps and striving to implement innovative and transformational changes while supporting the organization's growth and persistence despite adversity [22]

The nature of these perspectives allows the adoption of a strategic approach defining organizational resilience as the result of reaction and ability to respond to a turbulent environment. This indicates that organizational resilience can be considered a dynamic capability of an organization, which evolves over time. Moreover, taking this perspective as a basis, organizational resilience can be conceptualized as a multidimensional feature of an organization that allows the company to successfully absorb, respond to, and potentially exploit unfavorable events [23–25]. On this basis, it can be concluded that the dynamic capabilities perspective provides a theoretical framework that allows for an appropriate examination of organizational resilience.

The literature has identified certain factors that have a positive impact on organizational resilience, such as strategic human resource management [26], employee engagement [27], or have a positive impact on the systemic control of organizational resilience, which include the enterprise resource system [28] and managing inter-organizational relationships (e.g., relationships between partners) [29]. Despite considerable attention to the antecedents of organizational resilience, research to date has focused primarily on human capital and social capital. In the era of digital transformation, organizations, including those from the energy sector, investing in digital challenges will have the opportunity to develop skills related to sensing changes in the environment, seizing opportunities for innovation, reconfiguring their product offering and value proposition [30]. It should be emphasized that so far, few studies have examined the impact of digital transformation on creating organizational resilience, especially when such a gap exists in relation to companies from the energy sector. Although publications can be found on the transformation process in this sector, its level, and the constraints and challenges that accompany it [31,32], there is still limited understanding of the relationship between digital transformation in energy companies and building organizational resilience. To fill this gap, this study proposes a theoretical link between digital transformation and organizational resilience, which was successively tested on selected energy sector companies.

The concept of digital transformation has been defined in the literature at several levels, namely at the societal level [33], the meso level [34], and the enterprise level [35,36]. Digital transformation is related to the process of using new digital technologies (such as artificial intelligence, mobile Internet, blockchain, cloud technology, or the Internet of Things) to find and take advantage of new business opportunities, streamline operational processes, improve customer relationships, and develop new, innovative business models [16]. As digital transformation involves a process of transformation of the organization, in order to measure the progress of digital transformation, a construct called digital maturity has been developed in the literature, describing “what the company has already achieved in terms of undertaking transformation efforts” [37] p. 4. Moreover, digital transformation is a continuous process, so the digital maturity construct should provide managers with a set of specific criteria allowing for comparison of the current state with the results successively achieved through digital transformation.

Among the various scales developed in the literature to determine the digital maturity of an organization, which identify the dimensions and reveal the capabilities necessary to achieve the desired stage of maturity, the two-dimensional scale developed by the MIT Center for Digital Business and Capgemini Consulting stands out. This scale applies to a wide range of different contexts and essentially consists of two dimensions: digital intensity and transformation management intensity [38]. Digital intensity refers to “technology-based initiatives aimed at changing the way a company engages with customers, internal operations, and even business models” [38], p. 2. Digital intensity increases help companies discover new digital opportunities, increase customer engagement, and conduct business using digital technologies. Transformation management intensity, in turn, refers to “the leadership capabilities necessary to drive digital transformation in an organization” [38], p. 2. Enterprises with high transformation management intensity are characterized not only by the transformation vision itself but also by a governance or culture that is fundamentally tasked with coordinating any digital initiatives or ventures for the highest business impact.

As several previous studies indicate, increasing digital maturity contributes to better organizational performance, employee retention, and other significant benefits, e.g., [38,39]. The energy sector also requires rapid adaptive adjustment to the requirements of digital transformation. With increased investment in digital technologies, for example, through the use of machine learning models for energy consumption and energy savings combined with the right management strategy and vision, energy companies can more easily and flexibly coordinate internal resources, manage, and continue to operate despite adversity. Through strategic investments in digitalization, utilities can also leverage external resources and gain new opportunities to support business operations and build resilience

in disruptive situations. Increasing transformation management intensity can contribute to active monitoring and scanning of the environment, developing new, innovative strategies, thereby improving the level of organizational resilience. Moreover, strengthening transformation management intensity can equip the company with a transformational vision based on understanding external changes and the current situation of the organization [40]. Thanks to the digital vision and employee involvement, organizations can create a digital culture that allows them to motivate employees to develop their skills and competencies, develop creative solutions that can better counteract any crises, and build the organization's resilience [39]. High digital maturity enables enterprises to better leverage internal and external resources, thereby increasing systemic control over organizational resilience.

It should be emphasized that the enabler of digital transformation is dynamic capabilities [41,42], which are described in the literature as higher-order organizational capabilities that help companies more accurately transform organizational structures, processes, and company culture, depending on their needs [43–45]. Dynamic capabilities are a source of organizational routines and the actions of managers and employees, and they describe how a company's competencies can be transformed to adapt to new environmental conditions [46]. Unlike mere capabilities, dynamic capabilities indicate an organization's capability to transform [47,48] and positively impact performance [49]. They can be divided into three dimensions: sensing, seizing, and reconfiguring [43]. With sensing capabilities, organizations can be among the first to find new markets relevant to their current products and properly identify both customer needs and innovation opportunities [43]. Seizing capabilities enable organizations to generate value or innovation in services and products by creating new structures, policies, and incentives while reconfiguring capabilities refer to the adaptation and readjustment of organizational resources to meet new requirements in new circumstances [43]. Moreover, reconfiguring capabilities are extremely important due to the possibility of replacing the resources that the organization already has to adapt to a new strategy or constructing new resources, as well as supplementing some of their deficiencies [50]. This capability becomes particularly important when market conditions change rapidly [51]. Given the challenges associated with digital transformation, many companies may experience deficiencies in their existing resource base, for example, related to digital knowledge, which is why it is so important to develop reconfiguring capabilities to enable companies to access new resources [50]. The combined sensing, seizing, and reconfiguring capabilities support companies' alertness and their appropriate, quick response to market changes compared to the competition [52]. Dynamic capabilities, therefore, allow adaptation to technological change and innovation through environmental scanning, sensing, and integration capabilities. Therefore, dynamic capabilities can be the basis on which companies are able to capture new information regarding digital changes, quickly and properly integrate digital technologies with business processes, and achieve a high level of digital transformation [53]. Overall, dynamic capabilities enable companies to deliver business outcomes focused on strategic change.

The approach based on dynamic capabilities provides insight into the understanding that, once recognized and diagnosed, opportunities allow the reconfiguration of the enterprise depending on new needs and changes taking place on the market, as well as in the introduced technological novelties [43]. As other studies indicate [54], dynamic capabilities influence performance by reconfiguring operational capabilities into new ones that are better suited to the environment. Organizational performance is also presented in terms of the organization's resilience [55]. In relation to a dynamic organization, reference is made to a continuous process of finding opportunities and a mindset to understand upcoming trends or tendencies. The common goal of both approaches is the same: to maintain sustainable competitiveness at all times.

In summary, although there is a consensus in the literature that dynamic capabilities are key to digital transformation, achieving sustainable development, and increasing organizational resilience, research rarely considers these factors together and analyzes them from a holistic perspective. To fill this gap, this study examines the mechanisms influencing

organizational resilience from a holistic perspective. Due to the complex combinations of antecedents, there are often multiple paths available through which companies can build organizational resilience that is difficult to explore using commonly used methods [56,57]. This paper presents a configurational framework by assuming that organizational resilience does not depend on a single condition but on the interaction between digital transformation and dynamic capabilities. Therefore, on the one hand, two dimensions of digital maturity were taken into account, i.e., digital intensity and transformation management intensity, and on the other hand, three dimensions of dynamic capabilities, sensing, seizing, and reconfiguring to enable enterprises to achieve organizational resilience (Figure 1). Adopting a configurational perspective will allow for a comprehensive approach to a total of five conditions that will be analyzed in order to trace their configurational, common fit leading to organizational resilience. This comprehensive framework will sequentially analyze the complex interactions between the five conditions mentioned above. This will firstly examine whether a single element of dynamic capabilities and digital transformation is a necessary condition for organizational resilience, secondly, how the conditions for dynamic capabilities and digital transformation are linked to ensure high organizational resilience and, thirdly, how these conditions are linked to contribute to low organizational resilience.

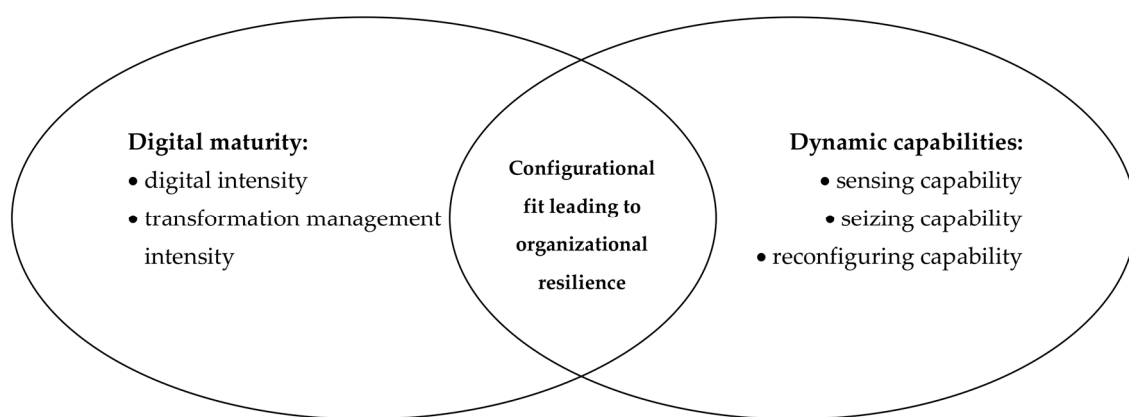


Figure 1. Research model. Source: own study.

Based on the above considerations, the following propositions were developed:

Proposition 1. *Digital transformation and dynamic capabilities lead to organizational resilience.*

Proposition 2. *Different combinations of digital intensity, transformation management intensity, sensing capability, seizing capability, and reconfiguring capability lead to high organizational resilience.*

Proposition 3. *Different combinations of digital intensity, transformation management intensity, sensing capability, seizing capability, and reconfiguring capability lead to low organizational resilience.*

3. Materials and Methods

3.1. Fuzzy-Set Qualitative Comparative Analysis

This paper uses the fuzzy set qualitative comparative analysis (fs/QCA) as the research method. The fs/QCA overcomes the barriers between qualitative and quantitative research while utilizing the features of both approaches [57]. Because the causes and conditions of social phenomena are often interrelated and require a holistic approach, the use of the fs/QCA method, which allows going beyond the typical dependence of regression studies and a simple linear dependence, is fully justified. The fs/QCA method is outcome oriented; through its use, it is possible to determine whether certain conditions are necessary to achieve an outcome [58]. The analysis of pathways to the outcome under investigation deals with complexity by identifying combinations of conditions [59]. Moreover, using the capabilities of fs/QCA, it is possible to examine the causal asymmetry for high and

low organizational resilience [56,57,60]. Furthermore, fs/QCA is based on the assignment of different degrees of membership in defined sets, which significantly influences and improves the quality of research, is also more case-oriented, and, importantly, allows for an accurate and precise explanation of all analyzed causal factors. The subsequent stages of the analysis, starting from data acquisition, carrying out the analytical process using fs/QCA to performing a robustness test to ensure the reliability of the analyses, are presented in the form of an algorithm (Figure 2) and described in the following sections of the paper.

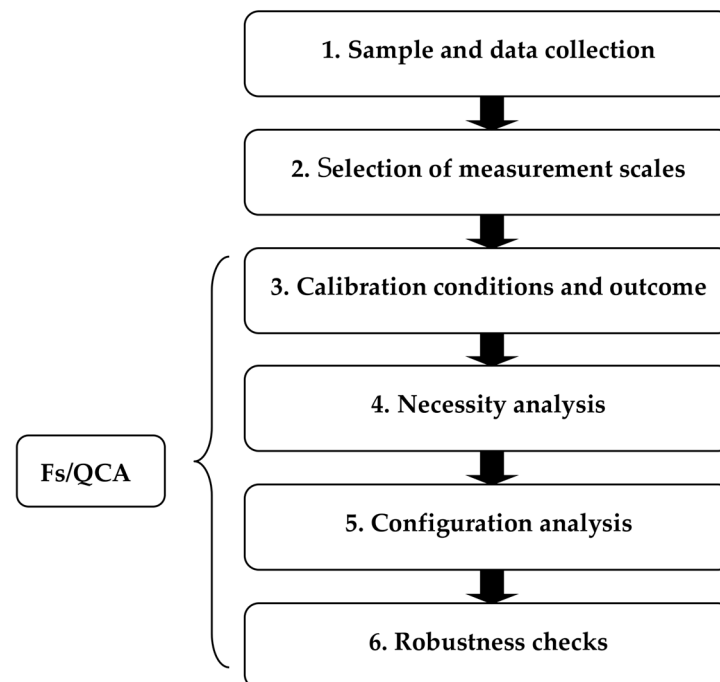


Figure 2. An algorithm of the research approach.

3.2. Sample and Data Collection

First, a pilot study was conducted to review the questionnaire and check the clarity and quality of the questions. To ensure the authenticity and reliability of the obtained research data and due to the convenience of using the Internet, respondents in the actual study were asked to complete electronic questionnaires via chat, mail, and other online channels or by direct means, after which online and offline questionnaires were received and sorted. The study took place in the first quarter of 2024. The respondents were employees and managers of six heat and power plants from the Silesian region in Poland who had appropriate knowledge of the area covered by the study, which allowed them to complete the surveys without errors. Of the selected CHP plants, in terms of legal form, five were joint stock companies, and one was a limited liability company. In terms of age, four CHP plants were over 30, one was between 20 and 29 years old, and one was under 19 years old.

The study included information from 207 surveys. After excluding incomplete surveys, the data for analysis included 153 valid surveys, which constitutes a response rate of 73.9%. The study involved 153 respondents, of whom 88% were men and 14% were women. The average age of respondents was 53.7 years. Due to the type of position held in the heat and power plant, most respondents were management staff (82.5%). Table 2 presents the characteristics of the surveyed companies and respondents.

Table 2. Characteristics of the research sample. Source: own study.

	Category	Statistic
Enterprise Information	CHP Plant age	≤19 (16.7%)
		20–29 (16.7%)
		≥30 (66.6%)
Information of Respondents	Legal form	Joint-stock company (83%)
		Limited liability company (17%)
	Gender	Female (14%)
		Male (88%)
	Position	Management team (82.5%)
		Other employees (17.5%)
	Age	Mean: 53.7 years

3.3. Variable and Measurement

All constructs analyzed in the study used previously validated scales. The survey items of all variables in the questionnaire were measured by Likert’s 5-level indicator (1 = strongly disagree, 5 = strongly agree). The variables used in the study are presented in Table 3.

Table 3. Key variables used in the research. Source: own study.

Variables		No. of Items	References	Cronbach’s α
Condition				
Digital maturity	1. Digital intensity	5	Westerman et al. [38]	0.91
	2. Transformation management intensity	5	Westerman et al. [38]	0.83
Dynamic capabilities	1. Sensing capability	3	Pavlou, El Sawy [54]	0.85
	2. Seizing capability	4	Pavlou, El Sawy [54]	0.79
	3. Reconfiguring capability	5	Pavlou, El Sawy [54]	0.84
Outcome				
Organizational resilience		4	Parker, Ameen [61]	0.83

The outcome is organizational resilience, which was measured as a first-order construct according to Parker and Ameen’s scale [61]. The items included in the questionnaire were as follows: “we are able to cope with changes in our operations caused by external crises”, “we are able to easily adapt our operations to external crises”, “we are able to quickly respond to the negative impact of external crises on our operations”, and “we are able to maintain high situational awareness at all times”.

Digital maturity is recognized by academia and industry as the standard for assessing digital transformation outcomes, e.g., [62,63]. To measure digital maturity, a two-dimensional scale was used, consisting of the digital intensity dimension and the transformation management intensity dimension, both with a 5-item scale [38]. Common entries for the digital intensity dimension include: “technology is allowing us to support customers and to improve operational processes in new ways”, “we use digital channels to provide customer service”, while for the transformation management intensity dimension, it is: “senior executives and middle managers share a common vision of digital transformation”, “the company is promoting the necessary culture changes for digital transformation”.

After reviewing the literature on dynamic capabilities, the measurements focused on three capabilities proposed by Teece [43]: sensing, seizing, and reconfiguring. In this study, taking into account the theoretical nature of Teece’s work, the scales developed by Pavlou and El Sawy [54] were adopted for measurement, consisting of three items on sensing capability (sample item: “we often scan the environment to identify new business opportunities”), four items on seizing (e.g., “we are effective in transforming

existing information into new knowledge”), and five items on reconfiguring (e.g., “we have effective routines to identify, value, and import new information and knowledge”).

3.4. Calibration

Before performing the actual fs/QCA analysis, the most important issue is the calibration of the measured constructs in order to translate them appropriately into sets. The calibrated range of set membership ranges from 0 to 1. To calibrate variables in the range 0–1, calibration anchors (full membership, crossover point, full no-membership) were defined based on the actual distribution of condition variables across cases. Drawing on the work of Ragin [57] in this paper, the 75%, 50%, and 25% quantiles of the sample data were selected as appropriate anchors. The process of calibration and transformation to fuzzy terms of both outcomes—organizational resilience and the conditions—digital transformation/digital maturity and dynamic capabilities is presented in Table 4.

Table 4. Calibration. Source: own study.

Condition			Calibration		
			Fully In	Crossover Point	Fully Out
Antecedent	Digital maturity	Digital intensity	4.5	4.1	3.9
		Transformation management intensity	4.7	4.2	3.3
	Dynamic capabilities	Sensing capability	4.6	4.3	3.7
		Seizing capability	4.5	4.2	3.4
		Reconfiguring capability	4.5	4.1	4.0
	Outcome	Organizational resilience	4.7	4.1	3.5

4. Results

Five conditions were considered in this study. Three dynamic capabilities (sensing capability, seizing capability, and reconfiguring capability) and two dimensions of digital transformation (digital intensity and transformation management intensity) were antecedent conditions, and organizational resilience was used as the outcome (Table 5).

Table 5. Definitions of conditions and outcome. Source: own study.

Condition/Outcome		Code
Outcome	Organizational resilience	OR
Antecedent condition	Digital intensity	DI
Antecedent condition	Transformation management intensity	TMI
Antecedent condition	Sensing capability	SEN
Antecedent condition	Seizing capability	SEI
Antecedent condition	Reconfiguring capability	REC

4.1. Necessity Conditions Analysis

Consistent with the literature on QCA, and with respect to the adopted agglomeration of research procedures (Figure 2), fs/QCA was used to test the ‘necessity’ of each antecedent condition that affects organizational resilience. The results of the test are presented in Table 6. To determine whether an antecedent condition is necessary, the level of consistency is used as a key benchmark. In order to reduce the likelihood of logical contradictions and to keep away from the pitfalls associated with implicit or false necessary conditions, a high consistency score threshold exceeding 0.9 [57,58,60] is required. In the present study, the

results obtained for the necessity or negation of the four conditions (see Table 6) did not allow any of them to be considered necessary for high and low organizational resilience.

Table 6. Analysis of necessity of conditions. Source: own study.

Condition	High Organizational Resilience	
	Consistency	Coverage
Digital intensity (DI)	0.626	0.613
~Digital intensity (~DI)	0.804	0.730
Transformation management intensity (TMI)	0.664	0.672
~Transformation management intensity (~TMI)	0.773	0.790
The sensing capability (SEN)	0.637	0.602
~The sensing capability (~SEN)	0.781	0.785
The seizing capability (SEI)	0.657	0.624
~The seizing capability data (~SEI)	0.782	0.741
The reconfiguring capability (REC)	0.645	0.804
~The reconfiguring capability (~REC)	0.753	0.646
Low organizational resilience		
Digital intensity (DI)	0.664	0.673
~Digital intensity (~DI)	0.695	0.788
Transformation management intensity (TMI)	0.627	0.698
~ Transformation management intensity (~TMI)	0.754	0.767
The sensing capability (SEN)	0.615	0.682
~The sensing capability (~SEN)	0.734	0.759
The seizing capability (SEI)	0.667	0.682
~The seizing capability data (~SEI)	0.704	0.759
The reconfiguring capability (REC)	0.619	0.688
~The reconfiguring capability (~REC)	0.715	0.790

Note: ~logical negation—the absence of conditions.

In both cases, i.e., for high and low organizational resilience, the consistency level falls below 0.9, and therefore, the result of organizational resilience is influenced by the simultaneous and coordinated effects of dynamic capabilities and digital transformation.

4.2. Condition Configuration Analysis

The next step in applying fs/QCA, after completing variable calibration and necessity testing, is configuration analysis according to the presented algorithm (see Figure 2). In this step, a truth table is developed that shows different configurations of antecedent conditions related to organizational resilience. The truth table shows 2^k configurations or rows, k denoting the number of conditions [57]. In the present study, there are five antecedent conditions, resulting in $2^5 = 32$ different combinations of antecedent conditions. Within each configuration, a value of 1 indicates that the score of the calibrated variable is greater than or equal to 0.5, and a value of 0 indicates that the score of the calibrated variable is less than 0.5 [57]. Due to the relatively small research sample, configurations with a single case were removed.

The consistency threshold was selected to separate configurations that were subsets of the outcome from those that were not. Values below 0.75 generally show significant inconsistency [57], and 0.85 was chosen as the consistency threshold. The score was assigned a value of 1 if the consistency of a given configuration exceeded the threshold of 0.85. The value 0 was assigned in the opposite situation.

Subsequently, after running the fs/QCA software (version 3.0 was used in this study [64]), a range of complex, parsimonious, and intermediate solutions appear. According to Ragin's classification criteria [57], core conditions include those found in both intermediate and parsimonious solutions, while peripheral conditions include those found only in intermediate solutions. This study looked for configurations leading to high and low organizational resilience, respectively. The specific configurations of antecedent conditions are offered in Table 7.

Table 7. Antecedent configurations of high and low organizational resilience. Source: own study.

Antecedent Condition	High Organizational Resilience			Low Organizational Resilience	
	HOR1	HOR2a	HOR2b	LOR1	LOR2
Digital intensity (DI)		●	●	⊖	⊖
Transformation management intensity (TMI)	●	●	●	⊖	
Sensing capability (SEN)	●	●		●	⊖
Seizing capability (SEI)	●		●		●
Reconfiguring capability (REC)	●	⊖	⊖		
Raw coverage	0.475	0.482	0.504	0.348	0.349
Unique coverage	0.028	0.023	0.058	0.032	0.031
Consistency	0.923	0.916	0.937	0.886	0.875
Overall solution coverage		0.589			0.527
Overall solution consistency		0.945			0.903

Note. ●—core causal conditions (present); ●—peripheral casual condition (present); ⊖—core casual condition (absent); ⊖—peripheral casual condition (absent); blank spaces indicate “do not care”.

Table 4 presents the results of the analysis of equifinal configurations leading to high and low organizational resilience. The results are presented using generally accepted fs/QCA symbols. Each column in the table represents a distinct configuration of conditions. When analyzing the results, the researcher should present the overall solution consistency and the overall solution coverage. As Ragin points out, “the overall coverage describes the degree to which a given result can be explained by configurations and is comparable to the R-square reported for regression-based methods, while overall solution consistency explains the degree to which solution membership is a subset of result membership” [65], p. 11.

In the case of high organizational resilience, there are three configurations, HOR1, HOR2a, and HOR2b, where HOR2a and HOR2b are a second-order-equivalent configuration, i.e., they have the same core conditions. The overall solution consistency is 0.945, exceeding the critical threshold of 0.85 for each configuration, indicating that 94.5% of cases consistent with these three configurations demonstrate a high level of organizational resilience. Moreover, the overall solution coverage was determined to be 0.589, meaning that the three configurations obtained in the study have solid overall explanatory power that accounts for 58.9% of the observed high organizational resilience in the study cases.

It is also worth noting that two configurations have been identified to explain low organizational resilience, namely configuration LOR1 and LOR2, characterized by an overall consistency of 0.903 and coverage of 0.527, which meet the criteria of the adopted analysis.

The final solution regarding high organizational resilience can be written in the following formula (Formula (1)):

$$TMI*SEN*SEI*REC + DI*TMI*SEN*\sim REC + DI* TMI*SEI*\sim REC \quad (1)$$

where the “*” sign represents the logical AND, and “+” is the logical OR.

The final solution for low organizational resilience can be represented by Equation (2):

$$\sim DI*\sim TMI*SEN + \sim DI*\sim SEN*SEI \quad (2)$$

where the “*” sign represents the logical AND, and “+” is the logical OR.

4.3. Robustness Test

In this study, a robustness test was also performed to ensure the reliability of the configurational analysis performed. The reliability of the research results was checked by changing the variables used to conduct the research. Inspired by, among others, the works of Du et al. [66] or Judge et al. [67], the case frequency thresholds were increased to three, the consistency threshold was adjusted to 0.75, and the grouping of dynamic capabilities and digital transformation in relation to organizational resilience was re-examined. After conducting the experiment, the results obtained did not change significantly. Given that the change in parameters did not contribute to major differences in the number, composition, consistency, and range of configurations, citing the conclusions of the study by Greckhamer et al. [68], the results obtained in this study can be considered robust.

5. Discussion

This paper uses the fs/QCA approach to examine the configurational effects of digital transformation and dynamic capabilities on the organizational resilience of Polish CHP plants. In terms of the conclusions drawn from this research, it can be stated that neither digital transformation nor dynamic capabilities in themselves provide the necessary conditions to achieve organizational resilience. The results obtained in the study show that with different configurations of antecedent factors, both high and low levels of organizational resilience can be achieved.

Adopting Ragin's logic framework [57] to demonstrate the findings of the research, i.e., the identified configurations leading to high organizational resilience of CHPs, it can be established that there are two fundamental pathways based on different core conditions: one with the dominance of dynamic capabilities and one with the dominance of digital maturity.

The dynamic capability-oriented configuration HOR1 (transformation management intensity*sensing capability*seizing capability*reconfiguring capability) indicates that sensing capability and reconfiguring capability are core conditions, and the seizing capability is a peripheral condition. The existence of high transformation management intensity will lead to organizational resilience. The consistency of this configuration is 0.923, with a unique coverage of 0.028 and a raw coverage of 0.475. It is worth noting that this path explains 47.5% of cases of organizational resilience among CHP plants. Therefore, high dynamic capabilities combined with high leadership skills necessary to carry out digital transformation and a strong transformation vision are the basis for achieving high resilience of the CHP plant.

A high digital maturity orientation indicates that high organizational resilience can be achieved under conditions of high digital intensity and high transformation management intensity. This type of resistance includes two paths, the HOR2a configuration and the HOR2b configuration. The core condition is digital intensity, and transformation management intensity must be present, which is a peripheral condition. Therefore, digital maturity is an important motivational factor in achieving high organizational resilience of CHP plants.

The configuration HOR2a (digital intensity*transformation management intensity*sensing capability*~reconfiguring capability) shows that regardless of seizing capability, high organizational resilience can be achieved thanks to high digital maturity and high sensing capability despite, however, low reconfiguring capability. The consistency of this configuration is 0.914, with a raw coverage of 0.482 and a unique coverage of 0.023. It is worth noting that this path is responsible for 48.2% of cases of organizational resilience of CHP plants.

In configuration HOR2b (digital intensity*transformation management intensity*seizing capability*~reconfiguring capability), a configuration path characterized by high takeover capabilities with high digital maturity can result in high organizational resilience despite low reconfiguring capability. This means that in the absence of a sensing capability, CHP plants can also achieve high maturity as long as they have strong seizing capability and high digital maturity. The configuration consistency coefficient is 0.937, with a raw coverage of

0.504 and a unique coverage of 0.058, which accounts for 50.4% of the cases of organizational resistance observed among CHP plants.

On both configuration paths in which digital maturity dominates, there is a mutual substitution effect between high sensing capability and high seizing capability. This context of high digital maturity can lead CHPs to achieve a high level of organizational resilience either by adequately discovering customer needs and innovation opportunities or by introducing new structures, policies, or incentives (Figure 3).

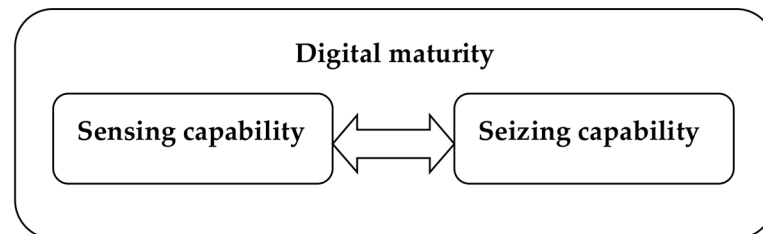


Figure 3. Substitution between sensing and seizing capabilities. Source: own study.

As the obtained results indicate, CHP plants have, on the one hand, developed capabilities to sense new opportunities, which involves activities related to scanning, creating, learning, and, as Teece points out [46], entails the identification, development, and assessment of technological possibilities about the customer's needs. These companies are, therefore, building digital sensing capabilities to better understand unforeseen changes in the environment and take action to manage the changes. On the other hand, a substitute is seizing capabilities, which involves designing business models to satisfy customers and capture value. Enterprises can then effectively decide whether certain information has potential value and transform potentially valuable information into specific business opportunities and business models tailored to strengths and weaknesses. The key here is proper timing, supporting employee motivation, and accurate cultural adjustment.

This study also identified two configurations leading to low organizational resilience of CHP plants. In the case of the first configuration LOR1 ($\sim$ digital intensity $\times$ $\sim$ transformation management intensity $\times$ sensing capability), the core condition is the lack of digital intensity, and the peripheral conditions are the lack of transformation management intensity and the presence of sensing capability. The configuration's consistency stands at 0.886, with a raw coverage of 0.348 and a unique coverage of 0.032. In turn, in the case of the second LOR2 configuration ($\sim$ transformation management intensity $\times$ $\sim$ sensing capability $\times$ $\sim$ seizing capability), the consistency coefficient is 0.875, with raw coverage of 0.349 and unique coverage of 0.031. Notably, these two pathways each account for almost 35% of the cases observed among CHPs. The LOR2 configuration indicates that the combination of low sensing capability, as a basic condition, with low digital intensity despite the presence of a seizing capability is sufficient to achieve low organizational resilience.

A horizontal comparison was then conducted to examine whether the antecedent conditions influenced each other rather than being independent [38]. A comprehensive comparison of the combination of variables shows that digital intensity and transformation management intensity occur only in configurations with high organizational resilience, while configurations with low organizational resilience have low digital intensity in the case of both configurations (LOR1 and LOR2) and low transformation management intensity in the case of LOR1 configuration. This indicates that digital maturity can significantly impact organizational resilience. Moreover, transformation management intensity is strongly correlated with high organizational resilience, as it is present in all three configurations, leading to high organizational resilience. Moreover, companies can achieve a high level of organizational resilience regardless of whether they have a high reconfiguring capability. Therefore, the reconfiguring capability must be effectively combined with other conditions to influence organizational resilience.

5.1. Implications for Theory

The theoretical contributions of this work are essentially focused on the following aspects. Firstly, the study identified two configurational pathways leading to high organizational resilience in CHP plants. The study thus extends the knowledge of factors influencing organizational resilience by additionally offering a constructed, comprehensive analytical framework to assess organizational resilience outcomes on the example of Polish CHP plants. Second, using a configurational approach, this paper empirically investigates the simultaneous synergistic alignment of various factors essentially relating to dynamic capabilities and digital transformation. The aim of the study was to check the possibility of achieving satisfactory organizational resilience through the configuration of these factors. The findings show that various configurations centered around dynamic capabilities and digital maturity can lead to high organizational resilience in CHPs through different equifinal pathways. It can, therefore, be concluded that this study explains certain aspects of high organizational resilience, which previously constituted the so-called “black box”.

Third, this study used the fs/QCA methodology while adopting a configuration-based approach. This analysis serves to explain the driving mechanisms that improve organizational resilience while contributing to the applicability of this method. The use of fs/QCA for research on organizational resilience allows for better adaptation to the actual conditions in which entities operate on the market. Through qualitative comparison and fuzzy set analysis, it was found that dynamic capabilities—in the case of the HOR1 configuration, or digital maturity—in the case of the other two configurations, HOR2a and HOR2b, are important antecedent conditions leading to high organizational resilience. Therefore, on the one hand, carrying out digital transformation, on the other hand, strong dynamic capabilities constitute a significant guarantee for enterprises to achieve high organizational resilience [55,65]. In response to previous literature, this study provides new evidence that dynamic capabilities combined with transformation management intensity or high digital maturity combined with sensing capability or seizing capability leads to high organizational resilience. The research results using fuzzy-set QCA confirmed all three propositions: proposition one, that digital transformation and dynamic capabilities lead to organizational resilience; proposition two, that different combinations of digital intensity, transformation management intensity, sensing capability, seizing capability, and reconfiguring capability lead to high organizational resilience; and proposition three, that different combinations of digital intensity, transformation management intensity, sensing capability, seizing capability, and reconfiguring capability lead to low organizational resilience. The different combinations identified represent equifinal solutions, which indicates that with different antecedent conditions, the desired result can be achieved, i.e., a low or high level of organizational resilience, respectively.

Fourth, the article adds to existing knowledge on organizational resilience. The existing literature lacks empirical research analyzing the simultaneous impact of digital transformation and dynamic capabilities on organizational resilience, especially poor literature on this topic among entities from the energy sector. The paper extends previous research in this area by providing insight into the interior of condition configuration systems.

5.2. Practical Implications

From the point of view of practical implications, it is worth emphasizing that from the perspective of CHP plant managers, there are many paths to achieving high organizational resilience. Managers, based on the resources and capabilities of energy entities, should focus on obtaining benefits from the mutual influence and adaptation of various conditions and approaches to this issue from a broader perspective. By taking into account and adopting an attitude towards coordinating the configuration of various conditions, managers can more consciously make various decisions that can contribute to strengthening organizational resilience. However, the importance of individual resources and capabilities should not be blindly emphasized, and instead, more attention should be paid to their synergistic interaction.

Energy companies have the potential to overcome limitations imposed by objective equipment conditions related to organizational or institutional factors by adopting advanced digital technologies and improving technological management capabilities. By increasing the efficiency of digital transformation, enterprises can achieve higher organizational resilience based on their resource base. Technology itself is not a sufficient condition for achieving high organizational resilience; the development of resources and capabilities, especially dynamic ones, is necessary.

Moreover, it is necessary to accelerate the pace of digital transformation to increase the resistance of CHP plants to digitalization. The transformation towards digital technology is essentially an innovative process that enables entities to be proactive in approaching changes and surviving in a turbulent environment. Managers should, therefore, demonstrate significant intensity in transformation management, have appropriate digital knowledge and digital thinking skills, and construct an appropriate digital strategy.

Managers should avoid a “one size fits all” strategy and follow a path appropriate to their resources, capabilities, and level of digital maturity (see HOR1, HOR2 configurations) to increase organizational resilience. Enterprises should strengthen and improve the sustainable development of their capabilities, especially dynamic ones, both by appropriately discovering customer needs and innovative opportunities as well as by introducing new policies and practices. Moreover, an important tip for managers is the development of digital intensity and transformation management intensity because research shows that these variables are inextricably linked to high organizational resilience.

5.3. Limitations and Future Research Directions

There are limitations in this work that require further research. The study analyzed dynamic capabilities and digital maturity, which included five antecedent conditions affecting organizational resilience. Subsequent research should, therefore, be supplemented with additional conditions presented from different perspectives and dimensions. Therefore, it is possible to create a more comprehensive research model enabling the assessment of organizational resilience. Moreover, the data used in this study come from a limited group of entities, so future research should be extended to other industries and types of enterprises, thus increasing the realism of the research. Furthermore, the study only examined the static relationship between antecedent conditions and organizational resilience outcomes, ignoring its dynamic nature. Future research could, therefore, try to incorporate a time dimension and apply QCA sequentially to capture changes in conditions over time and their effects on the outcome under study.

6. Conclusions

The main goal of this study was to fill a significant gap in the literature regarding the simultaneous impact of dynamic capabilities and digital transformation on organizational resilience. Using two dimensions of digital maturity, i.e., digital intensity and transformation management intensity, and based on the perspective of dynamic capabilities, this study develops a configurational framework and proposes a theoretical model to examine equifinal paths influencing organizational resilience in selected energy sector entities. This study deepens the theoretical understanding of the relationship between digital transformation, dynamic capabilities, and organizational resilience and provides enterprises with appropriate guidance on how to achieve resilience through the configurations of conditions studied.

The novelty of the approach used is the separation of core and peripheral causal conditions within the discovered configurations, both high and low organizational resilience, which allows the theory of equifinality to be extended by the introduction of neutral permutations. This notion suggests that, within a given configuration of conditions, the core causal condition may be surrounded by many combinations of different peripheral conditions, with all of these permutations being equally effective in terms of the outcome under investigation [56]. Moreover, on this basis, causal asymmetry was also

confirmed, i.e., the causes leading to the occurrence of the examined outcome, i.e., high organizational resilience, are different from those leading to low organizational resilience, which contrasts with the correlational understanding of causality. Research in this scope, layout, and approach has so far been conducted to a much-limited extent.

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