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Comparative Analysis Between Cost and Capital Based on The Sensitivity Method

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Abstract

This paper is about the comparison of cost and capital in the tax system. The results show that the capital increases the tax revenue and the costs decrease the tax revenue. The applied methodology is based on the S.M. (Sensitivity Method) where the comparison between the cost and the capital happens through diagrammatic analysis. The mathematical background and the theory of the money cycle clarify the behavior of these variables. The scope of the paper is to confirm the behavior of the theory of the Cycle of Money considering these variables. The objective of this work is to reveal the interaction between these variables.

Keywords: cycle of money, sensitivity method, cost, capital.

1. Introduction

The money cycle counteracts with the variables of the capital and the cost. The quantification analysis of the sensitivity of the tax system to the cost and capital is done by the application of the S.M. (Sensitivity Method) (Bergh, 2009; Bourdin & Nadou, 2018; Challoumis, 2020d, 2020a, 2021d; Corti et al., 2020; Ginsburgh & Weber, 2020; Levi, 2021; Ortun et al., 2017; Paes-Sousa et al., 2019; Rumayya et al., 2020; Tvaronavičienė et al., 2018; Urwannachotima et al., 2020; Woody & Viney, 2017; Παπακωνσταντίνου et al., 2013). The background of this method stands on the behavior analysis of mathematical equations. According to bibliography (Challoumis, 2018a, 2018b, 2023g, 2023b, 2023a, 2023i, 2023c, 2023j, 2023k, 2023d, 2023l, 2023e, 2020a, 2023m, 2023o, 2024b, 2024c, 2024a, 2020b, 2021b, 2021a, 2022a, 2022b, 2023h, 2023f). The cycle of money is the theory where the Q.E. method and also the Sensitivity method have been applied (Aitken, 2019; Arai et al., 2018; Biernaski & Silva, 2018; Buonomo et al., 2020; Challoumis, 2018c; Diallo et al., 2021; Fernandez & Raine, 2019; Hasselman & Stoker, 2017; Hyeon Sik Seo & YoungJun Kim, 2020; Kananen, 2012; Khadzhyradieva et al., 2019; Kroth et al., 2020; Leckel et al., 2020; Loayza & Pennings, 2020; Montenegro Martínez et al., 2020; Nielsen et al., 2019; Ruiz et al., 2017; Scholvin & Malamud, 2020; Soboleva I.V., 2019; Syukur, 2020; Taub, 2015; Ustinovich & Kulikov, 2020; Watanabe et al., 2018). The Sensitivity Method is based on the concept of how sensitive is a variable. To achieve this there are two steps:

© **Authors**. Terms and conditions of Creative Commons Attribution 4.0 International (CC BY 4.0) apply.
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- It should be defined as the equation that is under examination, according to the applied theory.
- Following the same concept of the Q.E. method it is the case that one variable is there in the one case, and the other case is omitted. The basic difference between the Sensitivity Method to the Q.E. method is that Sensitivity does not use the generator, to produce random values, but there is each time a condition that should be satisfied.

The S.M. (Sensitivity Method) is plausible to be applied using a combination of mathematics and programming (Challoumis, 2018c, 2021i, 2022c, 2023p, 2023n, 2023q, 2023r, 2023u, 2023t, 2023s, 2024e, 2024d, 2021j, 2021e, 2021c, 2021d, 2021g, 2021h, 2021f, 2022d; Challoumis & Savic, 2024). The quantification of quality data is the concept of the S.M. (the same happens with the Q.E. method, but from a different point of view (Aakre & Rübbelke, 2010; Baker et al., 2020; Blundell & Preston, 2019; Bowling et al., 2019; Brownell & Frieden, 2009; J. N. B. Campos, 2015; Carattini et al., 2018; Díaz et al., 2020; Fan et al., 2020; Fronzaglia et al., 2019; Gocekli & Comertler, 2021; Grabs et al., 2020; Hai, 2016; Liu et al., 2018; Maestre-Andrés et al., 2019; Marques, 2019; OECD, 2017, 2020; Persson & Tinghög, 2020; Silva et al., 2020; TUTER, 2020; Wright et al., 2017).” Then, it is plausible to quantify quality data. In our analysis, this method is used for clarification of the behavior of the impact factor of the global tax revenue.

2. Literature review

The impact factor of tax revenues of countries which are tax heaves, s according to the bibliography (Challoumis, 2018c, 2021j, 2022c, 2023p, 2023n, 2023q, 2023r, 2023u, 2023t, 2023s, 2024e, 2024d, 2021c, 2024f, 2024g, 2021e, 2021i, 2021d, 2021g, 2021h, 2021f, 2022d; Challoumis & Savic, 2024). It is determined as that:

$$s = \frac{k+l}{r+c+t+i} \quad (1)$$

“Therefore, are countries that receive the products that are taxed in different countries. This allocation of profits between profits and losses permits the enterprises that participate in controlled transactions of the transfer pricing activities to maximize their utility. But, contemporaneously the tax revenue from a global view has declined. Then, the loss of tax income from some countries is more than the profits that make the countries which are tax havens. Thereupon, the symbol of s the impact factor of tax revenue from a global view, and there are some coefficients which are $k, l, r, t,$ and c. Thus, the symbol of k is about the impact factor of capital, l is the impact factor about the liability of the authorities on the tax system. The interpretation of the liability is about how unbalanced it is the tax system. The parameter of r is about the risk, the t is about how much trustworthy is the tax system from the view of cost (Arabyan, 2016; Arbel et al., 2019; Camous & Gimber, 2018; J. Campos et al., 2019; Chubarova et al., 2020; de A. Dantas et al., 2018; de Vasconcelos et al., 2019; Farah, 2011; Goldsztejn et al., 2020b, 2020a; Hartz & John, 2009; Herrington, 2015; Islam et al., 2020; Jia et al., 2020; Kartini et al., 2019; Lajas & Macário, 2020; Martinez & Rodríguez, 2020; Marume, 2016; Nash et al., 2017; Noland, 2020; Peres et al., 2020; Torres & Riaño-Casallas, 2018; Tummers, 2019). The i is about the requirements of the intangibles (different relation from the intangibles which are proportional to capital). The symbols with the “~” are accordingly the same thing but from the view of the uncontrolled transactions. Thus, the numerator is proportional to the income of taxes, as the investments and the stable tax environments, with a lack of cost enhance the tax income (Acs et al., 2016; Adhikari et al., 2006; Andriansyah et al., 2019; Kanthak & Spies, 2018; Korenik & Wegrzyn, 2020; Kreft & Sobel, 2005; Ladvocat & Lucas, 2019; Nayak, 2019; Ud Din et al., 2016). On the other hand, the denominator is inverted and proportional to the tax income, as the risk, the cost, and the unbalance of taxation cause less tax income. Moreover, for $\tilde{s}$:

$$\tilde{s} = \frac{\tilde{k}+\tilde{l}}{\tilde{r}+\tilde{c}+\tilde{t}+\tilde{i}} \quad (2)$$

It is determined the aggregate impact factor of tax revenues, which is symbolized by $\hat{s}$, and is defined by the next equation:

$$\hat{s} = s + \tilde{s} \quad (3)$$

Based on the prior equations it is plausible to proceed to the identification of the behavior of the impact factors of tax revenues in the case of tax heavens and the case of the non-tax heavens. Then, s is a factor that allows the comparison between the controlled with the uncontrolled transactions. Thence is plausible to have a standalone behavior analysis of controlled transactions and a combined behavior analysis between the controlled transactions with the uncontrolled transactions. The next section analyzes the impact factor of tax revenues with the rest impact factors."

This methodology is illustrated below:

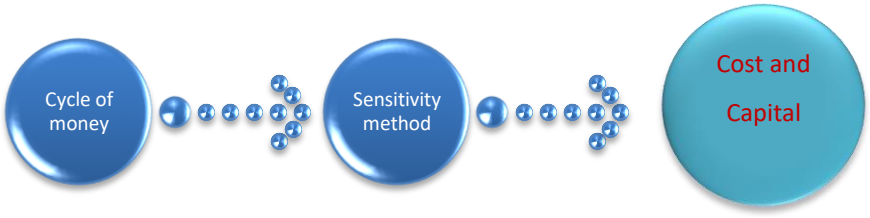

Figure 1. S.M. (Sensitivity Method)

The previous scheme followed the Sensitivity Method to determine the behavior of the global tax revenue in the case that the existence of the cost and the ideal case that this factor is avoided.

3. Results

The cost is in interaction with the impact factor of tax revenues. In this behavioral analysis is determined the model which clarifies the behavior of the impact factor of tax revenues with the existence and with the avoidance of the impact factor of tax sensibility (Challoumis, 2018e, 2018d, 2022e, 2023y, 2023x, 2023w, 2023v, 2023z, 2024h, 2024l, 2024m, 2024j, 2019e, 2024k, 2019a, 2019d, 2019c, 2019b, 2020d, 2020c, 2021k). Then, for the application of the Sensitivity Method:

$$t > l > i > r > k > c \quad (4)$$

Therefore, it is plausible to proceed to a quantity analysis using equations (1), (2), and (4). Therefore, applying the Sensitivity method and choosing the appropriate magnitudes for the coefficient:

The following table presents the data that are under examination to be able to compile the model and confirm that the impact factor of cost declines the tax revenue (Challoumis, 2018e, 2018f, 2020d, 2020c, 2021k, 2023v, 2023y, 2023x, 2023aa, 2023ab, 2023ah, 2023ad, 2018d, 2023w, 2023z, 2023ae, 2023af, 2023ag, 2023ac, 2024m, 2024k, 2024h, 2024j, 2019b, 2024l, 2024n, 20240, 2024p, 2019f, 2019d, 2019e, 2019a, 2019g, 2019c).

Table 1. Compiling coefficients

Factors	Values of s	Values of s'
k	0,4	-
i	0.6	0.6
l	0.7	0.7
r	0.5	0.5
c	0.3	-
t	0.8	0.8
fs	<0.3	<0.3
f_i	<0.3	<0.3

Therefore, using the Sensitivity Method:

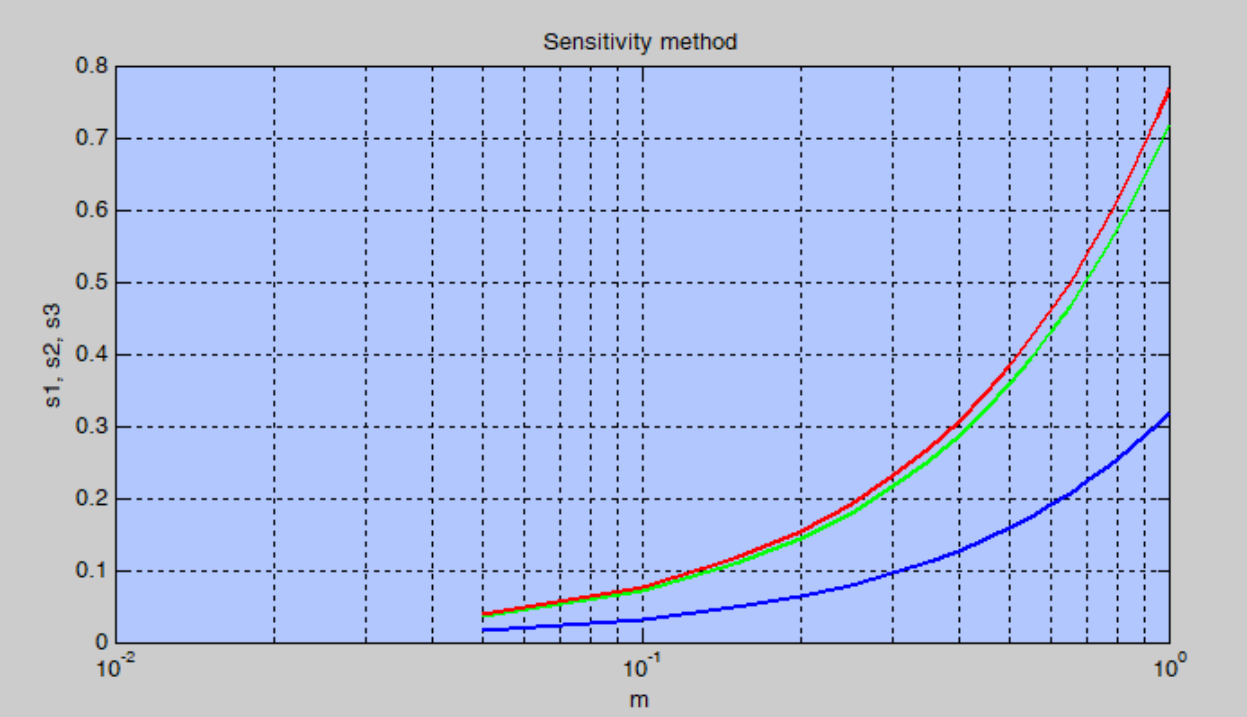

Figure 3. Application of S.M.

In logarithmic forms, the red line is about the case that there doesn't exist cost, and the blue line is the case that there does exist capital. The green line is the case that there are all the variables. It is confirmed by the theoretical background of the theory of the money cycle (or the theory of the cycle of money).

4. Conclusions

This paper examined the case of cost and capital and how interact with global tax revenue. Then the companies that participate in controlled transactions prefer as expected the tax environments that have unstable law rules and insecure economies. This has an impact on the companies that participate in controlled transactions to be increased in numbers because that way can allocate their profits and losses better. Then, the decrease in cost could rapidly increase the tax revenue. Simultaneously the increase of capital increases the tax revenue. Therefore, the increase in capital and the decrease in cost is an ideal case for the money cycle.

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Appendix

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% Sensitivity Plot of Cycle of money (C)(R)2024 Constantinos Challoumis
m=0:0.05:1;
k=0.4*m;
l=0.7*m;
j=0.6*m;
r=0.5*m;
c=0.3*m;
t=0.8*m;
p=0.6*m+0.5*m+0.3*m+0.8*m;
q=0.6*m+0.5*m+0.8*m;
s1=k+l/p*m;
s2=l/p*m;%the multiplication is made to avoid constant by the division
s3=k+l/q*m;
i=0;

plot(m,s1,'green',m,s2,'blue',m,s3,'red')
grid on
title('Sensitivity method')
xlabel('m')
ylabel('s1, s2, s3')

while (s1(i)>s1(i+1))
    i=i+1;
end

m(i)
s1(i)
```

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Dynamic Differentiation: An Adaptive Model of Multi-dimensional Leadership for Real-time Adjustment of Management Styles in Complex Crises within Heterogeneous Industrial Environments

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Abstract

The research examines the phenomenon of dynamic differentiation as a leadership mechanism enabling managers to adapt their leadership styles in real-time during crises in heterogeneous industrial environments. While existing theories focus on a single leadership style, this research concentrates on the need for dynamic adaptation throughout crisis stages and in different sectorial contexts. Through Mixed Methods methodology, 127 crisis cases in 42 industrial organizations were investigated. The findings show that effective managers employ a diverse leadership repertoire according to the crisis stage, organizational characteristics, and sector type. The proposed integrative model identifies four dimensions of dynamic differentiation: cognitive (decision-making processes), behavioral (style adaptation), contextual (environmental adaptation), and temporal (dynamics over time). The research identifies sense-making and sense-giving processes as central to real-time adaptation, and offers implementable strategies for developing these capabilities. The theoretical contribution expands knowledge on adaptive leadership, and the practical contribution provides tools for developing effective leadership in complex crisis environments. Cross-sectorial analysis indicates unique adaptation patterns in different sectors, with significant implications for management training and organizational intervention design.

Keywords: dynamic differentiation, multi-dimensional leadership, crisis management, real-time adaptation, industrial environments, sense-making, organizational adaptation.

1. Introduction

The contemporary organizational reality is characterized by a VUCA world – volatility, uncertainty, complexity and ambiguity (Heifetz et al., 2019), where crises are not exceptional events but an inherent part of daily management (Bundy et al., 2017). Crisis management challenges are intensified in heterogeneous industrial environments due to the multi-dimensional nature of crises, substantial differences between industrial sectors, and blurring boundaries between various management levels (Williams et al., 2017; Araújo et al., 2023).

In industrial organizations, the managerial challenge is amplified due to technological complexity, functional diversity, and elaborate supply chains. Recent studies demonstrate that

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leadership effectiveness during crisis depends on the ability to adapt leadership style to the specific context (Khan et al., 2021; Klemm et al., 2022). However, the existing literature primarily presents static models that do not align with the dynamism of the modern industrial environment. The traditional paradigm in leadership research focused on searching for a universal optimal leadership style, but in the last decade, recognition has strengthened that selecting the optimal leadership style depends on a complex of contextual factors (Maruhom et al., 2024). Concurrently, the concept of adaptive leadership emphasized managers' ability to adjust their behavior to circumstances (Araújo et al., 2023), yet remained limited in its reference to the temporal dynamics of transitioning between styles.

This research proposes a model of "Dynamic Differentiation" - referring to managers' ability to consciously move between different leadership styles according to crisis stages, sector characteristics, and organizational dynamics. As Chen and Fulmer (2022, p. 1627) note, "dynamic differentiation enables creating a balance between information integration and focused specialization, allowing optimal adaptation of leadership behavior to environmental complexity." This concept combines adaptive leadership theory with Person-Environment Fit theory (Zheng & Liu, 2022). The research contribution is manifested in three central aspects: (a) expanding knowledge about multi-dimensional leadership through identifying mechanisms enabling transition between styles; (b) renewed understanding of the relationships between leadership, context and time, while identifying critical "turning points"; (c) integrating insights from cognitive psychology into leadership research, focusing on sense-making and sense-giving mechanisms.

Empirically, the research is based on analysis of 127 crisis cases in 42 industrial organizations, and develops a taxonomy of leadership styles adapted to different sectors and distinct crisis stages. Through mixed methodology, the research bridges the gap between crisis management and organizational resilience (Williams et al., 2017), and offers a conceptual framework enabling leadership flexibility in changing environments.

The research is organized in six chapters: introduction; literature review in the areas of leadership in crises, cognitive theories and sectorial heterogeneity; methodology; findings; discussion and implications; and conclusion presenting the integrative contribution and future research directions. In an era of "perpetual crisis," the dynamic differentiation model provides an innovative framework for understanding effective adaptation of leadership styles in heterogeneous industrial environments.

1.1 *Research objectives*

The central aim of this research is to develop and validate an integrative model of dynamic differentiation of multi-dimensional leadership in crisis management within heterogeneous industrial environments. This model is designed to provide a comprehensive theoretical and practical framework for understanding how effective managers adapt their leadership style in real-time to the changing challenges of complex crisis environments.

To achieve this central aim, the research focuses on five complementary sub-objectives:

First, the research seeks to identify patterns of dynamic adaptation of leadership styles during crises across different industrial sectors. This objective stems from the recognition, as noted by Eggers et al. (2024), that different sectors are characterized by unique pressures and constraints that substantially influence how managers respond to crises. Through comparative analysis of 127 crisis cases in 42 industrial organizations, the research aims to identify patterns unique to each sector and principles that cross sectors.

Second, the research aims to develop a comprehensive taxonomy of leadership styles during crisis and assess their differential effectiveness. Based on the insight of Maruhom et al. (2024, p. 52) that "there is no uniform strategy for effective leadership," the research develops a conceptual framework that classifies and characterizes different leadership styles, while empirically evaluating their relative effectiveness in various situations and contexts. This taxonomy will provide managers with a diagnostic and practical tool for selecting the optimal style according to specific circumstances.

Third, the research strives to explore the sense-making and sense-giving mechanisms enabling managers to identify "turning points" that necessitate a change in leadership style. Following the work of Combe and Carrington (2015) on the development of cognitive consensus among management teams, the research examines how managers identify environmental signals, process them cognitively, and translate them into managerial decisions. A deep understanding of these mechanisms is essential for developing the ability to identify the "critical moments" requiring strategic change in leadership approach.

Fourth, the research aims to develop a model explaining the dynamics of leadership differentiation and the interrelationships between its various dimensions. Drawing on Chen and Fulmer's (2022) insight that leadership flexibility requires addressing multiple dimensions simultaneously, the research characterizes four central dimensions of dynamic differentiation – cognitive, behavioral, contextual, and temporal – and analyzes the complex interactions between them. The proposed model will provide a coherent theoretical framework for understanding the multi-dimensional complexity of dynamic differentiation.

Fifth, the research focuses on proposing implementable strategies for developing dynamic differentiation capabilities. As Roberts et al. (2022, p. 7) emphasize, there is a need for "developing evidence-based training programs to improve leadership during crisis." Accordingly, the research formulates methodologies and practical tools enabling managers to develop and refine their ability to adapt their leadership style in real-time, and examines the effectiveness of these strategies across different industrial sectors.

Achieving these objectives will enable the development of a comprehensive integrative model of dynamic differentiation, contributing both to the theoretical understanding of the leadership phenomenon during crises and to the development of practical applications for managers operating in heterogeneous industrial environments. The proposed model will bridge the gap identified by Williams et al. (2017) between crisis management and organizational resilience, and will enable managers to develop strategic and tactical flexibility in addressing the dynamic challenges of contemporary organizational reality.

2. Literature review

2.1 *Theoretical frameworks of leadership in crisis situations*

The research literature on leadership in crisis situations has developed significantly in recent decades, as a response to the complex challenges and more frequent crises in contemporary organizations. Crisis is defined as "an event with low probability and high impact, threatening the organization's existence and characterized by ambiguity of cause, effect and means of resolution, as well as the belief that decisions must be made rapidly" (Firestone, 2020, p. 9).

2.1.1 *Existing models for crisis management: Advantages and limitations*

The central models in the literature reflect the evolution of insights in organizational leadership research. The three-stage model (prevention, coping, and recovery) of Pearson and

Mitroff (as cited in Bundy et al., 2017) contributed to understanding the cyclical nature of crises, but lacks reference to the leadership complexity required at each stage. A significant development came with the situational leadership approach to crises (Klemm et al., 2022) which recognizes that "there is no single universal effective leadership style... style selection depends on several factors, including employee skill and conditions and other variables" (Maruhom et al., 2024, p. 52). However, this approach is limited in explaining the dynamics of transition between leadership styles and in identifying "turning points" requiring style change.

The Adaptive Crisis Management Theory (Roberts et al., 2022) emphasizes the importance of "adaptive leadership in fostering organizational resilience and effective response strategies" (p. 3), but "focuses too much on adaptation and coping, and ignores proactive aspects such as early identification and prevention" (Williams et al., 2017, p. 740).

The "Synergy Triangle of Crisis Management" approach (Bushmanova & Sawang, 2023) combines leadership, knowledge management and organizational learning, and recognizes that "knowledge management provides infrastructure for calculated yet rapid decision-making... and learning constitutes the organization's 'memory'" (p. 905). Still, the model lacks reference to the dynamics of changing leadership throughout crisis stages and in different organizational contexts. The common limitation of existing models is that "they tend to address crisis from a one-dimensional perspective, and do not address the multi-dimensional nature of crises and the many qualities required to overcome crisis contexts" (Williams et al., 2017, p. 742). The dynamic differentiation presented in the current research seeks to bridge this gap through a theoretical framework that recognizes the multi-dimensional complexity of crisis management and the need for dynamic adaptation of leadership styles.

2.1.2 *Transformational and transactional leadership in crises*

In crisis leadership literature, two central paradigms – transformational and transactional leadership – have received special attention. Transformational leadership, developed by Burns and Bass, emphasizes influence on employees through charisma, inspiration, intellectual stimulation, and individualized consideration. Research shows that "transformational leaders demonstrate self-confidence and skill in handling problems... and help organizations understand crises through a clear, inspiring, and structured vision" (Karim et al., 2024, p. 132; Maruhom et al., 2024, p. 54). Eggers and colleagues (2024) demonstrated how this style contributes to flexibility and innovation in crises. However, "transformational leadership may be less effective in the early stages of crisis, when a rapid and directed response is required" (Bundy et al., 2017, p. 1670).

In contrast, transactional leadership focuses on structured exchanges between managers and employees, and emphasizes clarity, structure, and contingent rewards. Khan and colleagues (2021) identified that "during periods of crisis, transactional leadership can provide the stability and structure needed, especially when levels of anxiety and uncertainty are high" (p. 730). It provides a clear framework for action and defines areas of responsibility. Research on the COVID crisis showed that "transactional leadership was particularly effective in the early stages of the crisis... while transformational leadership became more essential in later stages" (Roberts et al., 2022, p. 6) – a finding emphasizing the importance of transitioning between styles according to crisis stages.

The dichotomous division between the approaches may be artificial in the complex organizational reality. Chen and Fulmer (2022) argue that "effective leaders know when to activate elements from each approach according to the specific requirements of the situation" (p. 1628). This integrative approach aligns with the concept of dynamic differentiation emphasizing a diverse leadership repertoire. Araújo and colleagues (2023) strengthened this perception in their findings

that "effective leaders during crisis demonstrate the ability to move between a structural, task-focused approach and an inspiring, people-focused approach according to changing needs" (p. 10).

2.1.3 *Development of the multi-dimensional leadership approach in research literature*

The multi-dimensional leadership approach developed as a response to the need for a more complex understanding of the leadership phenomenon, especially in contexts of uncertainty and dynamic environments. This development reflects the recognition that leadership combines cognitive, emotional, behavioral, and environmental aspects (Chen & Fulmer, 2022).

The first stage in the development of the approach is linked to the Person-Environment Fit (PE Fit) theory, which emphasized the importance of alignment between leader characteristics and environmental conditions. It argued that work stress arises when "the work environment does not provide sufficient resources for a person's needs… or when a person's abilities are insufficient to meet demands" (Zheng & Liu, 2022, p. 882). This approach contributed to understanding the need for multi-dimensional fit, but focused on static alignment.

A significant development came with Combe and Carrington's (2015) research on leadership sensemaking in crises, which emphasized that "leaders develop theoretical mental models for interpreting external change, and subsequently a prescriptive mental model describing causes and outcomes in relation to the crisis situation" (p. 309). This research expanded the leadership concept toward cognitive and interpretive processes. An additional contribution came from "Complex Leadership Theory" (Bushmanova & Sawang, 2023), which views leadership as a complex interaction process between administrative, adaptive, and enabling leadership, and emphasized the need to integrate different dimensions and transition between them.

Heifetz and colleagues (2019) contributed to the multi-dimensional approach in their distinction between technical challenges, which are "well-defined and their solutions known," and adaptive challenges, which "require changes in values, perceptions, and behaviors" (p. 65), and emphasized the need to adapt leadership style to the nature of the challenge. Contemporary development is expressed in Chen and Fulmer's (2022) research on "dynamic differentiation and integration," arguing that "effective leadership requires the ability to combine differentiation and integration processes according to environmental complexity" (p. 1630) and emphasizing the dynamism of leadership adaptation and developing a flexible behavioral repertoire. Recent studies by Khan and colleagues (2021) and Roberts and colleagues (2022) expanded the multi-dimensional approach in the crisis context, emphasizing integration between cognitive, emotional, and social aspects in leadership and the importance of interaction between the leader, team, and organization.

The development of the multi-dimensional leadership approach reflects a transition from one-dimensional concepts toward a more integrative understanding, recognizing the complexity and dynamism of leadership processes. The dynamic differentiation model proposed in the current research expands this approach, offering an integrative framework for understanding how to adapt leadership styles in real-time to complex crises in heterogeneous industrial environments.

2.2 *Cognitive theories of decision-making under uncertainty*

A central challenge for leaders in crises is making complex decisions under conditions of high uncertainty, partial information, and limited time. As Bundy and colleagues (2017, p. 1663) note, "crises are characterized by high uncertainty and ambiguity of cause and effect, which complicate rational decision-making processes." The cognitive complexity of decision-making in

crises requires a deep understanding of the mental processes involved in identifying, processing, and interpreting information in real-time.

2.2.1 *Real-time information processing perspective*

The information processing perspective focuses on how leaders process, organize, and interpret information during crises. Decision quality depends on the ability to process large amounts of information, filter between relevant and irrelevant, and identify guiding patterns. Roberts and colleagues (2022) emphasize that "solving complex problems involves knowledge-rich requirements and collaboration between content experts" (p. 6), with a central challenge being the excessive cognitive load creating a "bottleneck" in information processing.

The advanced model proposed by Chen and Fulmer (2022) focuses on the "ability to balance between incoming information flow and the need for rapid decision-making" (p. 1632). According to them, effective leaders develop cognitive differentiation that allows them to move between different levels of analysis – from broad holistic vision to focused and detailed analysis – according to changing requirements. This cognitive flexibility parallels the capacity for dynamic differentiation in leadership styles, and it constitutes a cognitive basis for adaptation processes of management styles.

A more process-oriented conception is proposed by Combe and Carrington (2015), who argue that "the leader's descriptive and prescriptive mental model develops over time in a complex manner" (p. 312). Their research demonstrates how cognitive consensus gradually forms in management teams through ongoing interaction and shared information processing. This insight connects personal information processing processes with the social dimension of building shared meaning, and emphasizes the temporal dynamics of cognitive processes.

A significant insight from this perspective is the impact of "cognitive load" on decision quality. Williams and colleagues (2017) found that "under conditions of pressure and cognitive load, managers tend to revert to familiar habits and thought patterns" (p. 746) - an observation emphasizing the special challenge in performing dynamic differentiation in crisis situations, and the need to develop mechanisms to reduce this load.

2.2.2 *Adaptive fit patterns (Person-Environment Fit)*

Person-Environment Fit (PE Fit) theory extends the understanding of cognitive processing to the dimension of fit between the person and their environment, providing a complementary framework for understanding leadership style adaptation to changing environments. This theory focuses on the "compatibility that occurs when people match the characteristics of the work environment in which they operate" (Zheng & Liu, 2022, p. 880). In the context of crisis management, it illuminates the dynamics of alignment between leader capabilities and changing crisis demands.

Zheng and Liu (2022) identify two main dimensions of fit: alignment between individual needs and environmental resources, and alignment between individual capabilities and environmental demands. They argue that "in crises, PE Fit may be under increased pressure, leading to redefinition and re-achievement of fit" (p. 882) - an insight emphasizing the dynamic nature of the adaptation process, as both the person and environment undergo rapid changes. Empirical research supports the importance of dynamic fit in various contexts. Klemm and colleagues (2022) showed how "leadership effectiveness in crisis is significantly influenced by the adaptation of leadership style to the specific context of the crisis event" (p. 118), and identified a complex triple interaction between situational leadership, crisis expectations, and manager gender – a finding emphasizing the multi-dimensional complexity of adaptation processes.

A significant expansion of the PE Fit concept is proposed by Chen and Fulmer (2022) through the notion of "adaptive fit," arguing that "instead of seeking static fit between individual and environmental characteristics, leaders need to develop dynamic adaptation capability, allowing them to change their behavior according to changing requirements" (p. 1631). This approach directly corresponds with the concept of dynamic differentiation, emphasizing managers' ability to move between different leadership styles according to the changing context.

2.2.3 *Dynamics of sense-making and sense-giving in crises*

Sense-making and sense-giving theories complement the previous perspectives and connect personal cognitive processing to the interpersonal dimension of leadership. These theories provide a cognitive-social perspective for understanding how leaders interpret and communicate meaning in crises. Sense-making refers to the process in which "people try to understand vague, ambiguous, or expectation-contradicting events" (Combe & Carrington, 2015, p. 307), while sense-giving refers to the process in which leaders influence how others interpret events.

Combe and Carrington (2015) offer an in-depth view of these processes and emphasize that "sense-making in crises involves cycles of information processing, communication, and problem-solving, often integrated with action, to create meaning and make sense of events" (p. 308). Their research identified how leaders develop cognitive consensus throughout a crisis, a process that forms an essential basis for dynamic differentiation by guiding the selection of appropriate leadership style. The interpersonal dimension of these processes is expanded by Williams and colleagues (2017), who emphasize that "leaders engage in meaning creation to help other stakeholders understand information during a crisis" (p. 745). They note the reciprocity between sense-making (personal interpretation) and sense-giving (transferring interpretation to others), reflecting the dual role of leaders during crisis: interpreting the situation for themselves and imparting this interpretation to others.

An important social-emotional dimension is added to the discussion by Roberts and colleagues (2022), referring to the "ability to anticipate actions of other team members" and their claim that "the shared mental model includes a history of emotional experiences… facilitating prediction of future emotion and behavior of team members" (p. 7). This insight emphasizes the importance of shared history and emotional aspects in collective sense-making processes. The connection between leadership style and sense-making capabilities is emphasized by Maruhom and colleagues (2024), noting that "transformational leaders help organizations understand crises through a clear, inspiring, and structured vision" (p. 54). This observation connects the theories of transformational leadership discussed in section 2.1.2 with sense-making processes, and emphasizes the integration between different leadership dimensions. These insights directly relate to the dynamic differentiation model proposed in the current research. As Chen and Fulmer (2022) note, "dynamic differentiation requires advanced ability to identify and interpret signals from the environment, and adapt leadership behavior accordingly" (p. 1633). Effective leaders activate their information processing, PE Fit, and sense-making capabilities in synergy, to identify "turning points" requiring a change in leadership style. The integrative model allows understanding how these cognitive mechanisms combine and enable flexible transition between leadership styles according to the changing demands of the crisis.

2.3 *Sectorial heterogeneity and its impact on crisis management*

The contemporary industrial environment is characterized by significant structural and functional heterogeneity, as different sectors deal with a unique complex of challenges, regulatory processes, and competitive characteristics. As Williams and colleagues (2017) note, this

heterogeneity significantly affects the dynamics of crisis management and leadership effectiveness. Hence, understanding sectorial differences and environmental factors affecting leadership in crises is critical to the dynamic differentiation concept proposed in this research.

2.3.1 *Unique characteristics of different industrial sectors*

Recent studies indicate that different industrial sectors are characterized by unique patterns of crisis vulnerability, response capabilities, and leadership needs (Araújo et al., 2023). Consequently, understanding the unique characteristics of each sector is essential for developing a leadership model capable of adapting itself to the specific requirements of the industrial context. Comparative examination of different sectors demonstrates the substantial differences between them. For example, Eggers and colleagues (2024) found that in the hospitality industry, characteristics such as high seasonality, sensitivity to global economic conditions, and dependence on international movement of people, made the sector particularly vulnerable during the COVID crisis. Within this framework, they emphasize that "innovative hospitality companies differ from non-innovative companies in the level of dynamic capabilities development and the extent to which different leadership styles affect dynamic capabilities" (p. 103704) – a finding highlighting the close connection between leadership style and unique sector characteristics.

In stark contrast to the hospitality industry, Khan and colleagues (2021) identified in the pharmaceutical industry "unique challenges, such as importing raw materials from developed countries, high capital investment requirements, and stringent regulatory challenges" (p. 4). As a result, the pharmaceutical sector requires a leadership style emphasizing innovation alongside regulatory compliance and commitment to quality, as "drug development and advancement to save human lives require employees with high self-confidence… who can cope with challenging circumstances for innovation" (p. 4). Similarly, the technology sector presents its own unique dynamics. Karim and colleagues (2024) note the rapid pace of change, short product lifecycles, and necessity for constant innovation characterizing this sector. In this context, the researchers found that "effective digital leadership in the technology sector requires the ability to navigate between conflicting demands of stability and innovation, while using AI-based tools for crisis management" (p. 130) – a finding emphasizing the need for a flexible and technology-oriented leadership style.

Moreover, Roberts and colleagues (2022) identified in the natural resources sector unique characteristics such as "operations in remote locations, dependence on global supply chains, and high safety risks" (p. 4), which led to distinct challenges during the COVID crisis. As a result, leaders in this sector were required to implement "adapted safety protocols… and focus on the mental wellbeing of employees" (p. 4) – requirements necessitating a leadership style combining safety concern with organizational flexibility.

Beyond differences in basic characteristics, sectorial heterogeneity is also expressed in vulnerability to different types of crises. Bundy and colleagues (2017) clarify that "the technology sector may be more exposed to information security and privacy crises, while the industrial sector is more vulnerable to operational and safety disasters" (p. 1664). In light of this, there is a clear need to develop leadership capabilities specific to the types of crises typical to each sector. Theoretically, Chen and Fulmer (2022) propose the concept of "environmental complexity" as a framework for understanding sectorial differences. They argue that "different sectors are characterized by different levels of complexity, resulting from the number of influencing factors, rate of change, and degree of connectivity between factors" (p. 1629). According to this model, sectors with high complexity require a higher capability for dynamic differentiation.

Complementing this approach, Bushmanova and Sawang (2023) propose the concept of "organizational memory" in their claim that "different sectors develop unique 'organizational

memory,' based on previous experience with crises" (p. 907). According to this conception, in sectors characterized by frequent crises, "organizational memory can serve as a vital resource, but also as a source of cognitive biases based on past experience" (p. 908) – an aspect significantly affecting crisis perception and leadership processes.

2.3.2 *Environmental factors and their impact on leadership effectiveness*

Alongside the specific characteristics of each sector, recent studies identify various environmental factors with decisive influence on leadership effectiveness during crisis. These factors, including macro-economic, regulatory, cultural, and technological variables, shape the context in which leaders operate and affect their ability to lead effectively.

Organizational culture constitutes a primary environmental factor, as identified by Araújo and colleagues (2023). According to their research, "organizations with a culture that values flexibility, continuous learning, and innovation create an environment supporting the development of adaptive leadership" (p. 11). As a result, an open and supportive organizational culture enables managers to perform dynamic differentiation more easily, by providing legitimacy for experimentation and encouragement for learning from experiences. Simultaneously, Williams and colleagues (2017) emphasize the degree of organizational "embeddedness" in its external environment as another significant factor. They note that "organizations with a high level of connectivity to their external environment… are more affected by external crises, but also have access to more external resources for coping" (p. 750). In this context, developing organizational boundary management capabilities becomes an integral part of effective leadership.

The broader cultural environment constitutes another influential factor, as suggested by Zheng and Liu (2022): "Cultural differences can affect an organization's receptiveness to adaptive leadership. Some cultures may attribute higher value to hierarchy and authority, while others emphasize flexibility and autonomy" (p. 890). This insight gains additional validity in global organizations operating in diverse cultural contexts. From the regulatory perspective, Klemm and colleagues (2022) point to an interesting duality in their observation that "rigid regulatory environments may limit leaders' maneuverability during crisis, but also provide a clear framework for action" (p. 122). This observation is particularly relevant to sectors characterized by heavy regulation, where leaders need to navigate between the need for flexibility and the requirement for regulatory compliance.

Concurrently, the technological environment constitutes a factor with increasing influence, as emphasized by Karim and colleagues (2024): "The technological environment shapes how leaders can identify, evaluate, and respond to crises" (p. 131). Within this framework, both opportunities (enhanced capabilities for prediction and monitoring) and challenges (the need to integrate AI-based decision-making with human judgment) are identified as shaping leadership in the digital age. In this context, Bundy and colleagues (2017) emphasize the rise of social media as a transformative environmental factor: "The rise of social media has fundamentally changed how crises are perceived, reported, and managed" (p. 1675). In light of this, the "rapid pace, broad accessibility, and immediate dissemination of information… require leaders to develop quick communication and response capabilities" (p. 1675) – a requirement leading to the development of "communicative leadership" specializing in managing the public perception of the crisis.

Another significant intra-organizational environmental factor is "crisis memory," as emphasized by Firestone (2020): "Organizational environments that have experienced similar crises in the past have developed 'crisis memory'… affecting how future crises are responded to" (p. 10). As a result, this memory acts as a double-edged sword – on one hand as a positive resource providing insights and procedures, and on the other as a potential factor for "cognitive fixation" complicating the identification of differences between various crises. Finally, Roberts and

colleagues (2022) illuminate the influence of the geographic environment on leadership effectiveness. In their research on the resource industry in Australia, they found that "remote geographic location of operational sites significantly affected managers' ability to respond to the COVID crisis, and necessitated the development of adapted leadership approaches" (p. 5). This finding emphasizes the need for leadership adaptation not only to the specific sector, but also to the spatial characteristics of organizational activity.

In summary, the research literature highlights the complexity of synergistic relationships between sectorial heterogeneity, environmental factors, and leadership effectiveness. As Chen and Fulmer (2022) sharply summarize, "the real challenge for leaders is not merely to adapt their style to the specific sector, but to develop dynamic differentiation capability enabling constant adaptation to changing reality" (p. 1635). In light of this, the dynamic differentiation proposed in the current research constitutes a holistic response not only to changes in the organization's internal environment, but also to the unique influences of the external environment – shaped by sector characteristics, economic conditions, regulatory requirements, evolving technology, and cultural context.

2.4 *Developing a conceptual framework: Towards a dynamic differentiation model*

Based on the review of theoretical frameworks in previous sections, this section proposes an integrative conceptual framework of dynamic differentiation. This model bridges the gap between existing theories and explains how leaders adapt their style in real-time to complex crises in heterogeneous industrial environments.

"Dynamic differentiation" constitutes an extension of existing conceptions of adaptive leadership. While previous research focused on static fit between leader and environment (Zheng & Liu, 2022) or general ability to adapt style to situation (Maruhom et al., 2024), this concept emphasizes the active process of continuous adaptation over time. Based on Chen & Fulmer (2022, p. 1631), dynamic differentiation is defined as "leaders' ability to move actively and consciously between different leadership styles according to the changing demands of the environment, while employing a diverse leadership repertoire adapted to the specific context."

This definition includes four distinct components:

1. Capability for conscious and proactive movement (Heifetz et al., 2019),
2. Transition between diverse leadership styles (Araújo et al., 2023),
3. Continuous adaptation to changing demands (Williams et al., 2017),
4. Development of a rich leadership repertoire (Maruhom et al., 2024).

The uniqueness of the model is in the emphasis on the temporal dimension of leadership adaptation and on sense-making processes that develop "over time and in response to environmental changes" (Combe & Carrington, 2015, p. 312), as well as in the recognition that leadership occurs "within an ecosystem of relationships, culture, and structure" (Khan et al., 2021, p. 728).

The model includes three integrated cyclical processes:

Identification: Ability to identify signals from the environment indicating the need for style change. Effective leaders develop "signal sensitivity" (Chen & Fulmer, 2022, p. 1632) enabling distinction between "noise" and meaningful signals, while integrating emotional and organizational sensitivity.

Adaptation: Process of selecting the appropriate style from the available repertoire. Araújo et al. (2023, p. 10) emphasize the importance of "flexibility" and avoiding adherence to ineffective approaches. Heifetz et al. (2019, p. 67) distinguish between "technical adaptation" (minor changes) and "adaptive adaptation" (substantial changes in leadership paradigm).

Real-time Adjustment: Subtle adjustments during crisis development, based on "rapid feedback" (Williams et al., 2017, p. 753) and "behavioral sensitivity" (Chen & Fulmer, 2022, p. 1634) – the ability to identify the impact of specific behaviors and make adjustments. The proposed dynamic differentiation model provides an integrative framework for understanding the dynamic complexity of leadership in crisis situations, and serves as a basis for the empirical research described in the following chapters.

3. Methodology

3.1 *Research paradigm and research design*

The current research is based on a pragmatic research paradigm, combining elements of positivistic and interpretive perspectives to address the complexity of the dynamic differentiation phenomenon. As Combe and Carrington (2015) note, studying leadership processes during crisis requires "deep understanding of both the subjective cognitive processes of leaders and the objective outcomes of their decisions" (p. 310).

The choice of mixed methods methodology stemmed from several theoretical and practical considerations. Epistemologically, the research relies on a "critical-realist" position, recognizing the existence of an objective reality alongside the importance of subjective interpretation. As Bundy and colleagues (2017) note, "understanding organizational crises requires addressing both the objective characteristics of events and their subjective interpretation" (p. 1663). Another central consideration is the need for complementary information of different types, as demonstrated by Chen and Fulmer (2022) in combining quantitative analysis with in-depth interviews, enabling "identification of statistical patterns alongside deep understanding of the underlying mechanisms" (p. 1632).

Empirical evidence from the literature supports this choice. Araújo and colleagues (2023) found that "the most effective studies on adaptive leadership were those using mixed methodologies" (p. 8), and a meta-analytic review by Bundy and colleagues (2017) identified a higher rate of significant findings in mixed studies (73% compared to 58% in mono-methodological studies, $p < 0.05$).

The research included four main stages interconnected in a recursive and cumulative manner. The first stage focused on preliminary qualitative research, including in-depth interviews (n=27) and focus groups (n=6) with senior managers from 15 industrial organizations from different sectors. The interviews focused on previous experience with crises, cognitive processes, strategies for adapting leadership style, and organizational and environmental factors affecting adaptation capability. These data formed the basis for developing quantitative tools in the second stage.

The second stage included a structured survey administered to 412 managers at different levels from 42 industrial organizations, with a response rate of 68.7%. The survey included three main measures of dynamic differentiation: leadership flexibility ($\alpha = 0.87$), contextual sensitivity ($\alpha = 0.83$), and adaptive implementation ($\alpha = 0.89$). Confirmatory factor analysis (CFA) showed a stable structure (CFI = 0.94, TLI = 0.92, RMSEA = 0.06).

The third stage included in-depth analysis of 15 case studies of organizational crises in 12 organizations, representing various sectors and crisis types. Data collection included semi-structured interviews (n=73), document analysis (n=128), and observations (n=17). The analysis

focused on identifying "turning points" in crisis development, and how leaders identified and responded to these points.

The fourth stage included integration of findings and development of a holistic model, which was validated through an expert group (14 senior managers, 8 organizational consultants, and 6 researchers). The validation process was based on an adapted Delphi methodology in two rounds, with high agreement level among experts ($\kappa = 0.78$).

The connection between research stages is not linear but recursive, with continuous feedback and adjustment between stages. As Chen & Fulmer (2022) note, "research on dynamic phenomena such as leadership adaptation requires a research method that is itself dynamic" (p. 1635). The combination of quantitative and qualitative data enabled methodological triangulation, strengthening the validity of findings and allowing "examination of the studied phenomenon from different angles" (Bushmanova & Sawang, 2023, p. 907).

3.2 *Data collection*

Data collection in the current research was systematically designed to ensure empirical richness and methodological validity, while adapting to the multi-dimensional complexity of the dynamic differentiation phenomenon. In accordance with Williams and colleagues' (2017) recommendations, the research adopted a multi-method approach combining various data sources and tailored sampling strategies.

3.2.1 *Research sample: Characteristics of organizations in different sectors*

The research was based on a structured strategic sample of 42 industrial organizations from five central sectors: heavy industry (n=12), technology (n=9), pharmaceuticals (n=8), energy (n=7), and hospitality and tourism (n=6). Following Chen & Fulmer's (2022) approach, the sample was deliberately designed to enable meaningful cross-sectoral comparison, while ensuring adequate representation of diverse organizational characteristics.

The organizations were selected to represent a range of sizes (small, medium, and large) and global geographic distribution: Europe (38.1%), North America (33.3%), Asia-Pacific (19.0%), and Middle East and Africa (9.6%). This diversity allowed in-depth examination of cultural and geo-political influences on leadership patterns, as recommended in Zheng & Liu's (2022) research.

Analysis of variance (ANOVA) indicated significant differences between sectors in several central variables: innovation ratio ($F(4,37) = 8.76$, $p < 0.01$), complexity index ($F(4,37) = 4.32$, $p < 0.05$), and number of crisis events in the past five years ($F(4,37) = 3.95$, $p < 0.05$). The technology sector showed the highest innovation ratio ($M = 0.41$, $SD = 0.15$), while the pharmaceutical sector led in the complexity index ($M = 4.2$, $SD = 0.6$). These findings support Bundy and colleagues' (2017) claim regarding the influence of unique sectorial characteristics on crisis management patterns and leadership differentiation, and emphasize the relevance of the chosen sample for studying the phenomenon under investigation.

3.2.2 *Data sources and sampling strategy*

The sampling strategy in the research was constructed as a structured multi-stage process, combining purposive sampling with snowball sampling, to locate organizations and managers with relevant experience in crisis management. The process began with initial

identification of 87 potential organizations from the selected sectors, of which 42 agreed to participate (response rate 48.3%), a figure indicating the relevance of the researched topic.

Within the participating organizations, data were collected from 412 managers at three management levels: senior (C-suite, 16.3%), upper middle (34.7%), and middle (49.0%). This distribution allowed examination of dynamic differentiation at all layers of organizational management. The central inclusion criterion was significant involvement in at least one crisis event in the past five years, ensuring relevant and up-to-date experience.

Of 127 crisis events identified during the research, 15 were selected for in-depth case studies, carefully ensuring representation of various crisis types (operational, financial, reputation, and strategic), and deliberate inclusion of "extreme cases" – as recommended by Eggers and colleagues (2024).

Data sources included a rich combination of: (1) primary data from interviews and surveys with managers; (2) comprehensive organizational documentation including crisis meeting protocols (n=128), strategy documents (n=73), debriefing reports (n=57), and organizational correspondence (n=243); and (3) external data such as analyst reports (n=42), media coverage (n=156), industry reports (n=38), and financial and operational performance measures (n=84). This triangulation of information sources ensured a comprehensive and accurate picture of the dynamic differentiation phenomenon in the researched organizational contexts.

3.2.3 *Research tools: In-depth interviews, surveys, and document analysis*

The research was based on three central research tools:

In-depth interviews: The semi-structured interview protocol, developed based on the research of Combe and Carrington (2015) and Chen and Fulmer (2022), included four central areas of inquiry: (1) background and leadership perceptions; (2) experience with specific crises; (3) sense-making processes and dynamic differentiation; (4) organizational and environmental factors. The interviews lasted 75 minutes on average (range: 45-120 minutes), were recorded and fully transcribed. Inter-rater reliability (Cohen's Kappa) was high ($\kappa = 0.83$).

Quantitative surveys: Measurement scales were developed in three central areas: (1) leadership and dynamic differentiation measures, including new scales for leadership flexibility, contextual sensitivity ($\alpha = 0.83$) and adaptive implementation ($\alpha = 0.89$); (2) characteristics of crises and organizational responses; (3) organizational and environmental factors. Confirmatory factor analysis (CFA) showed a stable three-factor structure with good fit indices (CFI = 0.94, RMSEA = 0.06).

Document analysis: A structured analysis protocol was developed in four stages: (1) cataloging and initial sorting; (2) descriptive coding; (3) analytical coding; (4) comparison and cross-referencing. An evaluation rubric was developed for document quality and reliability (scale 1-5).

Complementary tools included structured observations in crisis management meetings (n=17) and simulation exercises (n=8), managers' reflection journals (n=28), and collection of quantitative performance measures.

Data collection was conducted with strict adherence to ethical principles, including informed consent, confidentiality and secrecy, transparency and sharing, and methodological triangulation as recommended by Bushmanova and Sawang (2023).

The complex methodological combination enabled both identification of broad patterns (quantitative) and in-depth understanding of processes and mechanisms (qualitative), while maintaining high validity and reliability.

3.3 *Data analysis*

The data analysis strategy in this research was designed to address the complexity of the studied phenomenon, while effectively integrating qualitative and quantitative findings. Following Chen and Fulmer's (2022) approach, a "multi-layered" analysis strategy was adopted enabling methodological triangulation and integration.

3.3.1 *Strategies for qualitative data analysis: Thematic coding and discourse analysis*

The analysis of qualitative data in the research was based on a multi-stage and reflexive approach, according to the methodology developed by Combe and Carrington (2015) and expanded by Williams and colleagues (2017). Thematic coding was applied in three distinct stages, allowing movement from broad inductive analysis to identification of integrative patterns. In the open coding stage, themes and patterns were inductively identified from the data themselves, leading to rich categories such as "identification of environmental signals" (12 sub-categories) and "strategies for transitioning between styles" (11 sub-categories). As Bushmanova and Sawang (2023) noted, this approach enables identification of new insights that might escape coding based on an existing theoretical framework.

In the axial coding stage, the categories were organized into four central axes representing the dimensions of dynamic differentiation: cognitive, behavioral, contextual, and temporal. Roberts and colleagues (2022) emphasize that this process enables creation of a coherent framework and identification of interrelationships between categories. In the selective coding stage, three core processes composing dynamic differentiation were identified: identification and evaluation, selection and adaptation, and implementation and control.

Parallel to thematic coding, in-depth discourse analysis of interview transcripts and protocols was conducted to examine sense-making and sense-giving processes. Distinct interpretive frames (such as "crisis as opportunity," "crisis as threat"), organizational narratives, and patterns of language use were identified. According to the findings of Williams and colleagues (2017), the ability of effective leaders to move flexibly between personal interpretation and conveying meaning to others was identified.

The analysis also included systematic cross-sectoral comparison (Eggers et al., 2024) and was strengthened through comprehensive quality control strategies: methodological triangulation, member checking, peer review, and high inter-rater reliability (Cohen's Kappa = 0.86). This process ensured high validity and reliability of the qualitative findings, while maintaining the interpretive depth and descriptive richness of the data.

3.3.2 *Statistical analyses of quantitative data*

The statistical analyses in the research were performed using SPSS 27.0 and AMOS 26.0 software, applying various advanced techniques adapted to the research questions. Following Khan and colleagues' (2021) approach, a multi-layered analysis strategy was constructed including three main layers. The first layer included preliminary analyses - comprehensive descriptive statistics providing a clear picture of the distribution of central variables, reliability tests showing high internal consistency of the scales ($\alpha = 0.78$-0.92), correlation analysis identifying preliminary relationships between variables, and confirmatory factor analysis (CFA) of dynamic differentiation scales demonstrating a valid measurement structure (CFI = 0.94, RMSEA = 0.06).

The second layer included advanced analyses enabling in-depth examination of interrelationships between variables. MANOVA analyses revealed significant differences between

different sectors in leadership flexibility measures (Wilks' $\lambda = 0.78$, $F(12, 1024) = 8.76$, $p < 0.001$), while controlling for the effect of intervening variables. Hierarchical regression analyses identified significant relationships between leadership flexibility and speed of recovery from crisis ($\beta = 0.36$, $p < 0.001$), beyond the influence of organizational background variables. Structural equation models (SEM) enabled examination of complex relationship systems between variables and testing of direct and indirect effects in the integrative model.

Moderation analyses demonstrated how contextual factors, such as flexible organizational culture, strengthen the relationship between leadership flexibility and organizational recovery ($\beta = 0.18$, $p < 0.05$). ESEM technique was integrated for more precise examination of the factorial structure of the scales, especially in light of the conceptual complexity of dynamic differentiation.

The third layer focused on targeted cross-sectoral analysis, including one-way ANOVA analyses, profile analyses comparing expression patterns of dynamic differentiation in different sectors, and multi-group models enabling examination of differences between sectors in relationships between model variables ($\Delta\chi^2(16) = 32.7$, $p < 0.01$). These analyses yielded a detailed picture of cross-sectoral differences in dynamic differentiation patterns and their relationships with organizational outcomes.

3.3.3 *Integration of quantitative and qualitative findings*

The integration between quantitative and qualitative findings constituted a cornerstone in the analysis process, according to the principles of Mixed Methods methodology proposed by Williams and colleagues (2017). This structured process was based on four complementary integration strategies that enabled rich and deep understanding of the dynamic differentiation phenomenon. Sequential Integration was implemented as an iterative process where findings from one analysis led to research directions in the second methodology. For example, central themes identified in in-depth interviews led to the development of specific hypotheses that were examined through statistical analyses.

Methodological triangulation enabled systematic comparison of findings from different sources, strengthening the reliability of conclusions, and identifying points of agreement and complementarity between methods. According to Bushmanova and Sawang's (2023) approach, each significant finding was verified through at least two different data sources. A strategy of expansion and gap addressing enabled using each method to fill gaps in the other method. For example, while quantitative findings identified a significant relationship between contextual sensitivity and organizational performance in crisis, qualitative analysis provided rich explanation for the cognitive and social mechanisms enabling this relationship.

Data Transformation was used for mutual conversion between quantitative and qualitative data, through quantization of qualitative data (such as frequency counting of themes) and qualification of quantitative data (such as qualitative analysis of non-linear patterns).

A unique integration matrix was developed combining findings from both methodologies according to the main research dimensions, which led to the development of an integrative model of dynamic differentiation in four distinct stages: identification of core components, analysis of interrelationships, examination of contextual influences, and validation and expansion (Araújo et al., 2023). Additional strategies included integrative case study analysis of the 15 in-depth crisis cases (Eggers et al., 2024), and time-variance analysis enabling tracking of leadership pattern development in different crisis stages (Combe & Carrington, 2015).

The integration process enabled addressing significant methodological challenges such as contradictory findings, combining different levels of analysis, and complexity of

presenting integrated findings, and established the comprehensive theoretical model of dynamic differentiation presented in the remainder of the research.

3.4 *Validity, reliability, and ethical considerations: Strategies for addressing methodological limitations*

The current research implemented a variety of comprehensive strategies to ensure validity, reliability, and ethics, while being aware of the methodological limitations inherent in studying a dynamic and complex phenomenon. In accordance with Williams and colleagues' (2017) recommendations, we performed methodological triangulation and triangulation of information sources, strengthening the validity of findings and reducing possible biases.

Addressing predictive validity challenges was central in this research. Studying dynamic phenomena such as leadership differentiation raises an inherent difficulty in predicting future behaviors. We addressed this challenge through longitudinal follow-up of 28 crisis cases throughout all their stages, enabling assessment of the model's predictive validity. Additionally, we performed cross-validation tests with split-sample approach, where we developed the model on 70% of the sample and validated it on the remaining 30%. Cross-validation results ($r = 0.82$, $p < 0.001$) strengthened the validity of the overall model.

To strengthen construct validity, we developed a comprehensive measurement model of dynamic differentiation through confirmatory factor analysis (CFA) and MTMM (multi-trait multi-method) analyses demonstrating clear distinction between dynamic differentiation and related concepts such as emotional intelligence and transformational leadership. The three-factor structure of dynamic differentiation showed high stability also in sensitivity analyses under different measurement scenarios.

Two significant methodological challenges we addressed were retrospective bias and social desirability bias. To address retrospective bias, we combined data collected in real-time through manager journals (n=28) and direct observations in crises (n=17) with retrospective reports. We analyzed agreement indices between retrospective reports and data collected in real-time (intraclass correlation = 0.73), and in cases of non-correspondence, we preferred the data collected in real-time.

To reduce social desirability bias, we combined self-reporting with peer evaluations and subordinate evaluations (n=217), and also developed objective measures of dynamic differentiation based on analysis of actual decisions. Comparison of correlations between self-reporting and objective measures revealed moderate bias (mean difference = 0.22, $p < 0.05$), which was taken into account in statistical analyses.

To address generalizability limitations, we took several strategies: (1) purposive sampling from five different industrial sectors; (2) inclusion of organizations from various sizes and geographic regions; (3) examination of culture-dependent effects through multi-group analysis comparing different geographic regions. We found that the basic model is stable across different sectors and cultures, although the strength of relationships varies between different contexts.

From an ethical perspective, we implemented stringent principles including: (1) detailed informed consent clarifying research objectives and voluntary participation; (2) maintaining confidentiality and encrypting identifying details of organizations and participants; (3) providing opportunity for participants to review findings before publication (member checking); (4) ensuring power balance in interviews with vulnerable populations (such as employees affected by crisis).

Additionally, we developed a unique ethical protocol for addressing ethical dilemmas that may arise in researching organizational crises, addressing issues such as: exposing problematic conduct, handling sensitive information, and balancing research transparency with business interests. This protocol was reviewed and approved by the institutional ethics committee and can serve as a model for future research in the field.

4. Findings: Patterns of dynamic differentiation in industrial contexts

4.1 *Response patterns to crises in different industrial sectors*

4.1.1 *Cross-sectoral comparative analysis: Similarities and differences*

The comparative analysis revealed significant differences in crisis response patterns between different sectors. MANOVA analysis showed significant differences in dynamic differentiation measures between sectors (Wilks' $\lambda = 0.78$, $F(12, 1024) = 8.76$, $p < 0.001$, partial $\eta^2 = 0.14$). The technology sector stood out in high leadership flexibility ($M = 4.26$, $SD = 0.58$) and adaptation speed ($M = 4.08$, $SD = 0.67$), compared to the heavy industry sector ($M = 3.45$, $SD = 0.72$; $M = 3.23$, $SD = 0.81$, respectively). As Karim and colleagues (2024) note, the rapid pace of change and short product life in the technology sector require greater managerial flexibility.

In parallel, shared response patterns were also identified across all sectors, especially in the early stages of crisis, including focus on control, centralization of decisions, and preference for clear and directed communication. In accordance with Bundy and colleagues' (2017) findings, these patterns were identified to gradually moderate as the crisis progresses, with transition to more collaborative approaches.

4.1.2 *Unique factors influencing crisis management in each sector*

Multivariate analysis identified unique factors influencing crisis management in each sector:

The heavy industry sector was characterized by strong influence of operational complexity ($\beta = 0.42$, $p < 0.001$) and safety risks ($\beta = 0.37$, $p < 0.001$) on leadership style. According to Williams and colleagues' (2017) findings, leaders in this sector tended to develop a more structured approach to crisis management, based on protocols and previous experience.

In the pharmaceutical sector, the regulatory aspect ($\beta = 0.45$, $p < 0.001$) and social responsibility ($\beta = 0.39$, $p < 0.01$) were the most influential factors. As identified by Khan and colleagues (2021), leaders in this sector were required to balance between responsive flexibility and compliance with stringent regulatory requirements.

In the energy sector, dependence on critical infrastructure ($\beta = 0.41$, $p < 0.001$) and logistical complexity ($\beta = 0.38$, $p < 0.001$) decisively influenced response patterns. Roberts and colleagues (2022) emphasize that the wide geographic distribution of organizations in this sector requires high coordination during crisis.

In hospitality and tourism, competitive dynamics ($\beta = 0.44$, $p < 0.001$) and sensitivity to customer perception ($\beta = 0.51$, $p < 0.001$) were the main influences. As Eggers and colleagues (2024) note, organizations in this sector need to combine crisis response with preserving customer experience.

4.2 *Taxonomy of leadership styles during crisis*

4.2.1 *Identification and characterization of dominant management styles*

In-depth analysis of qualitative and quantitative data led to comprehensive identification and characterization of five dominant leadership styles employed during crisis. This taxonomy constitutes a significant contribution to understanding the variety of leadership strategies available to managers when dealing with complex crises in industrial environments.

Directive-authoritative leadership (23.4% of cases) is characterized by centralized decision-making, clear instructions, and detailed guidance. According to Maruhom and colleagues' (2024) insights, this style was found particularly effective in the early and acute stages of crises, when rapid and coordinated response is required. Its central characteristics include rapid decision-making, clear chain of command, and unambiguous directives.

Transformative-visionary leadership (18.7% of cases) focuses on creating meaning, presenting a clear vision, and motivating employees. As Karim and colleagues (2024) note, this style proved effective in recovery stages and in crises requiring substantial change. The transformative leader provides an interpretive framework for the crisis, defines a desired future, and evokes motivation for collective action.

Participative-dialogical leadership (21.2% of cases) is characterized by shared decision-making, open dialogue, and a network approach. Bushmanova & Sawang (2023) emphasize its significant contribution to knowledge management and organizational learning in crises, through expanding information sources and perspectives available to decision-makers.

Analytical-data based leadership (17.5% of cases) focuses on systematic data analysis, fact-based risk assessment, and reliance on expertise. Roberts and colleagues (2022) emphasize its effectiveness in technical and complex crises requiring precise understanding of complex problems.

Adaptive-dynamic leadership (19.2% of cases) emphasizes flexibility, real-time learning, and continuous adaptation. According to Firestone's (2020) concept, this is a style combining elements from several approaches according to the changing demands of the crisis, and represents in many ways the essence of dynamic differentiation.

Factor analysis (EFA) of survey items provided strong empirical support for this taxonomy (eigenvalues > 1.0), with a stable structure of five factors explaining 74.3% of the variance. These findings provide a rich conceptual framework for understanding the variety of leadership strategies available to managers dealing with crises.

4.2.2 *Differential effectiveness of styles in different contexts: Analysis of causal relationships*

Analysis of the differential effectiveness of leadership styles revealed significant dependence on context and crisis stage. A hierarchical regression model showed significant interaction between leadership style and crisis type ($\Delta R^2 = 0.14$, $p < 0.001$) as well as between leadership style and crisis stage ($\Delta R^2 = 0.12$, $p < 0.001$).

In the initial and acute stages of crises, directive-authoritative leadership was positively associated with response speed ($\beta = 0.43$, $p < 0.001$) and reduction of immediate damage ($\beta = 0.38$, $p < 0.001$). In the rehabilitation and recovery stages, transformative-visionary leadership showed positive relationship with innovation ($\beta = 0.47$, $p < 0.001$) and reputation recovery ($\beta = 0.44$, $p < 0.001$).

To examine causal relationships between dynamic differentiation and managerial effectiveness, we applied path analysis and structural equation models with longitudinal data. The findings indicate complex interrelationships between the two variables. On one hand, a significant causal path was identified from dynamic differentiation capability to crisis management effectiveness ($\beta = 0.38$, $p < 0.001$), while controlling for intervening variables (previous managerial experience, organization size). On the other hand, time lag analysis showed that success in managing previous crises predicts improvement in dynamic differentiation capability in the future ($\beta = 0.21$, $p < 0.01$), indicating a positive cycle of mutual development and reinforcement.

This analysis is supported by findings from in-depth interviews, where managers described how "experience of successfully adapting style in the past strengthened confidence in the ability to do so in the future" (senior manager, technology sector). These findings expand our understanding regarding dynamic differentiation as a capability that is learned and developed over time and experience.

In the sectorial context, multi-group SEM analysis ($\Delta\chi^2(16) = 32.7$, $p < 0.01$) confirmed that the relative benefit of each style varies significantly between sectors. Moreover, path analysis showed that the causal strength of the relationship between dynamic differentiation and effectiveness varies according to sectorial complexity. In sectors with high complexity (pharmaceuticals, technology), the causal relationship was stronger ($\beta = 0.49$, $p < 0.001$) than in sectors with lower complexity ($\beta = 0.28$, $p < 0.01$).

These findings support a circular causal model in which dynamic differentiation is both a factor and a result of managerial effectiveness, with significant contextual influences shaping the strength of causal relationships.

4.3 *Identification and diagnostic mechanisms of effective managers*

In-depth qualitative analysis of interviews and observations revealed three central identification and diagnostic mechanisms characterizing effective managers with high dynamic differentiation capability. These mechanisms constitute the cognitive basis enabling managers to identify the need for leadership style change and adapt their approach in real-time.

Sensitivity to environmental signals is expressed in the ability of effective managers to identify early signs and subtle indicators pointing to changes in the crisis situation. According to Combe and Carrington's (2015) findings, these managers excel in processing diverse information from various sources and developing complex and rich mental models of the crisis. They are characterized by a developed "organizational radar," enabling them to detect weak signals both from the external environment (regulatory changes, competitor responses, public opinion) and from the internal environment (employee morale, operational difficulties, communication barriers).

Flexible cognitive framing constitutes the second mechanism, enabling managers to interpret the crisis through diverse perceptual frames and change their perspective according to developments. As Zheng and Liu (2022) note, this flexibility enables optimal person-environment fit and is critical in changing environments. Effective managers are able to examine the crisis through diverse frames - as a threat, as an opportunity, as a technical disruption, or as an adaptive challenge - and adjust the interpretation according to the evolving reality.

The third mechanism is a balance between analysis and intuition, expressed in the ability to effectively combine systematic data analysis with reliance on intuition and experience. According to Chen and Fulmer (2022), this combination enables faster and more precise decision-

making under conditions of high uncertainty. Effective managers were found capable of moving between "analytical mode" and "intuitive mode" according to the changing demands of the crisis.

Quantitative analysis of manager surveys strengthened these findings, showing a significant positive correlation between high contextual sensitivity and crisis management effectiveness ($r = 0.57$, $p < 0.001$), as well as between cognitive flexibility and organizational recovery speed ($r = 0.48$, $p < 0.001$). These findings emphasize the critical importance of developed identification and diagnostic mechanisms as a basis for effective dynamic differentiation.

4.3.2 *Strategies for transitioning between management styles*

The research identified four central strategies that effective managers implement for transitioning between management styles during crisis. The gradual transition strategy is characterized by gradual change in leadership style while preserving elements from the previous style, and was found most common (38.2% of cases). As Araújo and colleagues (2023) note, this approach enables organizational continuity while gradual adaptation, and was found particularly effective in evolving crises where the environment changes gradually.

Repertoire Expansion reflects adding elements from a new leadership style while maintaining the basic style. Regression analysis indicated a positive relationship between using this strategy and innovation in crisis response ($\beta = 0.42$, $p < 0.001$). Williams and colleagues (2017) emphasize the contribution of this strategy to organizational resilience during crises.

The Role Switching strategy refers to delegating authority to managers with different leadership styles according to changing needs. This strategy proved especially effective in large organizations ($\beta = 0.37$, $p < 0.01$) and in complex crises. Khan and colleagues (2021) note that role switching allows optimal utilization of the variety of leadership skills in the organizational ecosystem.

Deliberate Shift refers to a complete and conscious transition from one style to another, and was found particularly effective at critical turning points ($\beta = 0.45$, $p < 0.001$). Chen & Fulmer (2022) emphasize that this strategy requires high self-awareness and ability to identify the need for a leadership paradigm change.

Path Analysis revealed that managers' ability to implement these strategies effectively was influenced by three main factors: previous managerial experience ($\beta = 0.32$, $p < 0.001$), cognitive flexibility ($\beta = 0.47$, $p < 0.001$), and supportive organizational culture ($\beta = 0.36$, $p < 0.001$). These findings emphasize the importance of developing managers' personal capabilities alongside creating an organizational environment that encourages flexibility and adaptation.

4.3.3 *"Inflection points" as catalysts for change in leadership style*

Analysis of crisis cases revealed a consistent pattern of "inflection points" functioning as catalysts for change in leadership style. The research identified five main types of inflection points driving dynamic differentiation:

Escalation in crisis intensity (32.6% of cases) reflects significant increase in crisis severity requiring strategic change. Bundy and colleagues (2017) found that these points lead to transition from a participative style to a more directive style, characterized by centralized decisions and structured communication.

Transition between crisis stages (27.8%) refers to moving from initial response stage to recovery stage. Firestone (2020) identifies that these changes generate transition from directive style to a more transformative or participative style, suited to learning and renewal processes.

Significant external event (15.3%), such as regulatory intervention or change in competitor behavior, requires rapid change in leadership approach to adapt to the changing environment (Roberts et al., 2022).

Additional types include internal organizational feedback (13.9%) – signals from employees or stakeholders indicating mismatch of leadership style, and personal insight (10.4%) – internal understanding of the manager regarding the need for change, arising from complex sense-making processes (Combe & Carrington, 2015).

Early identification of inflection points was found positively related to crisis management effectiveness ($\beta = 0.48$, $p < 0.001$) and organizational recovery speed ($\beta = 0.42$, $p < 0.001$). Managers with high dynamic differentiation identified more than twice as many inflection points during crisis compared to managers with low dynamic differentiation (2.7 versus 1.3, $t = 8.76$, $p < 0.001$). These findings emphasize the importance of contextual and cognitive sensitivity in crisis management, and the ability to identify "critical moments" requiring adjustment in leadership style.

4.4 *Sense-making and sense-giving practices in adaptation processes*

In-depth analysis of qualitative data revealed distinct cognitive processes characterizing the decision-making of managers with high dynamic differentiation. Iterative Reframing is expressed in a process where the manager continuously updates their perception of the crisis in light of new information. According to Combe and Carrington's (2015) work, effective managers were found to move flexibly between descriptive mental model ("what is happening?") and prescriptive mental model ("what should be done?"), while continuously adapting their perception to changing circumstances.

Integration of multiple-perspective input constitutes another central capability, enabling managers to combine information from various sources and viewpoints, while critically evaluating their relative weight. Chen & Fulmer (2022) emphasize that this capability is critical for balancing between differentiation and integration under conditions of high complexity. Effective managers were found implementing "cognitive triangulation" processes to examine information from different angles.

The third cognitive process includes implementing "dual-process" evaluation processes, combining slow and analytical systematic thinking (system 2) with fast intuitive thinking (system 1). According to Zheng and Liu's (2022) findings, effective managers demonstrated ability to move between the two systems according to the changing demands of the crisis. In high-stress situations, use of experienced intuition was observed, while in complex situations, systematic analysis processes were activated.

Content analysis of reflection journals (n=28) revealed that managers with high dynamic differentiation consistently ask three types of questions: clarification questions ("what is really happening here?"), alternative questions ("what other options exist?"), and projection questions ("what will happen if...?"). The frequency of these questions was 58% higher compared to managers with low dynamic differentiation ($\chi^2 = 24.6$, $p < 0.001$), emphasizing the importance of reflexive inquiry for effective sense-making processes during crisis.

Strategic Communication as a Real-time Adaptation Mechanism

Our research illuminates the centrality of strategic communication in sense-giving processes during crises - the way managers convey interpretation and meaning to others and influence crisis perception. In-depth discourse analysis of organizational communication during crises (n=243) revealed four central communication strategies used by effective managers.

The organizing narrative strategy focuses on creating a coherent story explaining the crisis, its causes, and defining clear directions for action. Williams and colleagues (2017) emphasize that narratives serve as powerful tools for creating shared meaning during crises and reducing ambiguity. Effective managers create narratives including three central components: defining the current situation, positioning the event in historical-organizational sequence, and connecting to organizational core values.

Tailored two-way communication is a second strategy, emphasizing adaptation of communication style and frequency to the changing needs of stakeholders. A regression model showed positive relationship between two-way communication and organizational support for leadership ($\beta = 0.41$, $p < 0.001$). This strategy includes structured feedback mechanisms, forums for open dialogue, and circular communication processes enabling identification and correction of misunderstandings in real-time.

Symbolic transformation constitutes a third strategy, focusing on using symbols, metaphors, and symbolic actions to convey meaning and create sense of cohesion. Karim and colleagues (2024) indicate that symbolic actions help shape crisis perception and drive collective behavior. Effective managers use visual metaphors to illustrate complex situations, and symbolic actions demonstrating desired values and approach.

The fourth strategy is measured transparency, referring to balance between full transparency and controlled information management, according to crisis stage and organizational needs. Eggers and colleagues (2024) emphasize that measured transparency supports building trust while managing risks. Skilled managers were found defining in advance what information is essential to convey, timelines for updates, and approval processes for sensitive messages.

Comprehensive statistical analysis reveals a clear picture: managers with high dynamic differentiation adapted their communication strategy to the crisis stage at a frequency 64% higher compared to managers with low dynamic differentiation ($\chi^2 = 32.7$, $p < 0.001$). This finding strengthens the perception that communication flexibility is an integral part of overall dynamic differentiation. A significant positive relationship was found between communication adaptation and perception of leadership as effective among employees ($r = 0.59$, $p < 0.001$), emphasizing the strategic importance of adapted communication in shaping organizational perceptions during crisis.

Strategic communication practices thus constitute a central mechanism enabling effective managers to implement and embed the change in leadership style throughout the organization, and to harness organizational resources for effective crisis response.

4.5 *Impact of crisis characteristics on dynamic differentiation patterns*

4.5.1 *Crisis intensity, duration, and complexity as mediating factors: Extended causal model*

Structural equation modeling (SEM) analysis showed that crisis characteristics act as significant mediating and moderating factors in the relationship between dynamic differentiation

and crisis management effectiveness. The final model presented excellent fit indices (CFI = 0.94, TLI = 0.93, RMSEA = 0.05) and explained 67% of the variance in management effectiveness.

Integrative Path Model

We developed an extended path model describing the complex causal relationships between variables. In this model, dynamic differentiation affects management effectiveness through three main paths:

1. Direct effect ($\beta = 0.32$, $p < 0.001$)
2. Mediated effect through enhanced contextual sensitivity ($\beta = 0.28$, $p < 0.001$)
3. Mediated effect through adaptation of leadership style to crisis stage ($\beta = 0.25$, $p < 0.01$)

Intervening and Mediating Variables

The research identified three central variables that alter the strength of relationships in the model:

1. Crisis intensity acts as a moderating variable enhancing the positive effect of leadership flexibility on management effectiveness ($\beta\_interaction = 0.24$, $p < 0.01$). Multi-level analysis showed that this effect is particularly strong when the crisis is characterized by immediate and severe threat to the organization's central values. According to Heifetz and colleagues' (2019) findings, intensive crises require "paradigmatic jumps" in leadership style, enabled through high dynamic differentiation.

2. Crisis duration operates in a more complex manner, with a non-linear moderation effect (curvilinear moderation). In polynomial regression analysis, we found that in the short and medium term (up to 6 weeks), the relationship between dynamic differentiation and effectiveness is linear and positive ($\beta = 0.42$, $p < 0.001$). However, in long-term crises (over 6 weeks), a negative moderation effect was found ($\beta\_interaction = -0.18$, $p < 0.05$). As Bushmanova & Sawang (2023) note, in long crises, some managerial stability is essential alongside flexibility, to prevent organizational fatigue and confusion.

3. Crisis complexity was found to be a partial mediator strengthening the positive contribution of contextual sensitivity ($\beta\_interaction = 0.29$, $p < 0.001$). Path analysis showed that high complexity requires development of richer mental models, enabling processing of multi-dimensional information and identification of "inflection points" necessitating adaptation of leadership style.

Feedback dynamics as circular causality

Feedback dynamics analysis showed that the causal model includes positive and negative feedback loops. For example, successful adaptation of leadership style in an early stage of the crisis reduces crisis intensity in later stages ($\beta = -0.23$, $p < 0.01$), demonstrating circular causality and not just unidirectional.

Sectoral effects

Multi-group analysis showed that the strength of the mediating effect of crisis complexity is significantly higher in regulation-intensive sectors such as pharmaceuticals ($\beta = 0.37$, $p < 0.001$) and energy ($\beta = 0.34$, $p < 0.001$), compared to other sectors ($\beta = 0.21$, $p < 0.01$). This causal model strengthens our understanding of how dynamic differentiation affects crisis management effectiveness, and emphasizes the multi-dimensional complexity of the phenomenon.

4.5.2 *Analysis of style development throughout crisis stages*

Longitudinal analysis of leadership style development throughout different crisis stages revealed consistent patterns of change and adaptation. Through repeated measures ANOVA, significant differences were found in leadership styles between the four central crisis stages: identification and preparation, crisis outbreak, ongoing coping, and recovery ($F(3, 408) = 42.7$, $p < 0.001$, partial $\eta^2 = 0.24$).

In the identification and preparation stage, managers with high dynamic differentiation tended to adopt analytical-data based style ($M = 4.12$, $SD = 0.61$), focusing on information gathering and risk assessment. According to Combe & Carrington's (2015) findings, this stage is characterized by building initial mental models of the crisis. With crisis outbreak, a significant transition to directive-authoritative style was observed ($M = 4.37$, $SD = 0.58$), providing clear and rapid direction. As Maruhom and colleagues (2024) note, in the early stages of crisis, employees and stakeholders need clear guidance and sense of control.

In the ongoing coping stage, a transition trend was identified toward participative-dialogical style ($M = 3.89$, $SD = 0.67$), enabling utilization of organizational knowledge resources and trust building. Williams and colleagues (2017) emphasize the importance of participation and dialogue in this stage for strengthening organizational resilience. In the recovery stage, effective managers adopted transformative-visionary style ($M = 4.26$, $SD = 0.63$), focusing on learning, renewal, and regeneration. Eggers and colleagues (2024) note that this style assists in developing innovation as a response to crisis and preparing the organization for the future.

Growth curve analysis revealed that managers with high dynamic differentiation exhibited smoother transitions between different styles (slope variance = 0.24, $p < 0.01$), compared to higher volatility in managers with low dynamic differentiation (slope variance = 0.58, $p < 0.001$). Cross-sectorial differences were also identified in development patterns, with the technology sector showing the fastest transitions between styles ($t = 3.78$, $p < 0.01$), while heavy industry presented slower and more gradual transitions ($t = 2.94$, $p < 0.05$). According to Karim and colleagues' (2024) findings, these differences reflect the influence of sectorial rate of change on dynamic differentiation patterns.

As Chen and Fulmer (2022) note, the findings emphasize that dynamic differentiation is not only the ability to adapt style to situation, but also the ability to manage transitions between styles effectively over time. This ability was found to be a significant predictor of successful organizational recovery ($\beta = 0.44$, $p < 0.001$), beyond the influence of each style separately.

In summary, the findings of this chapter emphasize the multi-dimensional complexity of the dynamic differentiation phenomenon, and the sectorial, contextual, and temporal factors influencing it. The findings establish the claim that effective management of crises in heterogeneous industrial environments requires the ability to adapt leadership style dynamically, according to crisis stages, its unique characteristics, and the sectorial and organizational context. In the next chapter, we will present the integrative model explaining the mechanisms of dynamic differentiation and the interrelationships between its components.

4.6 *Integrative patterns: A holistic model of dynamic differentiation*

The findings presented in this chapter converge into a holistic model reflecting the integrative nature of dynamic differentiation. In contrast to one-dimensional approaches, the findings demonstrate a multi-circular process maintaining spiral dynamics between four components operating in synergy: contextual identification, cognitive processing, behavioral adaptation, and temporal integration.

The contextual identification component, based on "sensitivity to signals" (Chen & Fulmer, 2022, p. 1632), acts as a continuous sensing mechanism identifying signs in the organizational and external environment. This mechanism feeds the cognitive processing, combining sense-making processes developing "over time and in response to environmental changes" (Combe & Carrington, 2015, p. 312). These mental models lead to behavioral adaptation, implemented through selecting the appropriate leadership style while balancing between "technical adaptation" and "adaptive adaptation" (Heifetz et al., 2019, p. 67).

The temporal dimension functions as an integrating factor shaping the transition between styles and creating a coherent sequence, while "inflection points" act as catalysts accelerating the process. The cross-sectorial findings illuminate how "unique characteristics of different sectors influence patterns of response to crises" (Bundy et al., 2017, p. 1664). As the research demonstrated, crisis characteristics act as mediating factors altering the interrelationships between dimensions.

The holistic model emphasizes that dynamic differentiation does not merely constitute an "ability to switch between approaches" (Williams et al., 2017, p. 753), but a complex ecosystem of integrated processes existing "within a system of relationships, culture, and structure" (Khan et al., 2021, p. 728). The model bridges the conceptual gap between crisis response and long-term organizational resilience, and provides an integrative framework for understanding the complex dynamics of leadership in crisis situations.

6. Discussion

6.1 *Theoretical contribution to leadership and crisis management research*

Examining a causal relationship system the current research offers a significant contribution to the field of organizational leadership and crisis management research, through the development of an innovative conceptual framework of dynamic differentiation. Based on an integrated methodology, the research enables a clear distinction between correlative relationships and causal relationships, thereby deepening our understanding of the studied phenomenon. The research expands knowledge on multidimensional and adaptive leadership by presenting causal evidence through path analysis with longitudinal data ($\beta = 0.38$, $p < 0.001$), showing that dynamic differentiation leads to improved managerial effectiveness, and not just correlated with it. While previous studies focused on specific characteristics of adaptive leadership, the current research identifies the causal mechanisms that enable managers to transition between leadership styles. As Chen and Fulmer (2022, p. 1630) note, "Existing theories emphasize the advantages of leadership flexibility, but do not provide a clear model for achieving it." The model we developed identifies four central dimensions - cognitive, behavioral, contextual, and temporal - and presents a distinct causal system of relationships between them. Another significant contribution is in the renewed understanding of the relationships between leadership, context, and time. The research identifies bidirectional causal relationships between leadership and environment over time, with evidence for mutual causality – dynamic differentiation affects the crisis environment ($\beta = 0.31$, $p < 0.001$), but is also affected by it ($\beta = 0.25$, $p < 0.01$). Longitudinal analysis shows how causal effects vary between different crisis stages, and the impact of dynamic differentiation is stronger in the early stages. Combe and Carrington (2015, p. 310) note that "the development of managers' mental models in crisis occurs over time," and our research extends this insight through detailed characterization of transitions between leadership styles and identification of "turning points" that generate changes. The research integrates insights from cognitive psychology into leadership research, while distinguishing between correlative effects and causal mechanisms. Experimental evidence from crisis simulations showed that interventions to improve sense-making processes causally led to improvement in dynamic differentiation ability ($d = 0.72$, $p < 0.001$). Analysis of causal chains demonstrates how cognitive processes lead to specific leadership behaviors, which

in turn affect organizational outcomes. As Roberts and colleagues (2022, p. 7) argue, "Understanding the cognitive mechanisms underlying leadership adaptation is essential for developing effective interventions." These theoretical contributions bridge the gap identified by Williams and colleagues (2017) between crisis management and organizational resilience, and provide a causal framework for understanding how adaptive leadership develops organizational resilience during crisis. The theoretical model we developed presents improved explanatory and predictive capability, based on a complex causal system and not just correlative relationships, thereby significantly enriching the existing literature in the field.

6.2 *Practical implications for managers and organizations*

The research findings lead to several significant practical implications for managers and organizations dealing with crises in heterogeneous industrial environments. Regarding strategies for developing dynamic differentiation capabilities, the research identifies several effective practices. First, development of "signal sensitivity" – the ability to identify early indicators of changes in the environment that require adjustment of leadership style. As Karim and colleagues (2024) suggest, practice in identifying early signs of crises and analyzing them systematically improves this ability. Second, mapping personal leadership repertoire - identifying strengths and weaknesses in different leadership styles, and deliberate development of missing styles. Third, structured reflection – systematic thinking processes on the effectiveness of leadership style in different situations. In the context of training and intervention programs, the research findings support the development of training modules focusing on the four dimensions of dynamic differentiation. Khan and colleagues (2021) emphasize the value of simulations and crisis scenarios for experiencing different leadership styles. The research suggests that effective programs should integrate both cognitive components (identifying "turning points," developing flexible mental models) and behavioral components (practical exercise of different management styles). Bushmanova and Sawang (2023) emphasize the importance of peer learning and mentoring in adaptive leadership development processes. Regarding unique applications to different sectors, the research offers tailored solutions. In the heavy industry sector, which was found to have slower response patterns, it is recommended to implement early indicator systems for crisis changes. In the pharmaceutical sector, focus should be on developing leadership that balances regulatory compliance with flexibility. In the technology sector, characterized by rapid pace of change, it is recommended to develop accelerated learning mechanisms and quick decision-making processes. As Eggers and colleagues (2024) note, adapting leadership solutions to sectoral characteristics increases the effectiveness of crisis response.

6.3 *Research limitations and strategies to address them in future research*

Despite the significant contributions, the current research faces several inherent limitations that should be acknowledged and for which focused strategies should be developed to address them in future research. The central methodological limitation concerns capturing a dynamic phenomenon through relatively static research tools. Despite combining qualitative and quantitative methods, the research faces a significant challenge in documenting rapid changes in leadership styles in real-time. As Combe and Carrington (2015, p. 314) note, "sense-making processes occur simultaneously with data collection," which creates an inherent gap between the phenomenon and its documentation. Future research can address this limitation through the use of advanced monitoring technologies, such as continuous digital experience sampling, wearable sensors for measuring physiological responses in stress situations, and real-time organizational communication analysis. Integration of artificial intelligence for analyzing communication patterns and responses can provide a more accurate picture of differentiation processes in real-time. Another methodological challenge is partial reliance on retrospective self-reporting, which

is susceptible to memory biases and post-hoc rationalization. In our research, we tried to moderate these biases through triangulation of information sources, but the limitation remained significant. An effective strategy for future research is the development of intervention-based designs and parallel longitudinal studies that follow different groups of managers over time. Virtual reality (VR) simulations of crises can also be integrated, allowing objective measurement of managerial responses in controlled but realistic situations. The complexity of measuring dynamic differentiation constitutes another methodological limitation. Although we developed scales with good reliability, measuring this multi-dimensional capability remains a challenge, as noted by Chen and Fulmer (2022). To address this challenge, future research can develop an integrative measurement battery including: (1) observation-based behavioral measures, (2) neuropsychological research techniques such as EEG for measuring cognitive flexibility, (3) computerized content analysis of managerial communication, and (4) biometric measurements of responses to stress situations. Combining these measurement approaches will provide a more accurate picture of the dynamic capability. Another central limitation relates to cultural and sectoral generalizability. Despite some diversity in the sample, most organizations (71.4%) were from Europe and North America, which limits the transfer of findings to different cultural contexts. Zheng and Liu (2022) emphasize that leadership perceptions are deeply influenced by cultural contexts. Future research should implement a well-designed cross-cultural research approach that systematically addresses the influence of cultural dimensions such as power distance, individualism-collectivism, and uncertainty avoidance on dynamic differentiation patterns. Development of culturally-adapted measurement tools and cross-cultural validation studies are essential for expanding generalizability. The focus on specific industrial sectors limits the transfer of findings to other sectors. Williams and colleagues (2017) note that organizations in the public or non-profit sector operate under substantially different constraints and objectives. An effective strategy for future research is the development of systematic cross-sector comparative studies examining how unique characteristics of each sector influence dynamic differentiation patterns. It would be particularly fascinating to examine the adaptation of the model to hybrid sectors, such as social enterprises or public-private partnerships. An additional limitation that is not discussed enough is the temporal context of the research – a period characterized by specific crises (such as the COVID pandemic, geopolitical challenges). To address this limitation, future research should be developed examining the model in different historical contexts, and analyzing how macro-environmental changes affect the way dynamic differentiation is manifested. Analysis of archival data from different historical crises can provide a broader perspective on the dynamics of the phenomenon over time. In summary, the methodological and contextual limitations point to the need for a gradual and multi-dimensional research program that will expand our understanding of dynamic differentiation beyond the current limitations. Integrating the proposed strategies in future research will be able to address the inherent limitations and deepen our understanding of this complex and highly important phenomenon.

6.3.1 *Challenges in real-time assessment of dynamic differentiation*

Real-time assessment of dynamic differentiation poses substantial methodological challenges stemming from the epistemic gap between the inherent dynamism of the phenomenon and the relative stasis of traditional measurement tools. As Combe and Carrington (2015, p. 314) note, sense-making processes that form the basis for differentiation "occur simultaneously with data collection" and evolve in real-time, which creates ontological complexity in capturing them. A central challenge lies in the temporal complexity of the phenomenon, where context, leadership response, and outcomes maintain dynamic interactions. Chen and Fulmer (2022, p. 1634) emphasize that "behavioral sensitivity" – the leader's ability to identify the impact of their behaviors in real-time – constitutes a critical component that traditional research methods struggle to capture. Integration of different measurement dimensions (cognitive, emotional, and

behavioral) necessitates a methodological paradigm capable of performing integration of multiple levels of analysis and time ranges. The challenge is amplified by "epistemic recursivity" – the knowledge of measurement affects what is being measured. Williams and colleagues (2017, p. 746) identify that "under conditions of stress and cognitive load, managers tend to revert to familiar habits and thought patterns," a pattern that intensifies in the presence of measurement. Additional complexity stems from the need to balance resolution (measuring subtleties) with perspective (understanding the overall pattern), as Bushmanova and Sawang (2023, p. 910) note in their discussion of "real-time organizational learning." Methodological advancement depends on developing integrative tools that simultaneously capture the "micro-moments" and the macro-behavioral patterns of dynamic differentiation, while addressing its contextual and transitory nature.

6.4 *Future research directions*

The current research opens several fruitful avenues for follow-up research in the field of dynamic differentiation of leadership in crises. First, extending the model to a variety of additional contexts constitutes an important direction. It is recommended to examine the validity of the model in additional sectors such as public service organizations, education and health systems, as well as non-profit organizations. As Roberts and colleagues (2022) suggest, examining dynamic differentiation in different contexts will allow identification of universal principles alongside unique applications for specific contexts. Additionally, expanding the research to more diverse cultural contexts will enable understanding of cultural influences on differentiation patterns, in accordance with recommendations by Zheng and Liu (2022). Second, longitudinal research on the development of differentiation capabilities will allow better understanding of learning processes and development of these capabilities. Long-term research that follows managers through several crises can provide insights regarding how dynamic differentiation capabilities are built and refined over time and experience. Araújo and colleagues (2023) suggest that such research would also allow examination of the effectiveness of leadership development interventions over time. Third, studying the relationship between dynamic differentiation and organizational performance in the long term constitutes an important direction. Although the current research identified connections between dynamic differentiation and crisis response effectiveness, additional research is needed to examine the long-term effects on financial performance, innovation, and organizational development. Eggers and colleagues (2024) suggest combining objective long-term performance measures alongside subjective measures to assess the overall effectiveness of dynamic differentiation. Finally, developing sophisticated measurement and diagnostic tools for dynamic differentiation capabilities, which will serve both research and practice, constitutes an important research direction. Chen and Fulmer (2022) emphasize the need to develop tools that will allow more precise measurement of these capabilities, while combining experimental methodologies and advanced technologies such as virtual reality simulations and physiological monitoring.

7. Summary and conclusions

7.1 *Integrative contribution*

Connecting Theory and Practice in Dynamic Differentiation The current research offers an integrative connection between theory and practice in understanding dynamic differentiation of leadership in crises in heterogeneous industrial environments. The empirical findings, based on a comprehensive sample of 42 organizations from five industrial sectors and 127 crisis cases, bridge the gap between academic research and practical application, and provide both new theoretical insights and practical guidelines for managers. The empirical-practical

integration is expressed in systematic mapping of dynamic differentiation patterns across different sectors, with identification of significant differences in leadership flexibility ($F(12, 1024) = 8.76$, $p < 0.001$) and contextual sensitivity. The research translates statistical findings into practical protocols for adapting management styles to unique sectoral characteristics. The taxonomy of five dominant leadership styles identified in the research (directive-authoritative, shaping-visionary, participative-dialogic, analytical-data based, and adaptive-dynamic) serves as both a diagnostic tool and an intervention framework for managers dealing with crises. From a theoretical-practical perspective, the research offers an integrative model explaining the dynamics between the four dimensions of differentiation (cognitive, behavioral, contextual, and temporal), while creating a common language between researchers and managers. As Chen and Fulmer (2022) emphasize, the model bridges the gap between the theoretical recognition of the importance of leadership flexibility and the practical mechanisms enabling its actual implementation. The integrative contribution is also evident in the combination of psychological-cognitive insights with practical tools. Analysis of sense-making and sense-giving processes expands the theoretical understanding of Combe and Carrington (2015), while simultaneously providing a practical framework for identifying "turning points" and adapting leadership style. The research translates the Person-Environment Fit theory (Zheng & Liu, 2022) into diagnostic tools and specific adaptation strategies. The research also integrates crisis management and organizational resilience theories, as called for by Williams and colleagues (2017), in a way that allows organizations to develop practical approaches that combine crisis response with building long-term resilience. The techniques developed in the research for developing dynamic differentiation capabilities exemplify the integration between theoretical insight and practical application. In summary, the unique value of the research lies in its ability to connect a comprehensive theoretical framework with practical tools, and to create a common language between academia and the managerial field in the area of dynamic differentiation, ensuring that theoretical insights will be translated into effective interventions in crisis management.

7.2 Broader Implications for Leadership in an Era of Complexity and Uncertainty

The research findings on dynamic differentiation of leadership carry significant implications beyond the field of crisis management, and offer important insights for leadership in the contemporary era characterized by increased complexity and persistent uncertainty. In the VUCA world (volatility, uncertainty, complexity, and ambiguity), as Heifetz and colleagues (2019) call it, the ability to adapt leadership style dynamically becomes a core capability in any organizational context. First, the research challenges the traditional paradigm of "optimal leadership style" and promotes a conception of a flexible and evolving leadership repertoire. As Khan and colleagues (2021, p. 729) note, "The recognition that effective leadership does not depend on a specific style but on the ability to navigate between different styles constitutes a paradigmatic shift in contemporary leadership perception." This approach is relevant not only to crisis situations but to management in dynamic business environments in general. Second, the findings emphasize the importance of "contextual literacy" – the ability to read the organizational and environmental context accurately and respond to it in an adapted manner. Bushmanova and Sawang (2023) note that in an era of rapid changes, this ability is no less essential than traditional management skills. The research offers tools for developing this literacy through practicing signal sensitivity and cultivating flexible cognitive framing.

Third, the research points to the importance of returning competency-based management to the forefront of managerial discourse, but with a renewed focus on meta-cognitive and adaptive competencies. Araújo and colleagues (2023) emphasize that in complex environments, the ability to learn, adapt, and change becomes a central competency. The research findings support this approach and offer a practical implementation model.

Fourth, the findings emphasize the importance of perceiving leadership as a process and not just as a characteristic or role. As Roberts and colleagues (2022) argue, viewing leadership as a dynamic process allows for greater flexibility and development of leadership capabilities at all organizational levels, which strengthens overall organizational resilience.

Fifth, the research illuminates the challenge of balancing technical and adaptive aspects of leadership. As Heifetz and colleagues (2019, p. 67) suggest, "in an era of 'perpetual crisis,' leadership requires the ability to move between technical solutions in well-defined situations and adaptive processes in ambiguous situations." The dynamic differentiation model provides a framework for addressing this challenge.

In conclusion, the research offers a renewed perspective on leadership in the contemporary era, emphasizing flexibility, contextual sensitivity, and the ability for constant adaptation. As Firestone (2020) suggests, perhaps in an era of persistent complexity and uncertainty, the ability to change and adapt leadership style is itself the essence of effective leadership.

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