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VALUE DESTRUCTION AND CREATION: TURNAROUND AND INNOVATION

DESTRUIÇÃO E CRIAÇÃO DE VALOR: TURNAROUND E INOVAÇÃO

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Resumo

O artigo analisou a associação entre Inovação e Turnaround em empresas brasileiras de capital aberto. Investigou-se quais empresas perderam valor durante a crise econômica de 2015 e 2016 e como seu desempenho evoluiu entre 2017 e 2022, a partir da análise de indicadores de inovação e resultados financeiros. A amostra de empresas foi analisada por estatística descritiva e modelagem estatística, usando o modelo Generalized Equations Estimating. A estatística descritiva não encontrou correlação entre variáveis. A modelagem estatística obteve resultado que pode ser interpretado como uma relação negativa entre as atividades do Inovação e os resultados do processo de Turnaround.

Palavras-chave: Inovação. Gastos com P&D. Ativos intangíveis. Turnaround.

Abstract

The article analyzed the association between Innovation and Turnaround in publicly traded Brazilian companies. To this end, it investigated which companies lost value during the 2015 - 2016 economic crisis and how their performance evolved between 2017 and 2022, based on the analysis of innovation indicators and financial results. The sample of companies was analyzed by descriptive statistics and statistical modeling, which used the Generalized Equations Estimating model. Descriptive statistics didn't find a correlation between variables. Statistical modeling obtained a result that can be interpreted as a negative relationship between Innovation activities and the results of the Turnaround process.

Keywords: Innovation. R&D expenses. Intangible assets. Turnaround.

Introduction

This study analyzes the relationship between the construct of Innovation and the Turnaround process, which refers to strategies adopted by companies during periods of decline to reverse losses and restore their competitiveness. Turnaround may occur internally or within a regulated and legal framework, as in the case of Judicial Recovery (JR). The relevance of such processes in the Brazilian economy is illustrated by high-profile cases, such as that of the retailer Americanas, which, in early 2023, filed for JR with a debt of BRL 43 billion (Ignacio, 2023). Furthermore, another 20 major judicial recoveries recorded in the country in recent decades involved debts ranging from BRL 2 billion to BRL 98 billion, and the number of JR filings has risen significantly in recent years, increasing from 891 in 2021 to 1.405 in 2023 (Serasa Experian, 2024).

Among the various strategies a company may adopt in a Turnaround process, Innovation stands out as a viable option. The concept of "creative destruction," proposed by Schumpeter (1961), suggests that economic development occurs through the replacement of obsolete structures with new solutions, driving market renewal. This phenomenon creates a point of intersection between Turnaround and Innovation, as the loss of value may lead companies into a recovery process, while innovation can serve both as a strategy to reverse losses and as an initiative that, by demanding time and resources, may precipitate decline.

Given this context, this study seeks to understand how innovation activities are associated with the Turnaround processes of publicly traded Brazilian companies listed on the Brasil, Bolsa, Balcão (B3) stock exchange. To this end, it investigates which companies experienced losses in value during the 2015 - 2016 economic crisis and how their performance evolved between 2017 and 2022, the period immediately following the crisis, based on the analysis of innovation indicators and financial results. The six-year time series (2017 to 2022) aligns with the perspective of several authors (Robbins & Pearce, 1992; Trahms et al., 2013; Vetrano, 2018), who argue that turnaround processes typically unfold over a period of up to four years. In addition to analyzing performance, the study tests the relationship between innovation and the performance of these companies over this period, seeking to determine whether the adoption of innovative practices influences their recovery.

The justification for this study rests on two main aspects: its academic originality and its socioeconomic relevance. Originality is demonstrated through three bibliometric searches conducted in national and international databases, which revealed the absence of studies simultaneously addressing the relationship between Innovation and Turnaround. In December 2022, a search across five academic databases did not identify any articles covering this relationship. The same result was found in a search for theses and dissertations in four national academic repositories. In April 2023, a new search using the terms "recuperação judicial," "judicial recovery," and "judicial reorganization" confirmed this gap in the literature.

Moreover, the relationship between Innovation and Turnaround is highly relevant to the economy, companies, and society. According to the Oslo Manual (OECD, 2018), understanding innovation also entails studying obsolescence, which can be a factor in decline and in the need for business recovery. At the same time, Turnaround processes directly affect the economy and the labor market, making their analysis essential for the development of effective business strategies and public policies. Thus, by integrating these two topics, this study contributes both to academic theory and to business practice and strategic decision-making.

Innovation Dynamics and Business Recovery

The section Innovation Dynamics and Business Recovery addresses the fundamental concepts underpinning the analysis of the relationship between Innovation and Turnaround. It begins by discussing Innovation and its variables, exploring different theoretical perspectives and its influence on

organizational performance. It then examines Turnaround, highlighting its variables and the strategies adopted by companies in decline to reverse losses and regain competitiveness. Finally, it analyzes the intersection between these two phenomena, considering how Innovation can function as a business recovery mechanism while, at the same time, obsolescence and the need for renewal influence processes of crisis and organizational transformation.

Innovation and its variables

In 1911, the concept of Innovation was discussed by Schumpeter (1997) under the term "new combinations." These could take the following forms: (a) the introduction of a new product; (b) the introduction of a new method of production; (c) the opening of a new market; (d) access to a new source of raw materials; or (e) the establishment of a new organization within an industry. In 1942, Schumpeter (1961) also proposed the concept of "creative destruction," according to which the capitalist engine operates through a process of industrial mutation driven by innovations, involving the continuous destruction of the old and the creation of new elements.

Subsequently, some researchers sought to understand how Innovation unfolds and conceptualized its generations. Rothwell (1994) proposed five generations, as shown in Table 1.

Table 1

Generations of Innovation

Generation		Description	Period
1st	Technology Push	Innovations resulted from technological developments occurring within companies.	From 1950 to the mid-1960s.
2nd	Reverse Model	Innovations resulted from demand-side factors, that is, from the market.	From the mid-1960s to the early 1970s.
3rd	Coupling Model	Innovations stemmed from the coupling of company developments and market demands.	From the early 1970s to the mid-1980s.
4th	Integrated Model	Innovation processes encompassed networks of organizations, for example, a company and its suppliers.	From the early 1980s to the early 1990s.
5th	Parallel and Integrated Model	Phases of the Innovation process (such as marketing, product development, and product manufacturing) occurred in parallel, enabling the manufacturer to reach the market before competitors.	From the 1990s onward.

Source: Adapted from Rothwell (1994)

Other authors have proposed a sixth generation. Marinova and Philimore (2003) introduced the Innovative Environment, in which Innovation is seen as a territorial phenomenon, dependent on local resources and potentially difficult to replicate in other locations. Boehm and Fredericks (2010) proposed Network Integration, which encompasses concepts of innovation networks, globalization, and customer experience.

In 2018, the Organization for Economic Co-operation and Development (OECD) published the fourth edition of the Oslo Manual (OECD, 2018), aimed at providing guidelines for the collection and interpretation of innovation data. This manual defines Innovation as a new or improved product or service (product innovation) or business process (business process innovation) that has been put into use. The fundamental understanding underlying these concepts is that Innovation results from innovation activities. It is also necessary that the Innovation be implemented or made available to other

stakeholders.

Regarding innovation indicators, the third edition of the Oslo Manual (OECD, 2005) proposes two fundamental categories of indicators: (a) statistics related to patents and (b) investments in research and development (R&D). Patents have limitations in their use, which encourages reliance on indicators from the second category. In 2010, Jarboe and Ellis highlighted the relationship between intangible assets and Innovation, as these assets enable innovations that drive business expansion. Lunkes et al. (2019) state that investments in Innovation can be quantified by the value of expenditures on research, intangible assets, and research expenses per employee.

Specifically, regarding research and development (R&D) expenditures, Yunlu and Murphy (2012), Rashad Abdel-Khalik (2014), and Zhang (2017) explored the relationship between this variable, Innovation, and other business aspects. Cappellesso et al. (2020) also employed the R&D expenditure variable in their study on Innovation in the Brazilian food sector.

Thus, the following indicators were selected for Innovation: (a) intangible assets and (b) R&D expenditures. The fact that these are financial indicators does not alter the study's focus on the Innovation construct.

Turnaround and its variables

The earliest studies on Turnaround date back to the 1970s (Schendel & Patton, 1975; Schendel et al., 1976) and analyzed it as a two-phase process: decline and the Turnaround itself.

Starting with research on the decline phase, Schendel and Patton (1975) examined why some companies succeed in emerging from a period of decline while others do not. Whetten (1980) also published an article focused on corporate decline at a time when, according to the author, attention was primarily directed toward business growth. Staw et al. (1981) studied the issue of organizational rigidity, which can exacerbate decline by hindering strategic correction or, conversely, contribute to recovery by preventing risks. Cameron et al. (1987) characterized decline as a situation in which there is a significant reduction in organizational resources over a specific period. In line with these works, Vetrano (2018) stated that when a company is in difficulty, the main symptom is the failure to meet its financial obligations.

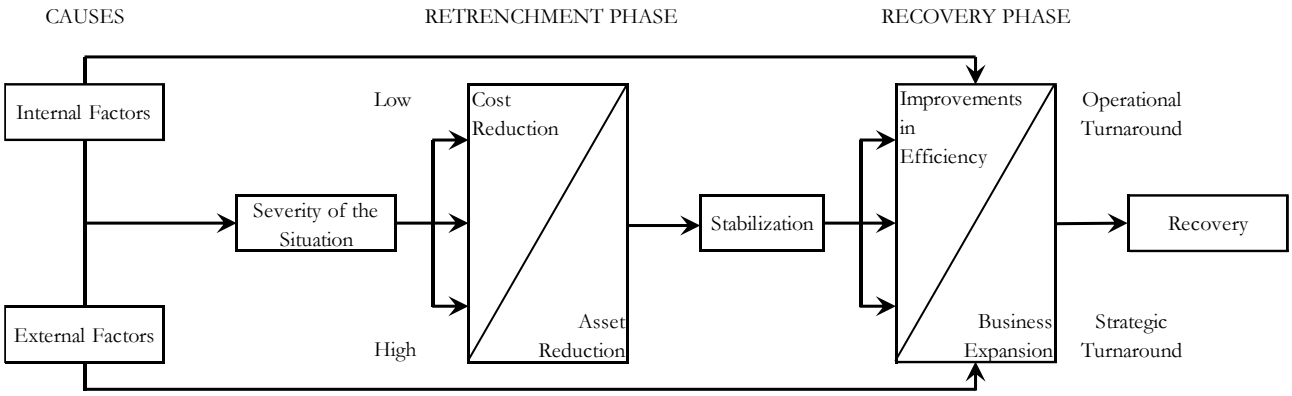
Regarding the actual Turnaround phase, Pearson and Clair (1998) addressed the ambiguity of causes, effects, and means of resolution, as well as the need to make quick decisions to enable recovery. Other authors divided the Turnaround phase into two subphases: retrenchment and recovery. According to Robbins and Pearce II (1992), the purposes of the retrenchment phase are survival and the restoration of cash flow, whereas the recovery phase aims at long-term profitability and growth.

As for the role of Innovation in this process, Mone et al. (1998) asserted that when companies face problematic situations, Innovation is often the preferred strategy. According to Smith (2006), management perspectives on Innovation include how it can change a company's position in the market. Morrow Jr. et al. (2007, p. 271) argued that the recombination of existing resources to create products, processes, or technologies (innovation activity) has a positive effect on organizational recovery. However, there is no consensus on the role of Innovation, as some authors question the positive relationship between corporate recovery and Innovation. According to McKinley et al. (2014), certain innovations may also consume critical company resources, thereby accelerating organizational decline.

In 1992, Robbins and Pearce II presented a detailed model of the Turnaround process, as shown in Figure 1.

Figure 1

Turnaround flow



Source: Robbins and Pearce II (1992).

In this model, it can be observed that the causes of decline may be either internal or external to the organization. It also shows the subphases of the Turnaround process: the retrenchment phase and the recovery phase. Accordingly, this study adopted the concepts proposed by Robbins and Pearce II (1992) as the reference framework for Turnaround.

Regarding judicial recoveries (JRs), these are special cases of Turnaround as they take place in a regulated legal environment. They are governed by Law No. 11.101 (2005) and Law No. 14.112 (2020). A JR is an agreement between parties (creditors and debtor) for the recovery of the latter, with the participation of third parties, namely the judicial institutions.

As for Turnaround indicators, they were selected based on previous studies, particularly Tascón and Gutiérrez (2012), Tascón et al. (2018), and Rodriguez-Masero and Lopez-Manjon (2020). It should be noted that the focus of these studies was corporate bankruptcy; however, since bankruptcy is a possible outcome of a failed Turnaround, these indicators were considered applicable to Turnaround as well.

Rodriguez-Masero and Lopez-Manjon (2020) propose three indicators: (a) ROA, which measures a company's ability to generate profits; (b) total debt, which assesses a company's financial health, since lower debt generally reflects better health; and (c) current liquidity, which evaluates the likelihood of default, as having more assets than short-term liabilities reduces the probability of default. These indicators are also recommended in the studies of Tascón and Gutiérrez (2012) and Tascón et al. (2018). For this reason, they were selected as the Turnaround indicators for this study.

The period used to characterize a company's decline was also defined. A two-year period was chosen, based on the following works: Hambrick and Schecter (1983), Robbins and Pearce II (1992), and Rodriguez-Masero and Lopez-Manjon (2020).

Relationship between innovation and turnaround

In 1959, Penrose (2009) indirectly addressed the topic of Innovation and Turnaround by noting that there are companies with vigorous and creative management that have altered their range of products - sometimes abandoning their original products and expanding total production - despite unfavorable demand conditions for their older products. Thus, Penrose (2009) indirectly suggests the possibility of using Innovation to deal with adverse situations. Martin-Rios and Parga-Dans (2016) argue that focusing on strategic renewal processes in response to economic threats makes it possible to examine how Innovation can facilitate corporate renewal. Vetrano (2018) mentions, among the actions taken by

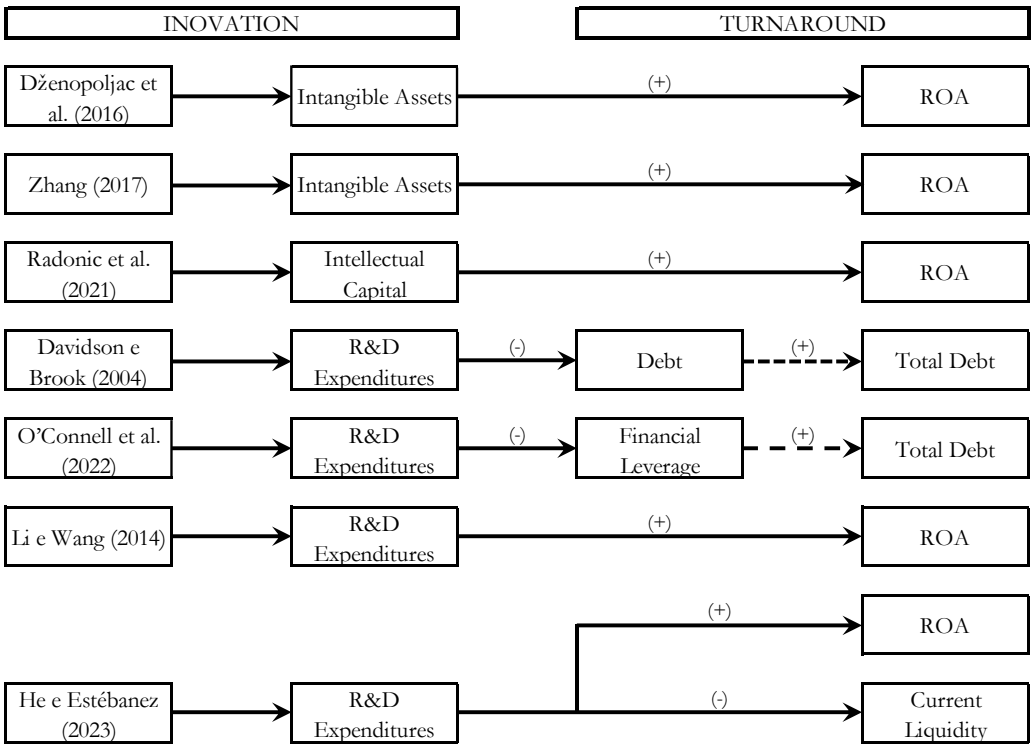
companies undergoing Judicial Recovery, the increase in capital allocated to Innovation. Finally, Lunkes et al. (2019) state that investments in Innovation may be positively correlated with organizational performance.

However, not all authors propose a positive relationship between Innovation and Turnaround. Morrow Jr. et al. (2007) argue that Innovation initiatives do not guarantee recovery and may even worsen a company's performance. According to Pearce II and Robbins (2008), Innovation is a creative process, and the time required for its development can hinder corporate recovery. McKinley et al. (2014) examined how an organization reacts after experiencing decline and found two possibilities: one in which organizational decline stimulates adaptation and Innovation, and another in which decline hinders adaptation and Innovation.

Regarding the direct relationship between the selected Innovation indicators (intangible assets and R&D expenditures) and the selected Turnaround indicators (ROA, total debt, and current liquidity), Dženopoljac et al. (2016) and Zhang (2017) identified a positive impact of intangible assets on ROA. Radonić et al. (2021), in a quantitative study, reported a positive relationship between intellectual capital (intangible asset) and various financial performance indicators, including ROA. The study by Davidson and Brook (2004) found that R&D intensity is associated with lower debt in a company's capital structure. Quantitative research by O'Connell et al. (2022) indicates a negative relationship between R&D expenditures and a company's financial leverage. Studies by Li and Wang (2014) and He and Estébanez (2023) showed a positive relationship between R&D expenditures and ROA. The work of He and Estébanez (2023) also found no significant influence of R&D expenditures on total debt and a negative influence on current liquidity.

Figure 2

Relationship between independent and dependent variables



Source: Based on Robbins and Pearce II (1992).

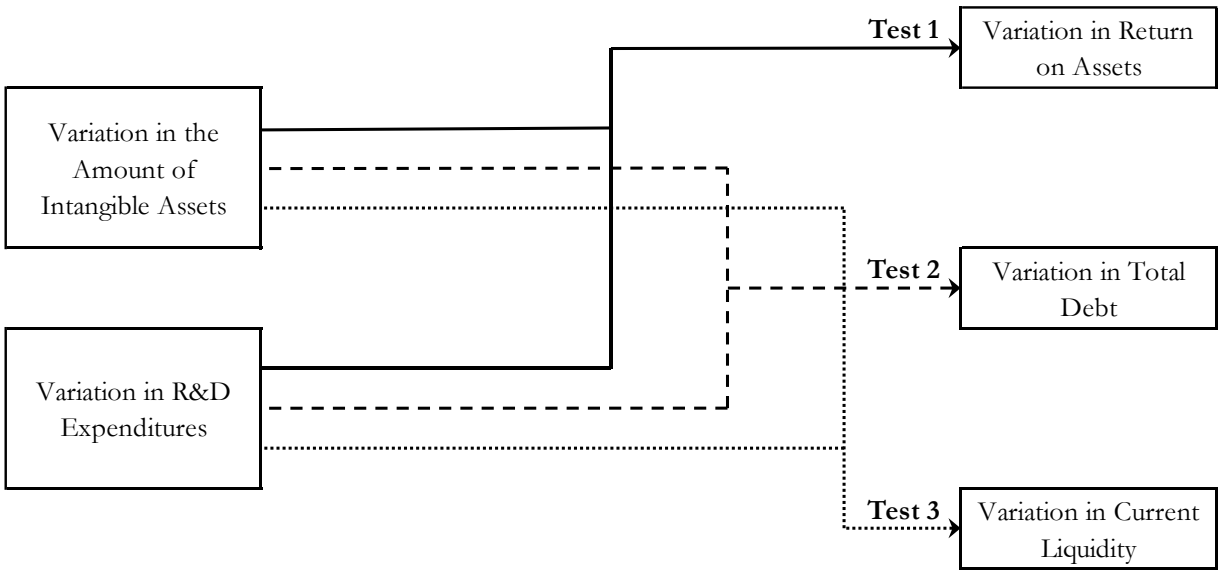
Figure 2 schematically presents the relationships between variables proposed by the aforementioned authors. Solid arrows identify relationships proposed in these studies, while dashed arrows indicate complementary relationships proposed by this research. The signs in parentheses indicate whether the relationship is positive or negative.

Since there is no convergent understanding, the specific objective of testing the relationship between Innovation activities and company performance was broken down into the three tests presented in Figure 3:

- Test 1 – to test the relationship between the variation in the amount of intangible assets and R&D expenditures and the variation in return on assets;
- Test 2 – to test the relationship between the variation in the amount of intangible assets and R&D expenditures and the variation in total debt; and
- Test 3 – to test the relationship between the variation in the amount of intangible assets and R&D expenditures and the variation in current liquidity.

Figure 3

Model of the tests to be conducted



Source: Research Data.

Methodology

The typology of this study, in terms of purpose and approach, was descriptive and quantitative. Documentary research was used to define the population and sample. For sample analysis, descriptive statistics and longitudinal statistical modeling were applied, since the variables for each company were measured over time.

The population studied comprised publicly traded Brazilian companies listed on the Brazilian stock exchange that experienced a loss of value in 2015 and 2016. The choice of publicly traded companies

was due to the fact that their financial statements - the data source - are publicly available. Data were collected for the period from 2014 to 2022. Financial statements for the years 2014 to 2016 were used to verify whether the company lost value during the Brazilian economic crisis of 2015 and 2016. The statements from 2016 to 2022 were used for descriptive statistics and statistical modeling.

Some considerations regarding the use of the Economic Crisis are as follows: (a) the fact that a company lost value during the economic crisis does not mean that this process could not have started earlier; (b) the economic crisis was used as a cut-off point, assuming there would be an increase in the number of companies that lost value, thus ensuring that the population size would be adequate for statistical modeling; and (c) the population includes companies that lost value during the period, not only those undergoing Judicial Recovery (JR).

To illustrate the crisis, the performance of five economic indicators is shown in Table 2.

Table 2

Economic indicators from 2010 to2016

Indicator	2010	2011	2012	2013	2014	2015	2016
IPCA Variation	5.91	6.50	5.84	5.91	6.41	10.67	6.29
INPC Variation	6.46	6.08	6.20	5.56	6.23	11.28	6.58
GDP Variation	7.5	3.9	1.9	3.0	0.5	-3.8	-3.6
Unemployment Rate (4th quarter)	6.7	6.0	6.9	6.3	6.6	9.1	12.2
Real/Dollar Exchange Rate	1.6654	1.8751	2.0429	2.3420	2.6556	3.9042	3.2585

Source: Adapted from IBGE (2024) and Central Bank (2024).

In the 2015–2016 biennium, most economic indicators showed less favorable results compared to previous years. It is also observed that, between 2013 and 2023, the years with the highest number of Judicial Recovery (JR) filings in Brazil were 2016 and 2017, with 1,863 and 1,420 cases, respectively (Serasa Experian, 2023). These data suggest a possible relationship between the economic crisis and an increase in the number of companies that lost value.

Regarding data collection, it was carried out based on the list of publicly traded companies available on the Brasil, Bolsa, Balcão (B3, 2023) website. This list contained 433 companies, and their data were obtained by downloading the standardized financial statements (DFP) from the website of the Brazilian Securities and Exchange Commission(https://sistemas.cvm.gov.br). Some companies had both individual and consolidated financial statements, and the consolidated data were chosen. The DFPs include the following information: balance sheet, assets and liabilities; income statement (IS); explanatory notes; and other details.

From the DFPs, the following information was collected: (a) total assets, (b) current assets, (c) intangible assets, (d) current liabilities, (e) non-current liabilities, (f) operating revenue, and (g) R&D expenditures. Items (c) and (g) are the independent variables for the Innovation construct. Items (a), (b), (d), and (e) were used to calculate the dependent variables related to Turnaround, as follows: return on assets (ROA) was calculated as operating revenue / total assets; total debt as (current liabilities + non-current liabilities) / total assets; and current liquidity as current assets / current liabilities. Regarding the two control variables: company size was assessed using item (f) operating revenue, and the industry sector was obtained from the list of publicly traded companies (B3, 2023), being the only data not sourced from the DFPs.

The number of companies analyzed was smaller than the 433 listed in the initial B3 report (2023) due to the application of the following criteria. First, the financial sector was excluded, as the structure of its DFPs differs from that used in other sectors, reducing the sample to 363 companies. The "Others" sector was also excluded, as it does not have a specific classification and is mostly composed of holding

companies. This reduced the number to 350 companies. Next, companies that started trading on the stock exchange after 2016 were excluded, bringing the number down to 241. Three criteria were then applied to verify whether there was a loss of value in the 2015–2016 biennium: (a) a decrease in ROA, (b) an increase in total debt, and (c) a decrease in current liquidity. This reduced the number to 218 companies. The final step was to exclude companies whose parent company was also listed on the stock exchange, removing five duplicates and resulting in a final sample of 213 companies, whose distribution by sector is shown in Table 3.

Table 3

Sector classification of the studied population

Sector	Number of Companies in the Sample
Oil, Gas and Biofuels	9
Basic Materials	20
Industrial Goods	40
Non-Cyclical Consumption	19
Cyclical Consumption	53
Health Care	13
Information Technology	6
Communications	4
Public Utilities	49
Total	**213**

Source: Research Data

These 213 companies were divided into three non-mutually exclusive groups: 142 companies with a reduction in ROA, 147 companies with an increase in total debt, and 136 companies with a reduction in current liquidity. Descriptive statistics and statistical modeling were applied to each of these groups.

For the period from 2017 to 2022, immediately following the crisis, measures of central tendency, dispersion, and the existence (or absence) of correlations between the variables were evaluated. Regarding statistical modeling, three tests were originally planned to examine the relationship between Innovation activities and company performance, as shown in Figure 3. The values of the dependent variables (variation in ROA, variation in total debt, and variation in current liquidity), independent variables (variation in intangible assets and variation in R&D expenditures), and one of the control variables (company size) were calculated or collected for the years 2017 to 2022. For this calculation, absolute variations were used, based on the difference between the indicators in subsequent years. The six-year time series (2017 to 2022) covers the usual duration of a turnaround process. Robbins and Pearce (1992), Trahms et al. (2013), and Vetrano (2018) note that turnaround processes typically span periods of three to four years, one to three years, and two to three years, respectively.

The software used for the analyses was R version 4.3.2, and the adjustments of the GEE (Generalized Estimating Equations) models were performed using the following equation, whose elements are described in Table 4:

$$Yij = \beta0 + \beta1 \times Xij1 + \beta2 \times Xij2 + \beta3 \times Xij3 + \beta4 \times Xij4 + \varepsilon ij$$

Table 4

Elements of the statistical modeling equation

Element	Description
Y_{ij}	Value of the response variable (variation in ROA, variation in total debt, or variation in current liquidity) for the i-th company in the j-th year.

Element	Description
β_0	Model intercept, corresponding to the value of Y_ij when all explanatory variables are equal to zero.
β_1, β_2, β_3 e β_4	Coefficients associated with the explanatory variables
X_{ij1}	Variation in intangible assets of company i in year j.
X_{ij2}	Variation in R&D expenditures of company i in year j.
X_{ij3}	Control variable: operating revenue of company i in year j.
X_{ij4}	Control variable for the sector of company i in year j, with the reference sector being Oil, Gas, and Biofuels. Therefore, X_ij4=0 when the company is in this sector and X_ij4=1 for all other sectors.
ε_{ij}	Error term associated with the i-th company in the j-th year.

Source: Research Data

In addition to the original statistical modeling, two alternative models were developed with the purpose of exploring potentially different perspectives, seeking new insights, refining the analysis, and validating the results of the original model.

In the first alternative model, the year-to-year variation of the variables was divided by the variation of the previous year. In other words, this alternative model used relative variation instead of absolute variation.

To describe the second alternative model, it is necessary to address one of the aspects observed during data collection: for many of the companies studied, there was no information on R&D expenditures in the income statement (IS). This means that these companies either had no such expenditures or did not include this data in their financial statements. Since the original data collection criterion required the existence of quantitative data on these expenditures in the IS, such expenditures were considered zero. On the other hand, even if a search for this quantitative information were carried out in the explanatory notes, the lack of a standardized structure in these notes would prevent the collection of reliable figures.

One alternative for addressing this situation was to treat R&D expenditures as a binary (dummy) variable. This variable would take the value "1" when there was any mention of R&D activities in any part of the DFP and "0" when there was none. This approach formed the basis of the second alternative model. Consequently, the R&D expenditure database was revised to reflect this binary variable, while the other variables continued to be treated as in the original statistical modeling.

Analysis and discussion of results

This section presents the analysis and discussion of the results obtained in the research, focusing on the relationship between Innovation and Turnaround in publicly traded Brazilian companies. It begins by exploring the general characteristics of the data through descriptive statistics, providing a preliminary view of the variables involved. Next, different statistical models are developed and tested, starting with the original approach and subsequently applying two alternative models, which allow for the assessment of the robustness of the results. Finally, the findings from the statistical analyses are consolidated, highlighting the main evidence on the association between innovation and the performance of companies undergoing recovery processes.

Descriptive Statistics

In the descriptive analysis of the control variables (categorical), absolute and relative frequencies were used. For the independent and dependent variables (numerical), the mean, standard deviation, minimum, median (second quartile), and maximum were calculated. Spearman's correlation (Hollander & Wolfe, 1999) was also applied to the numerical variables. The dataset analyzed comprised 1,275 observations (N), covering 213 companies monitored from 2017 to 2022. Each company had one observation per year, except for two cases - one with financial statements available only up to 2020 and

another only up to 2021. Table 5 presents the analysis of the control variable company size.

Table 5

Descriptive analysis of the control variable company size

Variable	Year	N	Mean	S.D.	Mín.	2ºQ	Máx.
Control Variable: Company Size (Operating Revenue)	Overall	1275	13,280,592	49,569,571	-145,261	1,992,911	798,615,522
	2017	213	9,360,921	30,322,868	35	1,538,191	283,695,000
	2018	213	10,753,451	35,802,701	0	1,635,237	349,836,000
	2019	213	11,220,207	35,414,718	-145,261	1,839,990	302,245,000
	2020	213	12,138,092	40,032,588	1,570	1,773,188	367,647,302
	2021	212	16,621,096	60,518,785	1,985	2,366,012	581,753,222
	2022	211	19,665,417	77,720,595	-37,403	2,512,656	798,615,522

Source: Research Data.

Regarding the distribution of companies by sector another control variable among the nine sectors listed in Table 3, four account for more than 75% of the 1,275 observations: (a) cyclical consumption, with 24.78%; (b) public utilities, with 22.98%; (c) industrial goods, with 18.82%; and (d) basic materials, with 9.41%. As for the independent variables, Table 6 presents the year-by-year descriptive analysis.

Table 6

Descriptive analysis of the explanatory variables of the GEE model

Year	Variable	Mean	S.D.	Mín.	2ºQ	Máx.
Overall	Variation in Intangible Assets	328,671	4,051,070	-60,799,000	0	74,988,405
	Variation in R&D Expenditures	3,280	94,991	-1,256,000	0	1,675,000
2017	Variation in Intangible Assets	188,395	2,191,864	-2,923,000	-11	30,231,132
	Variation in R&D Expenditures	10,143	123,955	-148,264	0	1,675,000
2018	Variation in Intangible Assets	50,845	681,812	-4,453,672	0	4,040,196
	Variation in R&D Expenditures	-2,042	94,966	-1,256,000	0	514,000
2019	Variation in Intangible Assets	454,367	4,829,892	-4,370,508	1	67,619,000
	Variation in R&D Expenditures	-2,198	70,665	-947,000	0	389,000
2020	Variation in Intangible Assets	213,226	1,302,567	-3,195,110	0	14,051,536
	Variation in R&D Expenditures	-5,050	90,577	-1,121,000	0	527,000
2021	Variation in Intangible Assets	92,528	4,409,365	-60,799,000	73	7,866,865
	Variation in R&D Expenditures	8,512	98,501	-265,000	0	1,214,000
2022	Variation in Intangible Assets	977,647	6,988,315	-3,828,156	90	74,988,405
	Variation in R&D Expenditures	10,405	82,445	-26,500	0	1,054,000

Source: Research Data.

The average variation in intangible assets was BRL 328,671, with the smallest variation (-BRL 60,799,000) occurring in 2021 and the largest (BRL 74,988,405) in 2022. The average variation in research and development (R&D) expenditures was BRL 3,280, with more than half of the observations showing no variation. This behavior may be a consequence of the database containing many zero values, which may indicate either that the company had no R&D expenditures or that such data were not included in the financial statements. As for the dependent variables, Table 7 presents the year-by-year descriptive analysis.

Table 7

Descriptive analysis of the response variables of the GEE model

Year	Variable	Mean	S.D.	Mín.	2ºQ	Máx.
Geral	Variation in Return on Assets	1.29%	17.59%	-127.27%	1.17%	112.87%
	Variation in Total Debt	-13.79%	451.07%	-10,975.55%	0.62%	4,036.38%
	Variation in Current Liquidity	0.26%	196.20%	-2,246.86%	0.10%	3,153.18%

Year	Variable	Mean	S.D.	Mín.	2ºQ	Máx.
2017	Variation in Return on Assets	0.97%	16.43%	-58.34%	0.64%	112.44%
	Variation in Total Debt	-46.44%	753.82%	-10,975.55%	0.06%	532.79%
	Variation in Current Liquidity	-5.59%	242.09%	-2,215.42%	0.75%	1,930.81%
2018	Variation in Return on Assets	2.29%	13.18%	-54.75%	1.26%	85.25%
	Variation in Total Debt	14.64%	147.52%	-249.31%	1.00%	1,951.37%
	Variation in Current Liquidity	12.30%	115.03%	-241.84%	3.22%	1,327.93%
2019	Variation in Return on Assets	-3.00%	20.41%	-127.27%	-0.01%	110.01%
	Variation in Total Debt	1.67%	86.38%	-665.95%	0.84%	959.69%
	Variation in Current Liquidity	-3.37%	187.01%	-2,246.86%	-0.31%	833.72%
2020	Variation in Return on Assets	-4.46%	17.56%	-84.80%	-2.63%	47.50%
	Variation in Total Debt	15.46%	310.57%	-1,846.93%	1.22%	4,036.38%
	Variation in Current Liquidity	6.21%	209.41%	-1,017.66%	0.29%	2,500.37%
2021	Variation in Return on Assets	8.08%	17.24%	-63.21%	6.32%	104.12%
	Variation in Total Debt	-35.92%	641.97%	-9,182.83%	0.58%	1,449.13%
	Variation in Current Liquidity	2.78%	251.48%	-1,453.09%	-0.59%	3,153.18%
2022	Variation in Return on Assets	3.92%	17.08%	-81.90%	2.78%	112.87%
	Variation in Total Debt	-32.41%	340.38%	-4,088.51%	-0.02%	110.57%
	Variation in Current Liquidity	-10.88%	132.40%	-1,141.48%	-2.18%	514.69%

Source: Research Data.

The mean variation in return on assets (ROA) was 1.29%, with the highest annual mean (8.08%) occurring in 2021 and the lowest (-127.27%) in 2019. The mean variation in total debt was -13.79%, with the highest annual mean (15.46%) in 2020 and the lowest (-46.44%) in 2017. Finally, the mean variation in current liquidity was 0.26%, with the highest annual mean (12.30%) in 2018 and the lowest (-10.88%) in 2022. To conclude, Table 8 presents the correlation matrix between the variables.

Table 8

Correlation matrix between the variables

	Variation in Intangible Assets	Variation in R&D Expenditures	Variation in Return on Assets	Variation in Total Debt	Variation in Current Liquidity	Control Variable: Operating Revenue
Variation in Intangible Assets	1					
Variation in R&D Expenditures	0.03	1				
Variation in Return on Assets	0.09	0.02	1			
Variation in Total Debt	-0.02	0.01	-0.07	1		
Variation in Current Liquidity	-0.04	-0.02	-0.04	-0.26	1	
Control Variable: Operating Revenue	0.19	0.05	-0.03	-0.02	0	1

Source: Research Data.

No strong correlations were found between the variables, as the Spearman coefficients did not present values close to 1 or -1. The low correlation among the variables, particularly between the independent and dependent variables, does not indicate a relationship between the Innovation construct and the Turnaround processes.

Original Statistical Modeling

The original statistical modeling aimed to carry out the three proposed tests to address the third specific objective, namely:

a) Test 1: to test the relationship between the variation in the amount of intangible assets and R&D expenditures and the variation in ROA;
b) Test 2: to test the relationship between the variation in the amount of intangible assets and R&D expenditures and the variation in total debt; and
c) Test 3: to test the relationship between the variation in the amount of intangible assets and R&D expenditures and the variation in current liquidity.

For each dependent variable, a specific model was developed, with the main analysis criterion being the p-value test. A summary of the results of this modeling is presented in Table 9.

Table 9

Summary of the Results of the Original Statistical Modeling

Independent or Control Variable	Dependent Variable	Original Test Result		
		Influence	p-Value	b
Intangible Assets	Return on Assets	Negative	< 0.001	-1.21
	Total Debt	Not significant	0.130	0.72
Intangible Assets	Current Liquidity	Not significant	0.915	-0.36
R&D Expenditures	Return on Assets	Not significant	0.587	-0.12
	Total Debt	Not significant	0.600	-0.2
	Current Liquidity	Not significant	0.471	-1.15
Company Size or Operating Revenue	Return on Assets	Positive	0.008	0.8
	Total Debt	Not significant	0.330	0.79
	Current Liquidity	Not significant	0.480	0.63

Source: Research Data.

The only statistically significant influence negative in this case found was between the variation in intangible assets and the variation in ROA, as the p-value was less than 0.001 ($p < 0.05$). For each increase of one standard deviation in the variation of intangible assets, there is a decrease of 1.21 in the variation of ROA ($\beta = -1.21$).

First Alternative Statistical Modeling

As in the original modeling, a test was performed for each dependent variable, replacing the absolute variation from the original model with the relative variation, as shown in Table 10.

Table 10

Calculation of Variation for the Original Modeling and the 1st Alternative Modeling

Model	Variation Calculation
Original	X_{ij1} = Intangible Assets$_{ij}$ – Intangible Assets$_{i(j-1)}$
1st Alternative	X_{ij1} = (Intangible Assets$_{ij}$ – Intangible Assets$_{i(j-1)}$) / Intangible Assets$_{i(j-1)}$

Source: Research Data.

A summary of the results of this alternative modeling is presented in Table 11.

Table 11

Summary of the results of the first alternative statistical modeling

Independent or Control Variable	Dependent Variable	Result of the 1st Alternative Test		
		Influence	p-Value	b
Intangible Assets	Return on Assets	Negative	< 0.001	-2.56
	Total Debt	Not significant	0.089	0.80
	Current Liquidity	Not significant	0.058	-3.91
R&D Expenditures	Return on Assets	Not significant	0.342	1.14
	Total Debt	Not significant	0.282	0.15
	Current Liquidity	Not significant	0.354	-0.90
Company Size or Operating Revenue	Return on Assets	Not significant	0.116	-4.39
	Total Debt	Not significant	0.125	-0.54
	Current Liquidity	Not significant	0.106	-5.40

Source: Research Data.

Again, the only statistically significant negative influence found was between the variation in intangible assets and the variation in ROA, as the p-value was less than 0.001 ($p < 0.05$). For each increase of one standard deviation in the variation of intangible assets, there is a decrease of 2.56 in the variation of return on assets ($\beta = -2.56$).

Second Alternative Statistical Modeling

In the two previous models, it was observed that all tests involving R&D expenditures showed no significant influence on any dependent variable. One possible cause is that many companies reported zero values for R&D expenditures in their income statements. This may indicate either that the company had no R&D expenditures or that such data were not included in the financial statement.

This difficulty in obtaining R&D expenditure data has been noted by other authors. Barsh and Souza (2018) state that companies provide little disclosure regarding R&D expenditures. Karoline Ventura et al. (2018), in a study analyzing the composition of intangible assets in 43 Brazilian companies in the electric power sector from 2013 to 2016, also corroborate this difficulty.

Furthermore, it was observed that many companies presented unstructured information about these expenditures in the explanatory notes. For example: (a) differences in the description of R&D expenditures in the explanatory notes of the same company over the years, hindering longitudinal analysis; (b) R&D expenditures being qualified but not quantified; and (c) information on R&D expenditures disclosed only for part of the years analyzed.

To address this situation, the criterion for collecting R&D expenditure data was modified. The search focused on the mention of R&D activities that is, on qualitative information present anywhere in the DFPs. Consequently, the independent variable R&D expenditures was transformed into a binary (dummy) variable, taking the value "1" when there was any mention of R&D activities and "0" when there was none. This served as the basis for the second alternative model. The other independent and dependent variables continued to be treated using absolute variation, as in the original statistical modeling.

A summary of the results of the second alternative statistical modeling is presented in Table 12.

Table 12

Summary of the Results of the Second Alternative Statistical Modeling

Independent or	Dependent variable	Result of the 2nd Alternative Test

Control Variable		Influence	p-Value	b
Intangible Assets	Return on Assets	Negative	< 0.001	-2.73
	Total Debt	Not significant	0.095	0.78
	Current Liquidity	Not significant	0.097	-3.70
R&D Expenditures	Return on Assets	Not significant	0.332	-13.33
	Total Debt	Not significant	0.922	0.13
	Current Liquidity	Not significant	0.148	-64.41
Company Size or Operating Revenue	Return on Assets	Not significant	0.184	-2.78
	Total Debt	Not significant	0.138	-0.51
	Current Liquidity	Not significant	0.811	0.59

Source: Research Data.

As in the two previous models, the only statistically significant—and negative—influence found was between the variation in intangible assets and the variation in ROA, as the p-value was less than 0.001 ($p < 0.05$). For each increase of one standard deviation in the variation of intangible assets, there is a decrease of 2.73 in the variation of return on assets ($\beta = -2.73$).

Consolidation of the Results of the Statistical Models

All three models produced similar results: only one statistically significant—and negative—relationship was detected, between the variation in intangible assets and the variation in return on assets. The summary of the results of the three models is presented in Table 13, where "ns" denotes a statistically non-significant influence.

Table 13

Summary of the Results of the Statistical Modeling

Independent or Control Variable	Dependent Variable	Original Test Result		Result of the 1st Alternative Test		Result of the 2nd Alternative Test	
		Influence	p-Value	Influence	p-Value	Influence	p-Value
Intangible Assets	Return on Assets	Negative	< 0.001	Negativa	< 0.001	Negativa	< 0.001
Intangible Assets	Total Debt	ns	0.130	ns	0.089	ns	0.095
	Current Liquidity	ns	0.915	ns	0.058	ns	0.097
R&D Expenditures	Return on Assets	ns	0.587	ns	0.342	ns	0.332
	Total Debt	ns	0.600	ns	0.282	ns	0.922
	Current Liquidity	ns	0.471	ns	0.354	ns	0.148
Company Size or Operating Revenue	Return on Assets	Positive	0.008	ns	0.116	ns	0.184
	Total Debt	ns	0.330	ns	0.125	ns	0.138
	Current Liquidity	ns	0.480	ns	0.106	ns	0.811

Source: Research Data.

This result is consistent with the work of Morrow Jr. et al. (2007), Pearce II and Robbins (2008), and McKinley et al. (2014), who argue that the relationship between Turnaround and Innovation is not necessarily positive. On the other hand, it differs from the conclusions of studies by Dženopoljac et al.

(2016), Zhang (2017), and Radonić et al. (2021). One way to reconcile these differing results is through the observation of Radonić et al. (2021) that there is a lack of research on the topic of "the impact of intangible assets on company performance" in developing countries, considering that the topic presents different characteristics in developed countries.

As for the lack of a relationship between R&D expenditures and the three dependent variables, this finding aligns with the results of the quantitative study by He and Estébanez (2023) regarding total debt, but not for ROA and current liquidity. Other studies on R&D expenditures that found some relationship with the dependent variables include: Davidson and Brook (2004), who state that R&D intensity is associated with lower debt in a company's capital structure; Li and Wang (2014), who concluded that R&D expenditures positively affect financial performance; and O'Connell et al. (2022), who found a negative relationship between R&D expenditures and a company's financial leverage.

Final considerations

This study sought to identify and analyze the Innovation process in Brazilian publicly traded companies, focusing on its relationship with Turnaround processes. It addressed the following research problem: what type of association exists between Innovation activities and Turnaround processes in Brazilian publicly traded companies listed on B3? This question translated into the following general objective: to identify the type of association between Innovation activities and Turnaround processes in Brazilian publicly traded companies listed on B3, along with three specific objectives.

To this end, the research investigated which companies suffered value losses during the Brazilian economic crisis of 2015 and 2016 and how their performance evolved between 2017 and 2022. This time frame was grounded in the Turnaround literature (Robbins & Pearce, 1992; Trahms et al., 2013; Vetrano, 2018), which indicates that turnaround processes typically unfold over up to four years. Thus, a six-year longitudinal analysis allowed for a clearer observation of the post-crisis trajectory.

The studied sample comprised 213 companies from various sectors, with emphasis on cyclical consumption, public utilities, industrial goods, and basic materials. The results of the descriptive statistics indicated that there were no strong correlations between variables. Regarding statistical modeling, during the research process it was decided to work with two additional alternative models, aiming to explore potentially different perspectives, search for new insights, refine the analysis, and confirm the results of the original model.

The differences among the three statistical models, summarized, are as follows: (a) the original model used absolute variations for both independent and dependent variables; (b) the first alternative model used relative variations for the same variables; and (c) the second alternative model used absolute variation for the variables, except for "R&D expenditures," which was treated as a binary (dummy) variable taking the value "1" when such expenditures were mentioned in one of the company's financial statements (DFP), or "0" when they were not.

Regarding R&D expenditures, several companies presented zero values for this variable in their income statement, which does not necessarily indicate an absence of investment but may reflect accounting record issues or different practices in expense recognition and intangible asset capitalization. However, some of these companies provided unstructured information about such expenditures in the explanatory notes. This fact led to the third modeling approach using a binary variable.

This difficulty in obtaining data on R&D expenditures was noted by Barsh and Souza (2018), who argue that companies rarely disclose this type of expenditure. Another study confirming this difficulty is Karoline Ventura et al. (2019), who analyzed the composition of intangible assets in 36 Brazilian electric sector companies between 2013 and 2016 and found that the share of R&D in total intangible assets was equal to or lower than 2.71%.

All three models presented similar results, as shown in Table 13: (a) a negative relationship between intangible assets—an independent variable related to the Innovation construct—and ROA, a dependent variable associated with Turnaround; and (b) no statistically significant relationships for the other combinations of independent and dependent variables. The first result may be interpreted as a statistically negative relationship between Innovation activities (when measured by intangible assets) and Turnaround outcomes (when measured by ROA). This negative result does not invalidate the importance of Innovation but indicates that, in crisis contexts, it may be financially disadvantageous.

This finding aligns with studies by Morrow Jr. et al. (2007), Pearce II and Robbins (2008), and McKinley et al. (2014), which suggest that Innovation may represent an additional cost and a source of uncertainty during corporate recovery periods. By contrast, it diverges from studies by Dženopoljac et al. (2016), Zhang (2017), and Radonić et al. (2021), which identified positive correlations between intangible assets and financial performance.

Beyond statistical interpretation, the results suggest a situation of potential conflict: in times of crisis, the pursuit of stability contrasts with the need for Innovation. The Turnaround strategy - focused on cost-cutting and operational adjustments - clashes with the nature of Innovation, which is capital-intensive, risk-based, and future-oriented. This conflict can translate into a trade-off: innovation is indispensable for long-term sustainability but may compromise short-term financial recovery.

Given the pioneering nature of this study, it may contribute in several ways: first, by filling a gap in national literature, offering a systematic empirical analysis of the relationship between Innovation and Turnaround; second, by proposing a replicable methodology based on GEE (Generalized Estimating Equations) models that can be applied to other periods or countries; and third, by providing practical insights for managers and policymakers.

Regarding Innovation, some final reflections: the results presented here apply to the studied population under the defined methodology, which naturally does not invalidate the strategic role of Innovation for organizations - a role that extends beyond this study's scope. On the other hand, one may ask: could this result indicate that the companies studied should increase their Innovation activities? If so, why don't they? Does the Brazilian market have lower economic freedom compared to other countries, or is there economic concentration in certain sectors? If so, would this situation hinder competition and consequently discourage investment in Innovation?

Thus, this research and the present article contributed to broadening the understanding of the relationship between Innovation and Turnaround, not only by seeking answers to the proposed research question but also by recognizing the study's limitations and transforming them into opportunities for future developments.

Regarding future research, one of the limitations of this study was the difficulty in obtaining structured information about R&D expenditures, which led to the development of three statistical models. One alternative to explore lies in the criterion used for collecting R&D data, which was limited to the information disclosed in the companies' standard financial statements (DFP). Therefore, different data collection methods could be used - combined or not - with other data sources, including non-financial ones.

For research on Innovation, another possible approach is to work with smaller and more homogeneous populations, focusing on specific sectors. This approach would allow addressing each sector's unique characteristics and analyzing how they affect Innovation activities. However, it may also bring statistical limitations, as sector-specific samples might be too small (fewer than 100 companies) for certain statistical models. In such cases, the analysis might be restricted to descriptive statistics.

This study suggests that innovating in crisis contexts can be an ambiguous act: it can represent both a

path to reconstruction and a deepening of decline. Thus, it invites reflection on how to balance efficiency and creativity, prudence and boldness, survival and transformation. This tension - between value destruction and value creation - is, ultimately, the core of the Schumpeterian logic that inspires Innovation and may, in turn, affect the Turnaround process itself.

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