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National Early Warning System for SME Mortality

National Early-Warning System for EMS Failure

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Summary

This article discusses the need to implement a **National Early Warning System for Small and Medium-Sized Enterprise (SME) Mortality,** analyzing its importance in the economic, social, and political context. SMEs, which represent the largest proportion of organizations in Brazil and much of the world, face high mortality rates in their first years of operation. Studies indicate that management failures, a lack of strategic planning, and vulnerability to external crises are determining factors in the failure of these ventures. Therefore, an early warning system based on accounting data, market indicators, and artificial intelligence could anticipate risks, propose corrective measures, and reduce bankruptcies. Based on a literature review and analysis of international models, such as Early Warning Europe, the article seeks to reflect on how Brazil could structure a national program that integrates academia, the private sector, and the government. The text argues that innovation in public policies aimed at SMEs not only increases business survival but also strengthens the economy and promotes sustainable development.

Keywords: Early warning; Business mortality; Small and medium-sized enterprises; Risk management; Public policies.

Abstract

This article aims to discuss the need for implementing a **National Early-Warning System for Small and Medium-Sized Enterprise (SME) Failure,** analyzing its importance in the economic, social, and political context. SMEs, which represent the majority of organizations in Brazil and worldwide, face high mortality rates in the first years of operation. Studies indicate that management failures, lack of strategic planning, and vulnerability to external crises are decisive factors in business failure. In this sense, an early-warning system based on accounting data, market indicators, and artificial intelligence could anticipate risks, propose corrective measures, and reduce bankruptcies. Based on a literature review and analysis of international models, such as Early Warning Europe, the article seeks to reflect on how Brazil could structure a national program that integrates academia, the private sector, and government.
The text argues that innovation in public policies aimed at SMEs not only increases business survival but also strengthens the economy and promotes sustainable development.

Keywords: Early-warning; Business mortality; Small and medium-sized enterprises; Risk management; Public policy.

1. Introduction to the Problem of SME Mortality

The failure of small and medium-sized enterprises (SMEs) is a recurring phenomenon that threatens the economic and social sustainability of several countries. In Brazil, data from SEBRAE (2019) indicate that approximately 23% of micro and small businesses close before reaching two years of existence. This scenario is not unique to Brazil: studies by Kirchhoff (1994) and Audretsch (2002) show that in developed countries, such as the United States and Germany, early-stage failure rates are also significant, although mitigated by public support and financing policies. This reality highlights that the survival of SMEs is linked to multiple factors, including access to credit, management training, innovation, and the regulatory environment.

Analyzing business mortality from the perspective of SMEs is crucial not only because of the representativeness of this segment but also because of its impact on employment and income generation. According to Birch (1987), small and medium-sized enterprises are the ones that contribute most to net job creation in emerging economies.
Therefore, understanding the causes of these organizations' failure is essential to structuring protection and sustainability mechanisms. This issue becomes even more urgent in the face of crises like the COVID-19 pandemic, which has disproportionately affected small businesses, according to a study by the International Labor Organization (ILO, 2020).

The literature shows that management failures, often related to a lack of strategic planning and financial control, are the main drivers of SMEs' premature closure (Chiavenato, 2005; Dornelas, 2018). This vulnerability is exacerbated by a competitive environment characterized by rapid technological change, economic fluctuations, and regulatory instability. Therefore, the creation of a **National Early Warning System** presents itself as a proposed institutional innovation capable of reducing risks and increasing business resilience.

The concept of early warning, initially applied in areas such as epidemiology and natural disaster prevention (Alexander, 1993), can be adapted to the business context. Just as weather systems anticipate hurricanes and epidemics, tools based on economic indicators, artificial intelligence, and accounting data can anticipate bankruptcies.
This conceptual shift is supported by recent studies that explore the integration between predictive analysis and public policies (Brynjolfsson; McAfee, 2017).

Therefore, this article examines the potential and challenges of creating a **National Early Warning System for SME Mortality,** discussing theoretical foundations, international practices, and avenues for implementation in Brazil. In doing so, we aim to contribute to the academic debate and offer practical insights for public policymakers and business managers.

2. Theoretical Foundation: Early Warning and Business Mortality

The concept of **early warning systems** is widely explored in applied social sciences, engineering, and healthcare. In the business world, it gains relevance when adapted to monitor signs that precede financial crises or bankruptcies. Beaver (1966) was a pioneer in the application of financial indicators to predict corporate insolvency, inaugurating a field of research that evolved with models such as the Altman Z-Score (1968). These models demonstrate that it is possible to predict corporate bankruptcy with reasonable accuracy based on the analysis of balance sheets and financial data.

Over the decades, researchers have expanded this field beyond financial metrics. Laitinen (1991) highlighted the importance of strategic and operational factors, such as innovation, management quality, and competitive positioning, as relevant variables for predicting business mortality. More recently, machine learning and big data techniques have revolutionized forecasting models, enabling the identification of nonlinear patterns and complex variables that escape traditional analyses (Hatie; Tibshirani; Friedman, 2009).

In the Brazilian context, studies such as those by Longenecker, Moore, and Petty (2007) and Leone (1999) indicate that a lack of planning and financial management remains the most important factor in the failure of SMEs. However, the absence of institutional instruments to transform this academic knowledge into effective public policies contributes to the continued high mortality rates. This highlights the gap between scientific production and its practical applicability, a recurring challenge in emerging economies.

Internationally, experiences such as **Early Warning Europe** show that implementing national monitoring systems can significantly reduce bankruptcies by offering specialized advice and personalized support to companies at risk (European Commission, 2019). This initiative, implemented in countries such as Denmark and Germany, integrates accounting information, market data, and management support, resulting in higher business recovery rates than those observed in countries without such mechanisms.

Another relevant point is the role of universities and research centers in the development of these systems. Etzkowitz and Leydesdorff (2000), when proposing the **Triple Helix model,** argue that interaction between government, business, and academia is essential for innovation and for building effective support systems for SMEs. Therefore, a Brazilian early warning system should consider this institutional integration to ensure efficiency and legitimacy.

Therefore, the theoretical framework demonstrates that it is possible to predict SME mortality based on multiple indicators and that institutionalizing such practices in public policies can significantly reduce bankruptcies. The challenge, however, lies in adapting these models to the Brazilian socioeconomic reality, characterized by high levels of informality, macroeconomic volatility, and fragility in access to credit.

3. The Importance of a National System in the Brazilian Context

The Brazilian reality presents unique characteristics that justify the need for a **National Early Warning System for SME Mortality.** According to data from the Brazilian Institute of Geography and Statistics (IBGE, 2018), approximately 99% of registered companies in the country are classified as micro, small, or medium-sized. These organizations represent approximately 27% of the country's Gross Domestic Product (GDP) and generate more than 50% of formal jobs. However, despite their economic and social relevance, they face a hostile environment characterized by high bureaucracy, difficult access to credit, and tax instability (SEBRAE, 2019).

This scenario reveals the structural vulnerability of SMEs and reinforces the need for mechanisms that can anticipate crises. While developed countries have established monitoring policies, Brazil lacks systematic tools to identify, in real time, companies at risk of failure. A national system could serve as a basis for preventive policies, reducing the social and economic costs arising from large-scale bankruptcy. According to Dornelas (2018), most SME support programs in Brazil focus on development and credit, but neglect the crucial diagnostic stage.

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Furthermore, Brazil's regional diversity makes the challenge even more complex. Regions such as the Southeast and South concentrate the majority of formalized SMEs with greater access to technological resources, while the North and Northeast have higher rates of informality (Leone, 1999). Therefore, an early warning system would need to be able to address local specificities, considering variables such as formalization, predominant economic activity, and the socioeconomic characteristics of the population.

Another relevant factor is the impact of business mortality on unemployment and tax revenue. Each company that closes represents job losses, an increase in informality, and a reduction in the state's tax base. Studies by Longenecker, Moore, and Petty (2007) highlight that small business failures, when not anticipated, generate significant indirect costs, ranging from a drop in local consumption to an increase in the demand for social benefits. Therefore, a monitoring system would have the potential to reduce not only private losses but also the negative effects on the national economy.

The recent experience of the COVID-19 pandemic has starkly demonstrated how the absence of early warning systems can compromise business resilience. While European countries quickly mobilized data and digital tools to support SMEs, Brazil found itself faced with the need for emergency and poorly coordinated measures, such as subsidized credit lines that did not reach all potential beneficiaries (ILO, 2020). This episode highlights the importance of institutionalizing a permanent monitoring and prevention mechanism.

Thus, considering the relevance of SMEs for the Brazilian economy, the high mortality rate and the associated social costs, the implementation of a national alert system

Early implementation is justified not only as a business management measure, but also as a strategic public policy. It is an investment that can reduce regional inequalities, increase competitiveness, and stimulate sustainable growth in the long term.

Therefore, the Brazilian context demands an innovative approach that combines technology, public policies, and institutional support. An early warning system would be a fundamental step in transforming SMEs' vulnerability into resilience, strengthening their contribution to the country's economic and social development.

4. International Reference Models

Analyzing international experiences, it can be seen that several countries have implemented mechanisms similar to early warning systems, with significant results in reducing bankruptcies. Denmark is one of the most emblematic cases, with the creation of **Early Warning Denmark,** launched in 2007, which offers free consulting services to companies in difficulty. According to the European Commission (2019), the Danish program has achieved recovery rates of over 60% of the companies served, representing a significant contribution to the local economy and job preservation.

Another notable model is **Early Warning Europe,** a network created in 2016 and funded by the European Union, which includes countries such as Germany, Poland, and Spain. This initiative seeks not only to support companies at risk but also to create a robust database for predictive analysis. According to a report by the European Commission (2019), the project has served as a benchmark for public policies supporting SMEs across the continent, consolidating its position as a replicable practice in different national contexts.

In the United States, although there is no unified national system, several state and private initiatives have developed methodologies for monitoring business risk.
Institutions such as the **Small Business Administration (SBA)** offer counseling and technical support programs, in addition to integrating credit databases that serve as indirect indicators of vulnerability. Altman (2013), when reviewing the use of the Z-Score in the US, highlighted that such tools remain relevant but need to be integrated with support systems to achieve greater effectiveness.

In Japan, the experience is equally significant. The country has policies aimed at monitoring the performance of SMEs through accounting and tax indicators, offering immediate support to companies at risk of bankruptcy. According to Shimizu (2018), the Japanese government uses tax reports as a primary data source, integrating them with financial databases to identify insolvency patterns. This practice demonstrates how the strategic use of public information can strengthen business resilience.

These international experiences reveal that early warning systems must be adapted to the economic and institutional realities of each country. While Denmark prioritized individualized advice, Japan opted to integrate fiscal data, and the United States

have advanced with decentralized models. Brazil, therefore, could learn from these practices, combining centralized monitoring and local initiatives, ensuring comprehensiveness and efficiency.

Furthermore, a comparative study of these models highlights the importance of cooperation between the public and private sectors. In all successful cases, universities, business associations, and government agencies worked together, which reflects the **Triple Helix** concept proposed by Etzkowitz and Leydesdorff (2000). This institutional cooperation is essential to legitimize the system and ensure that it meets the real needs of SMEs.

Thus, international models offer important lessons for implementing a Brazilian system. They show that success depends not only on technology adoption but also on governance, institutional cooperation, and adaptation to local specificities.

5. Structuring a National Early Warning System in Brazil

The proposal for a **National Early Warning System for SME Mortality** in Brazil must be designed in an integrated manner, encompassing different institutional, technological, and social dimensions. First, it is necessary to establish clear governance involving ministries such as the Ministry of Economy and the Ministry of Science, Technology, and Innovation, as well as agencies such as SEBRAE, public development banks, and business associations. This coordination would guarantee the system's legitimacy and facilitate the capillarity of its actions, reaching both large urban centers and peripheral regions. According to Etzkowitz and Leydesdorff (2000), the integration between the State, academia, and the productive sector, known as the triple helix model, is fundamental to the development of effective policies.

The system would need to operate through three main pillars: **data monitoring, expert advice, and preventive policies.** Monitoring would be based on financial, accounting, and market indicators, collected continuously from public records and voluntary information from companies. Advice should be provided by trained professionals who would guide entrepreneurs at risk. Preventive policies could include emergency credit lines, management training programs, and temporary tax incentives for companies identified as vulnerable.

In technological terms, the application of **artificial intelligence and big data** would be indispensable for analyzing large volumes of data and generating reliable forecasts. Studies by Brynjolfsson and McAfee (2017) show that machine learning algorithms are capable of identifying complex patterns and anticipating risk scenarios with greater accuracy than traditional models. In Brazil, these tools could be adapted by integrating existing databases, such as data from the Federal Revenue Service, the Commercial Registry, and public banks.

Another essential element in structuring the system is the issue of confidentiality and ethics in data use. The General Data Protection Law (LGPD), enacted in 2018,

establishes clear guidelines for the handling of sensitive information. Therefore, the system's implementation must be accompanied by legal guarantees that SMEs' data will not be used for inappropriate purposes, ensuring transparency and trust.
As Westin and Maia (2020) point out, trust is a fundamental element for entrepreneurs to accept sharing financial and strategic information.

The social dimension cannot be overlooked either. The system must include training and digital inclusion initiatives, especially in regions where informality predominates and the entrepreneurial culture is incipient. In this regard, the role of SEBRAE and community universities would be essential to democratize access to tools and guidance. Dornelas (2018) emphasizes that entrepreneurial education is one of the pillars for reducing business mortality, as it allows managers to anticipate and understand risk signals.

Furthermore, it is essential that the system operate in a **decentralized manner,** with regional units capable of adapting methodologies to local realities. The heterogeneity of the Brazilian market demands flexible solutions: while in São Paulo or Minas Gerais, SMEs may require more sophisticated credit analysis and innovation, in states in the North and Northeast, the challenge may be linked to formalization and access to basic financing lines. This decentralization would allow for greater efficiency and effectiveness in reducing mortality.

Therefore, structuring a national system in Brazil requires not only the development of advanced technological tools but also institutional and social coordination. The combination of solid governance, predictive technology, social inclusion, and preventive policies can transform the current vulnerability of SMEs into a model of business resilience.

6. The Role of Technology and Artificial Intelligence

Technological advances in recent years offer unprecedented possibilities for creating an effective and comprehensive early warning system. **Artificial intelligence (AI),** in particular, has proven to be a powerful tool in detecting risk patterns. Supervised and unsupervised learning algorithms can analyze millions of financial, tax, and market records in real time, identifying signals that humans would be unlikely to notice. According to Hastie, Tibshirani, and Friedman (2009), techniques such as advanced logistic regression, decision trees, and neural networks can achieve high levels of accuracy in predicting corporate insolvency.

In the Brazilian context, the application of AI can overcome historical challenges related to informality and the lack of reliable data. The integration of multiple public and private databases, from tax records to credit and consumption information, would allow the construction of robust forecasting models. Furthermore, the analysis of unstructured data, such as news and social media posts, can provide additional insights into the business environment, anticipating sectoral or regional crises. This approach broadens the scope of monitoring and reduces the exclusive reliance on financial statements.

The use of **big data** also plays a central role in this process. As Mayer-Schönberger and Cukier (2013) point out, the power of big data lies not only in the volume of information but also in its ability to correlate seemingly unrelated variables, revealing hidden trends. In the case of SMEs, this means identifying factors such as late payments to suppliers, inventory fluctuations, or a decline in digital presence as early warning signs. These data, when analyzed together, provide a holistic view of business risk.

Another important aspect is the usability of technological tools. It's not enough for the system to be sophisticated; it needs to be accessible to entrepreneurs and managers. Intuitive digital platforms, integrated with mobile apps, could facilitate real-time monitoring of a company's financial health. This accessibility is essential to democratize the system's use and ensure it's not restricted to large urban centers or highly educated entrepreneurs.

Furthermore, technology should be used to offer not only diagnostics but also **practical recommendations.** AI-based systems can suggest personalized corrective measures, such as debt renegotiation, cash flow adjustments, or training programs. This prescriptive dimension differentiates modern systems from mere retrospective analyses, transforming them into active management tools.

However, it is necessary to consider the ethical and operational challenges of intensive technology use. Issues such as data protection, the possibility of algorithmic biases, and digital exclusion must be addressed with clear governance and regulatory policies.
As Zuboff (2019) argues, the indiscriminate use of data can lead to practices of “surveillance capitalism”, which reinforces the need for a balance between innovation and the protection of individual rights.

Therefore, the role of technology and artificial intelligence in a national early warning system is central, but it cannot be seen as an isolated solution. Its success will depend on integration with public policies, social inclusion, and the building of trust between the government, the private sector, and society.

7. Challenges and Future Perspectives

Implementation of a **National Early Warning System for SME Mortality**
in Brazil presents significant challenges that must be addressed to ensure its effectiveness. The first challenge is related to **data integration.** Although there are several public and private databases that concentrate relevant information—such as the Federal Revenue Service, the Commercial Registry, public banks, and credit agencies—these platforms still operate in a fragmented manner. The lack of interoperability between systems hinders the construction of a solid monitoring foundation. According to Etzkowitz and Leydesdorff (2000), interinstitutional cooperation is key to innovation, but it requires coordinated efforts and incentive policies.

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Another significant challenge is the **cultural resistance of entrepreneurs.** Many SME managers in Brazil are still wary of sharing financial information for fear of oversight, excessive taxation, or exposure of weaknesses. This distrust can compromise the effectiveness of an alert system if transparency and data protection mechanisms are not established. The European experience shows that trust is a determining factor: without it, entrepreneurs' adoption tends to be low. Therefore, it is essential that Brazil establish legal and institutional guarantees that provide security to entrepreneurs.

The challenge of **digital inclusion** also stands out . In several regions of Brazil, especially in rural areas and low-income areas, internet connectivity remains precarious, hindering the use of digital systems. Digital exclusion can create inequalities in access to monitoring tools, leaving out precisely the most vulnerable entrepreneurs. As Dornelas (2018) and Leone (1999) point out, the survival of SMEs depends not only on supportive policies but also on the ability to make them accessible in different social and regional contexts.

Furthermore, the system's financial sustainability represents another obstacle. Implementing a robust technological infrastructure, with large-scale data collection and analysis, requires considerable investment. Therefore, cooperation between government, the private sector, and financial institutions is essential to make resources available. Hybrid financing models, with public and private participation, can be a viable solution, as demonstrated by the experience of Early Warning Europe (European Commission, 2019).

In terms of future prospects, the possibility of **internationalizing the system** stands out . As Brazil becomes increasingly connected to global value chains, the financial health of SMEs becomes a strategic factor for international competitiveness. A national alert system could, in the future, be integrated into regional and multilateral networks, promoting cooperation and information exchange with other Latin American countries. This integration would strengthen not only the resilience of Brazilian companies but also the country's insertion into the global economy.

Another promising horizon lies in the application of **emerging technologies,** such as blockchain and the Internet of Things (IoT), to increase data reliability and accuracy. Blockchain, for example, could ensure the integrity and traceability of financial information, reducing fraud and increasing trust in the system. IoT, meanwhile, could provide real-time data on production processes, contributing to even more accurate diagnostics.
According to Mayer-Schönberger and Cukier (2013), the convergence of digital technologies tends to radically transform the way governments and companies make decisions.

Finally, the future requires that the system be built with **flexibility and adaptability.** Market dynamics, technological changes, and global crises—such as pandemics and geopolitical instability—impose the need for resilient and evolving systems. In this sense, early warning should be understood not as a static policy, but as a continuous process of innovation, review, and improvement.

Conclusion

The creation of a **National Early Warning System for SME Mortality** in Brazil emerges as a strategic proposal capable of transforming the business landscape and strengthening the national economy. Throughout this article, it has been highlighted that SMEs are responsible for a large portion of employment and income generation in the country, but they face high mortality rates due to factors such as management failures, lack of access to credit, and vulnerability to external crises. This scenario imposes the need for innovative public policies capable of anticipating risks and offering preventative solutions.

The literature review demonstrated that international models, such as Early Warning Europe and the experiences of countries like Denmark, the United States, and Japan, offer valuable lessons for the Brazilian reality. These experiences demonstrate that the combination of data monitoring, expert advice, and preventive policies can significantly reduce bankruptcies and preserve jobs. Based on this framework, Brazil has the opportunity to adapt successful practices to its context, taking into account regional inequalities, informality, and the structural fragility of its SMEs.

The article also highlighted that technology plays a central role in this process. Artificial intelligence and big data tools allow for early identification of risk signals and personalized recommendations. However, the system's success depends not only on technological sophistication, but also on building trust between entrepreneurs, government, and society. Issues such as data protection and digital inclusion are crucial to ensuring the system's adoption and effectiveness.

Furthermore, the importance of governance and inter-institutional cooperation was emphasized. Integration between the State, academia, and the private sector, as advocated by the triple helix model, is essential to ensure legitimacy and efficiency. Without this coordination, the system risks becoming a fragmented initiative incapable of generating lasting impacts.

Another key point concerns challenges and future prospects. The need to overcome cultural, technical, and financial barriers requires careful planning and consistent public policies. At the same time, the opportunities are vast: integration with international networks, the use of emerging technologies, and adaptation to new economic scenarios can transform Brazil into a global benchmark in monitoring the health of SMEs.

Therefore, implementing a national early warning system should not be seen as a cost, but as a strategic investment in the future of the Brazilian economy. By reducing bankruptcies, preserving jobs, and stimulating innovation, the system will contribute to building a more resilient, inclusive, and sustainable economy. As Brynjolfsson and McAfee (2017) conclude, the ability to use data to anticipate problems and propose solutions constitutes one of the greatest competitive advantages in the 21st century.

Ultimately, the success of this system will depend on Brazil's willingness to invest in institutional, technological, and social innovation. Creating a more stable and predictable business environment will allow SMEs to move from being seen as vulnerable to being recognized as protagonists of economic development. This way, the country will be able to align itself with international best practices and establish itself as a model for public policies aimed at strengthening entrepreneurship.

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