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INTERVENTIONS AND ITERATIONS TO FORTIFY SMALL BUSINESS RESILIENCE

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ABSTRACT

Aim/Purpose	Globally, small businesses are experiencing alarmingly high failure rates. The Business Failure Modes and Effects Analysis (BFMEA) framework was developed as a proactive solution to address this challenge, specifically targeting small technology enterprises representing approximately one-third of the small enterprises sector. This research illustrates how targeted practitioner interventions and iterative refinements, guided by the elaborated Action Design Research (eADR) methodology, significantly enhanced the effectiveness of the BFMEA worksheet – evolving it into a structured, practical tool for improving business resilience.
Background	The BFMEA artifact, presented as a structured worksheet, enables business owners to systematically identify potential failure modes while emphasizing proactive risk identification and prioritization within small businesses or industries. Following its preliminary implementation in select small technology enterprises, the BFMEA framework is positioned for broader adoption across various industry sectors.
Methodology	The author applied the eADR methodology to evolve the BFMEA theory and the artifact (worksheet). Through the four stages of diagnosis, design, implementation, and evolution, eADR facilitated the iterative refinement of the BFMEA worksheet. Practitioner interventions throughout this process enhanced its effectiveness and expanded its scalability.
Contribution	Enhancing the resilience of small industries is vital to ensuring regional and global economic stability. This study presents the development and refinement of the BFMEA framework – a scalable, structured tool designed to reduce failure rates among small technology businesses – emphasizing the value of academic-practitioner collaboration in driving sustainable business solutions.

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Findings	This study underscores the value of the eADR methodology in developing innovative, sustainable solutions for small industries through iterative, practitioner-driven artifact design. It also highlights the importance of qualitative analytics and academic-practitioner collaboration in refining the BFMEA framework and enhancing the effectiveness of its worksheet.
Recommendations for Practitioners	This study highlights the essential role of practitioner involvement in applied research and developing practical business tools. The BFMEA worksheet empowers small industries to proactively identify and prioritize potential failure modes using the Risk Priority Index (RPI), enabling targeted mitigations that enhance operational resilience and support long-term sustainability.
Recommendations for Researchers	For applied research to effectively benefit the community, selecting the appropriate research methodology and engaging in relevant businesses, industries, or organizations is essential. The academics-practitioner collaborations ensure the collection of valuable insights that contribute to the refinement and evolution of the solutions.
Impact on Society	Small industries gain significantly by strengthening their growth, sustainability, and resilience while minimizing failure rates. This study supports global economic stability by offering practical insights and solutions that contribute to the long-term success of small businesses.
Future Research	Future research will focus on broadening the implementation of BFMEA across a wider spectrum of companies, investigating its potential to enhance small industry funding criteria through engagement with venture capitalists and business angels, and developing an AI-driven BFMEA application that can be universally adopted by businesses.

Keywords	business resilience, intervention, iteration, eADR, BFMEA, thematic analysis, academic-practitioner collaboration

INTRODUCTION

Globally, small businesses or enterprises are the backbones of both developed and developing economies of the world and play a vital role in driving economic growth (Blankson et al., 2018). However, the persistently high failure rates of small businesses worldwide (World Economic Forum, 2022, November) and in the United States (U.S. Bureau of Labor Statistics, 2020; Appendix A) have been a significant concern for decades. According to the U.S. Small Business Administration (SBA), there were 33.2 million small businesses in the U.S., representing 99.9% of all businesses. These businesses contributed 63% of all new jobs between 1995 and 2021. On a global scale, micro, small, and medium enterprises (MSME) accounted for approximately 90% of all businesses, per the International Financial Corporation (IFC). Furthermore, the World Economic Forum (WEF) reported that SMEs were responsible for 70% of job creation (World Economic Forum, 2022, November). According to WEF, 67% of SMEs worldwide struggle for survival despite their critical role. Addressing the high failure rates of small businesses requires a comprehensive approach that considers the diverse factors contributing to business failures. A small business, characterized by its workforce size or annual revenue, refers to one with fewer than 250 employees (Hait, 2021). While business failures impact all small enterprises, this research specifically focused on small technology businesses (STBs), which account for approximately 35% of small enterprises and operate within the technology sector. STBs specialize in developing, producing, and delivering technology-related products, services, and solutions, making sustainability crucial to broader economic stability and growth.

This study underscores the critical role of practitioner interventions in refining an artifact through academic-practitioner collaboration. By employing a rigorous iterative process, the research developed a holistic framework to reduce business failure rates and enhance sustainability. The researcher introduced Business Failure Mode and Effects Analysis (BFMEA), adapting principles from the product development risk analysis tool, Failure Mode and Effects Analysis (FMEA) (Dziuba et al., 2021; Hatty & Owens, 1994; Ravi Sankar & Prabhu, 2001; Stamatis, 2003). Small technology enterprises, representing a key segment of the small business sector, actively participated in the iterative evolution of the BFMEA artifact. The elaborated action design research (eADR) methodology (Gregor & Hevner, 2013; Hevner et al., 2004; Sein et al., 2011) supported an incremental, iterative approach to refining the artifact in collaboration with business practitioners. As an artifact (worksheet), the evolved business solution underwent multiple improvement cycles within the eADR framework, demonstrating its practical applicability. Academic peer reviews provided critical theoretical insights during the diagnosis and design phases, while implementation feedback from business practitioners led to incremental refinements and the continuous evolution of the artifact. The qualitative data collected through interviews and surveys were analyzed to enhance the capabilities of the BFMEA worksheet (Appendix D). These interventions and iterations solidified the design principles underpinning BFMEA, establishing a robust foundation for its business application. This study was a byproduct of the ongoing investigations into addressing the short lifespan of STBs (K. Nair, 2024; K. R. Nair, 2024). It illustrated how the researcher utilized feedback from business practitioners to intervene and evolve the BFMEA utility, developing it as an effective construct to potentially reduce small business failures (K. R. Nair, 2024). Initial implementation of BFMEA in select businesses – AI-based healthcare, professional, and IT services – yielded promising results, reinforcing its potential as a structured solution for mitigating failure rates and improving small business resilience.

The following section outlines the elaborated Action Design Research (eADR) methodology, including selecting academic and practitioner resources and the data collection methods employed in this study. Thereafter, a brief overview of the planning process for the eADR study highlights the critical role of interventions. Subsequently, the BFMEA framework is summarized, followed by a detailed description of the interventional process. The conclusion presents key findings and outlines directions for future research and implementation.

METHODOLOGY

The primary objective of this research was to develop a viable solution for reducing the failure rates among small technology enterprises or businesses. Recognizing the necessity of an iterative approach, the researcher collaborated with academics and industry practitioners to refine the solution incrementally. It was also determined that the solution needed to be proactive rather than reactive to ensure business success. Based on consultations with faculty and DBA alumni, the elaborated action design research (eADR) methodology was selected as the framework for developing the business failure modes and effects analysis (BFMEA). The eADR framework (Appendix B, Figure 3) consisted of four stages, each comprising five unique, detailed cycles of activities (Buys, 2024, pp. 17-32; Mullarkey & Hevner, 2019), and the researcher has documented the specifics of eADR applied to evolve BFMEA (K. R. Nair, 2024). This methodology allows for multiple iterations, ensuring comprehension and capturing context-specific knowledge going back and forth among stages. The researcher identified several STBs interested in implementing the artifact within their operations. The researcher worked closely with them to introduce the foundational principles of BFMEA and familiarize the initial version of the worksheet. The STBs were then guided to apply the worksheet by documenting potential business failure events or modes, and their feedback was systematically collected and integrated into iterative improvements. This iterative process continued until the BFMEA principles were baselined and an effective worksheet had evolved. The study used qualitative interviews and surveys as the primary data collection method. These approaches were particularly valuable for capturing entrepreneurs' emotional and contextual insights, providing direct feedback on the artifact's effectiveness and critical input on social dynamics, relationships, emerging patterns, and subjective

experiences. This rich qualitative data enabled the researcher to infer meaningful insights, refine the BFMEA framework, and enhance both its theoretical foundation and practical application.

PLANNING

Extensive planning was a critical component of academic-practitioner eADR research studies. The researcher proactively identified potential challenges, such as researcher-practitioner conflicts (K. R. Nair, 2024), and formulated risk mitigation strategies. The planning process included outlining the sequence of activities required before data collection, such as determining data collection methods, identifying modes of data analysis, and establishing strategies for capturing implicit content for enhancing the artifact. Additionally, plans were created to ensure that relevant information gathered during the process was systematically applied to iterate and evolve the artifact.

Planning to identify and engage academic experts and business owners was equally crucial for successfully executing academic-practitioner collaboration studies. The researcher developed a comprehensive plan to engage these stakeholders effectively and proactively devised a backup plan to address potential challenges or unforeseen adversities.

INTERVENTIONS

Interventions played a crucial role in refining the artifact. This feedback from experts in the field and business practitioners helped align it with real-world needs. In this study, it was an optimized worksheet to reduce the failure rates of small technology businesses. Some of the important advantages of interventions include:

- The artifact was verified and validated in a real-world business environment, enabling the validation that the underlying concepts and assumptions of building BFMEA hold in this environment.
- Feedback from academics and practitioners ensured that their concerns, questions regarding complexity, and suggestions, such as including a fully explained simple failure mode example with all fields completed in the worksheet. This feedback also helped refine elements such as the calculation of the risk priority index for each failure mode and addressed challenges faced during initial implementations.
- Data collection during interventions highlighted the strengths and weaknesses of both the BFMEA theory and the artifact. Opportunities for improvement were identified, revealing limitations in initial and subsequent designs and offering ways to enhance the worksheet's functionality.
- Continuous improvements through iterations ensured that the BFMEA theory and the worksheet systematically evolved, enhancing the worksheet's adaptability and resilience.
- It was evident that the interventions in such research studies bridged the gap between academics and industry needs, facilitating the development of a sound theoretical foundation while addressing practical challenges.

The researcher-practitioner-driven iterative intervention cycle applied in this study is shown in Figure 4 (Appendix C).

BFMEA

The business failure modes and effects analysis (BFMEA) artifact was a worksheet with columns representing critical business components, including business failure modes, the effects of the potential failures, and the causes for those failures. Failure mode refers to how something can fail to perform its intended function. It includes functional, performance, structural, safety, process, or systemic failure modes. Business risks and challenges vary by country (country risk) due to differences in

regulations, labor markets, and economic conditions. These could be factored in when identifying potential enterprise failures. The possible effects of each failure mode were calculated in USD or regional currencies as financial impact for each failure and represented as the severity index (SI). The non-financial impacts represented as valuation (V) and detectability (D) of any such failures were ranked on a scale of 1 to 10 (K. R. Nair, 2024). The descriptions of these parameters and how they were calculated for each business were described in K. R. Nair (2024), and the worksheet was built as a self-explanatory artifact. The interventional feedback extracted by the researcher was mapped to these critical business parameters, which defined the BFMEA process for the small technology business (STB) domain. Generating the three critical business parameters of SI, V, and D was essential, as these defined the Risk Priority Index (RPI), calculated as the product of (SI, V, and D) for each identified failure mode. This calculation allowed risks associated with potential business failure causes to be prioritized. The top 20%, determined using the Pareto principle (Oehmen et al., 2006), were addressed to reduce, mitigate, or eliminate their effects.

This study served as an example in several ways:

- It provided an example of how risk assessment tools from one domain can be adapted for business applications.
- It demonstrated an eADR exemplar for creating a theoretical framework and a business artifact by iterating through the relevant stages.
- It introduced a unifying theory and a holistic approach to addressing potential business failures and improving sustainability.

INTERVENTIONAL PROCESS

The data collected through unstructured interviews required detailed analysis to extract relevant intervention specifics and apply them to iteratively refine the stages, thereby enhancing the artifact's effectiveness. The qualitative data provided valuable insights for improving the theory and the artifact while highlighting potential enhancements for the worksheet. Furthermore, the data facilitated deductions of critical information that improved the worksheet's alignment with the social realities of business. It revealed patterns of human behavior and underlying motivations, emphasizing the need to tailor the artifact for greater effectiveness and applicability. Before the interviews, the researcher, who also served as the interviewer, presented the BFMEA theory and artifact details to the interview participants. The interviewer carefully designed the questions and formulated the probing follow-up queries to uncover the participants' thought processes and reasoning behind their responses.

After the business practitioners implemented the worksheet in their organization, the researcher designed a qualitative survey with 30 questions to validate its usability (Nielsen, 2012). The survey aimed to assess various aspects of user experience, a critical factor in determining the artifact's effectiveness and guiding its incremental improvements. Usability was defined by five key quality components: *ease of learning, efficiency, memorability, error correction, and satisfaction*. The survey included questions designed to stimulate the business owners' thought processes, focusing on these themes. It also addressed the relevance of the BFMEA worksheet within their business environments and sought suggestions for improvements in content and flow. The qualitative survey, featuring open-ended questions, served as a tool to gather detailed insights into the practitioners' experiences with the BFMEA worksheet. This feedback provided valuable opportunities for refining and enhancing the artifact's functionality and usability. Appendix G lists some sample questions from the interview and survey.

Some of the key strengths include:

a) *"Calculating the financial impact as a factor to quantify a failure mode is a constructive approach, and quantifying it in a currency will resonate with entrepreneurs."*

Some of the top weaknesses reported were:

b) *"Some of the impacts may not be immediate or may not be immediately apparent, but how does that translate into financial impact? For example, if a business owner loses key personnel or a key person leaves and goes to a competitor. Those are real risks to a small business and have a financial impact, but they are hard to quantify."*

Some of the opportunities raised were:

c) *"Create an example worksheet with clear directions on how to execute BFMEA."* Subsequently, this helped the researcher to create the instructions to complete the worksheet without the help of a detailed Execution Guidelines document. The instructions were refined and incorporated into the worksheet based on further feedback.

d) *"Generate continued focus on the psychology and communication elements that will lead to this being welcomed and adopted. Understanding the psychology of business clients is essential."* This feedback helped create a communication strategy for presenting the BFMEA theory and worksheet to the business owner(s), which impacted and resulted in their whole mindset and cooperation in the evaluation efforts.

A few more are detailed in the next section. All important and relevant key strengths, weaknesses, and opportunities identified were documented (K. R. Nair, 2024) as the research progressed.

INTERVENTIONAL CODES

The researcher explored how to identify the proper interventional "codes" in qualitative data that could support the iterative refinement of the artifact. The researcher selected *thematic analysis* – a method for identifying themes in qualitative data – as a strategic approach. Thematic analysis is an ideal approach to research for analyzing feedback, experiences, and intrinsic knowledge. The analysis process incorporated the primary research questions, goals, conceptual framework, and insights from the literature review (Saldana, 2016). Theming required an intensive effort, involving careful reflection on participants' interpretations to detect underlying concepts and their interrelationships. Thematic analysis was used to categorize patterns of meaning across the dataset, answering the research questions (Jnanathapaswi, 2021) and focusing on implicit and explicit ideas. As a meta-synthesis, the researcher identified thematic narratives and assertions within the data to uncover recurring patterns of *strengths*, *weaknesses*, and *opportunities* for improving the BFMEA theory and artifact. The data, transcribed using Otter.ai, was then analyzed qualitatively using two approaches.

- The *manual* thematic analysis identified key themes: strengths, weaknesses, and opportunities. The researcher meticulously examined the unstructured interview data for words, phrases, or sentences that effectively conveyed these identified themes and their patterns. The researcher also looked for cognitive meanings and emotional feelings that expressed the themes. This analysis aimed to uncover content and gather suggestions for refining the BFMEA principles and improving the artifact. The categories were identified as strengths, weaknesses, and opportunities. Example data for strength, weakness, and opportunity are given below.
    - "*There were no constructs, like BFMEA, where risk prioritization was a necessary component … BFMEA is an innovative/novel approach as it is a structured way to examine a set of potential business problems and prioritize them for action … It is a comprehensive tool to holistically look at a startup/small business, and it contributes to the prevention of catastrophic failures … It has business value as it would provide a methodical way to capture our thoughts, analyze the risks, and prioritize the mitigations (which are valuable to any company) … The worksheet is a checklist, and it provides more certainty in an uncertain business environment and increases the probability of success …*"
    - "*How can we prevent potentially incomplete analysis because SMEs or dominant personalities in an organization might have input bias? Different people within each organization may want to focus on one thing or another. Some may have a bias toward their functional area. These behaviors could deviate and*

cause a loss of focus on addressing the vital failure modes. There could be subjectivity around SI, V, and D calculations …"

- "*Not all technology firms are the same; we have different characters, personalities, and leadership styles. Based on the leadership style, there are different ways to implement BFMEA. Some leaders are bureaucratic and autocratic; others are like coaches, inspiring people to make the right choices. The researcher needs to account for such behaviors while recommending an implementation model. Depending on the employee's personality, there will be more effective ways to encourage people to use it. Also, business models and cultures vary from one technology business to another; BFMEA implementation should consider that …*"

- *Coding* using qualitative data analysis software Quirkos: a code is a word, phrase, or short sentence that symbolically represents a summative, salient, essence-capturing, or evocative attribute (Saldana, 2016) in a portion of a transcribed text. The First-cycle (Initial and Concept) and Second-cycle (Pattern) coding (Appendix E, Figure 5) were performed. Initial coding was open coding; it separated qualitative data into discrete parts and compared them for similarities and differences (Saldana, 2016; Strauss & Corbin, 1998). Concept coding assigns a concept category or a broader scheme for the codes. First-cycle coding thus summarized segments of data. Pattern coding further summarized themes or concepts (Saldana, 2016). Appendix F, Figure 6 illustrates the coding process. Codes are compared to each other to determine possible relationships based on their patterning, producing generalizations or categories. Combining categories gives rise to more comprehensive generalities called concepts (Saldana, 2016). Categories, derived inductively from the data, provide a holistic and factual description of the phenomena under study, generating new theoretical and conceptual ideas (Eriksson & Kovalainen, 2008). Two high-level themes below illustrated the example codes – words, phrases, sentences - that explicitly or implicitly conveyed themes.

  - Innovative and structured approach: "*really innovative*," "*methodological*," "*unique in systematically identifying and create actions*," "*gut instincts vs methodological approach*," "*methodical way to examine, methodical way to capture our thoughts*," "*drive business owners to think out of the box*," "*innovate your approach, so that we can create a climate that helps the business grow*," "*creates an awareness of organization's viability*," "*BFMEA gets people thinking, novel, unique approach*," "*companies will become deliberate and structured*," "*they start to come up with good ideas as opposed to people sitting around looking at each other*."
  - Employee empowerment, engagement, and cultural change: *"tool is a way to work smarter, harder," "the unknown is scary to the lenders within the industry and the employees who take risks to achieve that goal," "some entrepreneurs who had number successes focus more on the strength and opportunities and not pay attention to the weaknesses and threats - but other in the organization will be able to realize the mistakes using this tool," "they start to come up with good ideas as opposed to people sitting around looking at each other"*

These codes were systematically categorized, leading to the identification of key themes. Collectively, these themes provided a structured basis for validating the research propositions (K. Nair, 2024; K. R. Nair, 2024).

CONCLUSIONS

This research developed a practical utility to enhance the growth and stability of small technology enterprises or STBs. The initial implementation phase introduced an artifact (worksheet) that showed significant promise by the business owners. The future implementation phase will expand its application to a broader range of small technology enterprises and other small business sectors, such as restaurants and hospitality. This study underscored the critical importance of academic-practitioner collaboration in addressing real-world challenges, such as the high failure rates of small businesses. As the initial step, this study focused on a subset of the small business sector: the small technology

enterprises. The primary research objective was to create a solution to reduce business failure rates, and the subsequent focus was to identify and establish optimal BFMEA parameters that could contribute to calculating risk priority indices (RPIs). These steps established a structured approach for prioritizing and mitigating the top 20% of business failure causes, promising business resilience.

The iterative development of the BFMEA artifact demonstrated the value of multidisciplinary research (involving academics, engineering, quality, industry experts, and enterprise owners, to list a few) and feedback-driven interventions in creating a robust, practical tool for risk prioritization and mitigation. Manual analysis of interview data revealed strengths and weaknesses in the theory and worksheet, entailing iterative improvements. Qualitative data collected through interviews and surveys provided critical feedback for refining the BFMEA theory and artifact. The elaborated action design research (eADR) methodology offered a structured framework to bridge theoretical rigor with practical application, enabling the BFMEA worksheet's evolution to effectively address the needs of STBs. The artifact's baseline design was established as a reference for larger implementations, with plans to expand its use to hundreds of STBs and other small business segments. The BFMEA theory and artifact developed for STBs demonstrated potential for scalability to different segments (for example, food industry, manufacturing, and hospitality) within the small business domain but requires further research. The researcher highlighted and shared unique learning experiences with the research community, offering valuable insights into the feedback-intervention-iteration process.

Throughout the study, the researcher made several strategic decisions to achieve meaningful results and navigate challenges, ultimately reaching a well-founded conclusion. The researcher formulated plans to expand the validation of BFMEA by incorporating a wider range of STBs and other small business sectors. This expansion lays the groundwork for global implementation, enhancing the framework's applicability and impact.

Beyond its primary objective of reducing small technology enterprise failure rates, practitioners identified additional applications of BFMEA. For instance, venture capitalists (VCs) could leverage BFMEA to assess investment risk levels more effectively. Business owners highlighted its potential opportunity: "*Financial sponsors (venture capitalists) will know how much risk they are entering with their money. They might demand mitigation actions implemented within a timeframe for funding. This encourages VCs and businesses to engage in a healthy conversation about risks and their management.*" Additionally, BFMEA could provide a structured foundation for determining insurance coverage amounts, a factor that is currently assessed without a standardized approach. The Risk Priority Index (RPI) generated by BFMEA could be a key determinant in establishing appropriate insurance limits for startups. Practitioners emphasized this benefit, stating: "*RPI could help determine the insurance coverage amounts for the startups. These insurance limits are critical to obtain as they are a qualifying factor for securing contracts from large companies.*"

Future research will focus on expanding the validation of BFMEA across diverse small global enterprises. Also, plans are to develop an artificial intelligence-powered business application to automate the BFMEA process while integrating traditional business and lean methodologies. This software would enable entrepreneurs to visualize various business scenarios through what-if analysis, providing data-driven insights to identify failure modes. Additionally, the application would feature interactive prompts that systematically guide users through each step of the BFMEA framework, streamlining the process and significantly reducing the time and effort needed for the analysis. Companies should proactively plan for long-term innovative growth by identifying and developing sustainability capabilities, bridging resilience gaps, and integrating these elements into the core foundation of their business strategy.

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APPENDIX A

The U.S. government data is on the economic contributions of small businesses and their failure rates.

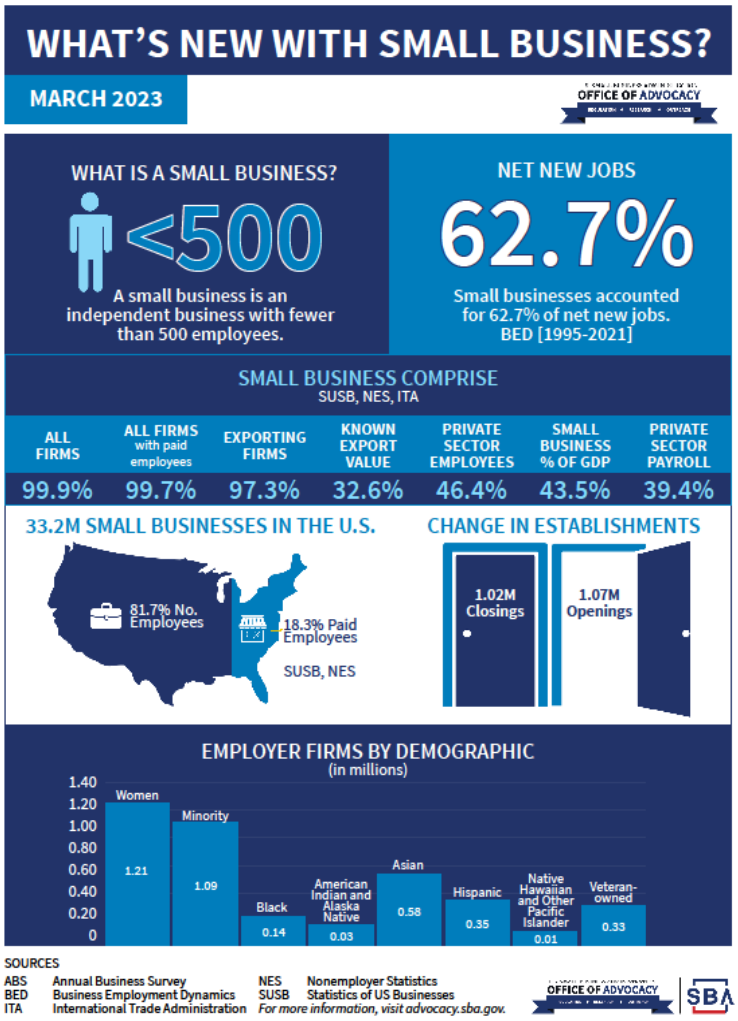

Figure 1. US Small Business Administration data showing the importance of small businesses
(Source: https://advocacy.sba.gov/2023/03/14/whats-new-with-small-business/; copyright permission not required for public domain information per Linking policy | U.S. Small Business Administration, Reproduction of SBA content)

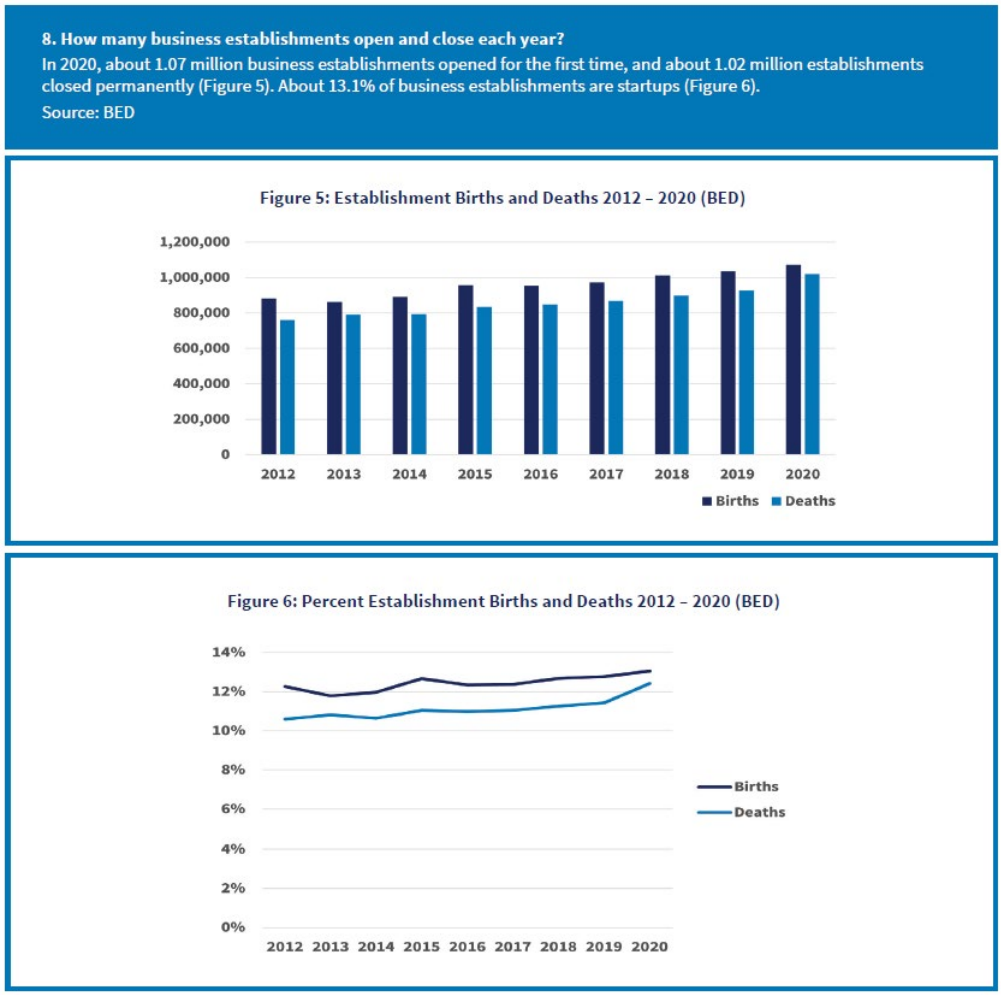

Figure 2. U.S. Department of Labor data showing the short lives of small businesses
(Source: U.S. Bureau of Labor Statistics – copyright permission not required per https://www.bls.gov/opub/copyright-information.htm)

APPENDIX B

ADR Methodology

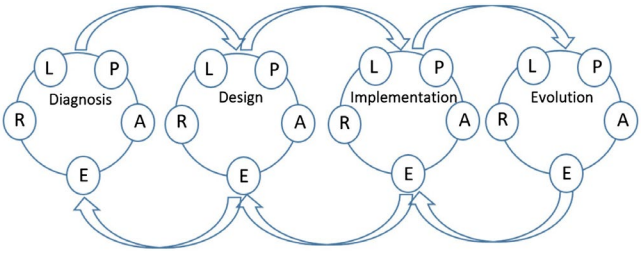

Figure 3. ADR stages
(adapted from Mullarkey and Hevner, 2019, 9)
P: Problem Formulation/Planning, A: Artifact Creation, E: Evaluation, R: Reflection, and L: Learning

APPENDIX C

Researcher-Practitioner driven intervention cycle.

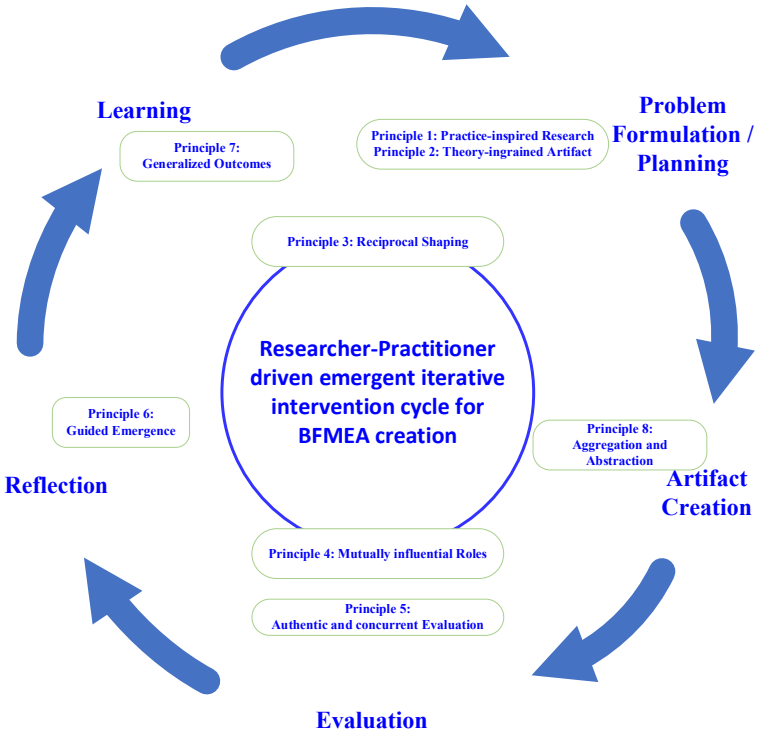

Figure 4. BFMEA artifact creation and intervention cycle
(adapted from Mullarkey and Hevner, 2019)

APPENDIX D

BFMEA worksheet (artifact) with example failure modes and RPI calculations (**Note**: email author for a sample Excel worksheet)

Potential Failure Modes	Potential Failure Categories	Potential Failure Subcategories	Potential Effects of Failure	Financial Impact $	Severity Index (SI)	Potential Causes of Failures	Valuation (V) (Non- financial impacts)	Current Controls to Detect/Prevent Detectability (D)	Risk Priority Index (RPI) - Based on Economic Impact	Actions
Instructions for completing BFMEA worksheet Business Failure Modes and Effects Analysis (BFMEA) is a structured tool for identifying and ranking the significance of various potential failure modes and their effects on a business. It produces a ranked list of Risk Priority Indexes (RPIs). Applying mitigation or corrective actions reduces or eliminates the risks associated with high-priority potential failure modes. This worksheet produces a holistic analysis of the business to improve growth and sustainability.										
Identify and list all potential failure modes. Failure mode refers to **how** something can fail to perform its intended function. It includes functional, performance, structural, safety, process, or systemic failure modes.	Identify the failure category. This categorization helpsnmap the potential failures to the organization's business functions and helps get expert opinions for the complete analysis.	See the example subcategories below.	List all potential effects of each failure mode	(CBA/ROI) (**need only high level estimates**)	Sum up all financial impacts for each failure mode.	List all causes of failure for each one of the identified failure modes.	Ranked from 1 to 10 (For each potential cause, the probability that the cause will occur and it will produce the failure. 1 stands for less impact on valuation (**non-financial impact**), and 10 for the most impact on valuation. Assign a value between (1-10) for each cause and an average for the V for the failure mode. **Important** - if a cause can be related to any effect (col E) and can estimate a financial impact, report it in terms of $ in col F. If it cannot be quantified in terms of $, attribute that cause to calculate V.)	Ranked from 1 to 10 (For each cause or failure mode, determine if any controls are available to prevent or detect that failure. For each control, D is the ability to detect or prevent either the failure mode or the cause. 1 = controls available and 10 = controls not available)	**RPI = SIxVxD**	
decreased productivity	productivity impact	**A**. financial impacts **B**. employee impacts **C**. customer impacts **D**. operational issues **E**. long-term impacts	**A. financial impacts**: a. reduced revenue or ROI b. increased costs c. missed deadlines d. lost opportunities **B. employee impacts:** a. low morale and engagement b. less innovation c. less growth opportunities d. high turnover **C. customer impacts:** a. poor customer service b. customer dissatisfaction c. strained customer relationships **D. operational issues**: a. increased mistakes and rework b. supply chain disruptions c. reduced competitiveness d. lower quality work **E. long-term impacts**: a. reputational damage b. difficulty attracting and retaining talent c. business stagnation d. loss of cutomer trust e. reduced performance	**A** (a=$10K + b=$5K + c=$2K + d=$10K) **B** (b=$2K + d =$3K) **C** - contributes to Valuation (V) **D** (a=2K + b=5K + c=1K + d=10K) **E** (b=2.5K + c=20K + e=3.5K) **Note**: those in **blue** in col. E contribute more towards Valuation (V)	A+B+D+E = $76K	**A. employee factors**: 1. workplace distractions 2. poor time management 3. health issues 4. demotivation 5. work-life imbalance 6. skill mismatch **B. organizational factors**: 7. poor management 8. lack of employee engagement 9. inadequate training and development 10. low morale and job satisfaction 11. poor work environment 12. ineffective communications 13. lack of manufacturing infrastructure 14. disruptive work environment **C. industry challenges**: 15. technology issues 16. bad press due to product issues 17. external factors (economic downturns, changes in market conditions, regulatory challenges, or disruptions in supply chains)	**A** (1 + 2 + 3 + 4 + 5 + 6) **B** (7 + 8 + 9 + 10 + 11 + 12 + 13 + 14) **C** (15 + 16 + 17) **A** (1 = 6 + 2 = 7 + 3 = 4 + 4 = 5 + 5 = 3 + 6 = 7) **B** (7 = 4 + 8 = 6 + 9 = 5 + 10 = 6 + 11 = 5 + 12 = 4+ 13 = 7 + 14 = 8) **C** (15 = 4 + 16 = 5 + 17 = 9) **Avg** = 5.59 ~ 6 **Note**: BFMEA Team determines with these values.	A (1 + 2 + 3 + 4 + 5 + 6) B (7 + 8 + 9 + 10 + 11 + 12 + 13 + 14) C (15 + 16 + 17) A (1 = 6 + 2 = 7 + 3 = **1** + 4 = 7 + 5 = **2** + 6 = **1**) B (7 = 4 + 8 = 7 + 9 = **1** + 10 = **4** + 11 = 5 + 12 = **2** + 13 = **2** + 14 = 6) C (15 = **2** + 16 = **9** + 17 = 3) **Avg** = 4.05 ~ 4 **Note**: BFMEA Team determines with these values.	**RPI** = 76000*6*4 = **1,824,000**	With Col L.'s list of prioritized risk items, take specific actions to mitigate or eliminate the top 20% of potential failures.
difficulty attracting and retaining talent										
disengagement and demotivation										
employees lacking accountability and failing to take initiative										
uncompetitive pricing structure		**A**. financial impacts **B**. company reputation, brand image, and market positioning **C**. client relationships **D**. reduced cleint acquisition and retention **E**. long-term impacts	**A. financial impacts** a. difficulty in attracting new clients b. decreased profit margin c. cash flow problems, (making it difficult to cover operating costs and meet payroll obligations) **B. company reputation, brand image, and market positioning** a. creates a perception of low quality of service with lower pricing b. make it harder for small businesses to compete c. loss of credibility of the small business d. negative reviews online or through word-of-mouth recommendations e. perceived lack of expertise f. difficulty demonstrating value **C. client relationships** a. meeting project goals within low budgets can lead to scope creep and client dissatisfaction b. limitation of resources available to deliver high-quality services c. difficulty attracting top talent d. damage to client relationships **D. reduced client acquisition and retention** a. loss of competitive bids b. difficulty attracting new clients c. increased client turnover d. reduced client base **E. long-term impacts** a. unsustainable business models b. limited growth opportunities.	**A** (b=$5K + c=$10K) **B** (a=$5K + e=$2K + d =$3K) **those marked in blue** - contributes more towards Valuation (V) **C** (a=25K + b=50K + d=75K) **D** (a=25K + b=5K + c=10K + d=10K) **E** (a=2.5K + b=20K) Note: those in **blue** in col. E contribute more toward Valuation (V)	A+B+C+D+E = $247.5K	**A. cost miscalculations**: 1. inaccurate cost analysis 2. not considering all the hidden costs 3. inefficiencies in processes, workflows, or project management **B. pricing strategy shortcomings** 4. relying on intuition or guesswork rather than data-driven analysis 5. not effectively communicating the unique value proposition of your services 6. inflexible pricing structure - one-size-fits-all pricing approach 7. focusing solely on competitor pricing without considering your own value proposition **C. operational inefficiencies** 8. low productivity 9. poor project management can increase overall costs 10. weak negotiation skills 11. lack of pricing expertise **D. external market factors** 12. rapidly changing industry trends, emergence of new competitors 13. clients might be highly price-sensitive or have bargaining power 14. economic downturns	**A** (1 + 2 + 3) **B** (4 + 5 + 6+7) **C** (8 + 9 + 10+11) **D** (12 + 13+14) **A** (1 = 5 + 2 = 7 + 3 = 6) **B** (4 = 8 + 5 = 5 + 6 = 7+7 = 5) **C** (8 = 2 + 9 = 5 + 10 = 4+11 = 5) **D** (12 = 4+ 13=7 +14 = 4) **Avg** = 5.29 **Note**: BFMEA Team determines with these values.	**A** (1 + 2 + 3) **B** (4 + 5 + 6+7) **C** (8 + 9 + 10+11) **D** (12 + 13+14) **A** (1 = 3 + 2 = 7 + 3 = 4) **B** (4 =9 + 5 = 3 + 6 = 2+7 = 6) **C** (8 =2 + 9 = 3 + 10 = 6+11 = 6) **D** (12=5 + 13 = 4 + 14 = 2) **Avg** = 4.43 **Note**: BFMEA Team determines with these values.	**RPI** = 247,500*5.29*4.43 = **5,800,088**	Proactively avoiding becoming uncompetitive due to high labor costs while maintaining the best talent and profitability requires a strategic approach. By implementing these strategies, professional services firms can strike a balance between attracting top talent, maintaining competitive pricing, and ensuring profitability, thereby avoiding the "death spiral" scenarios. Continuous monitoring and updating of these approaches are necessary to maintain growth and sustainability. (Please see the remaining mitigation activities in the Word doc previously provided for "Uncompetitive pricing structure").
high turnover										

APPENDIX E

Qualitative data coding schemes

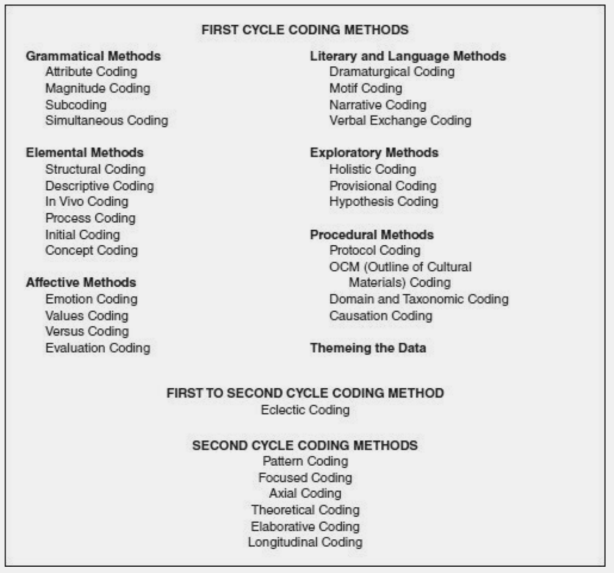

Figure 5: **Coding schemes used**
(adapted from Saldana, 2016, p. 68)

APPENDIX F

Data coding, categorization, and Theme building process.

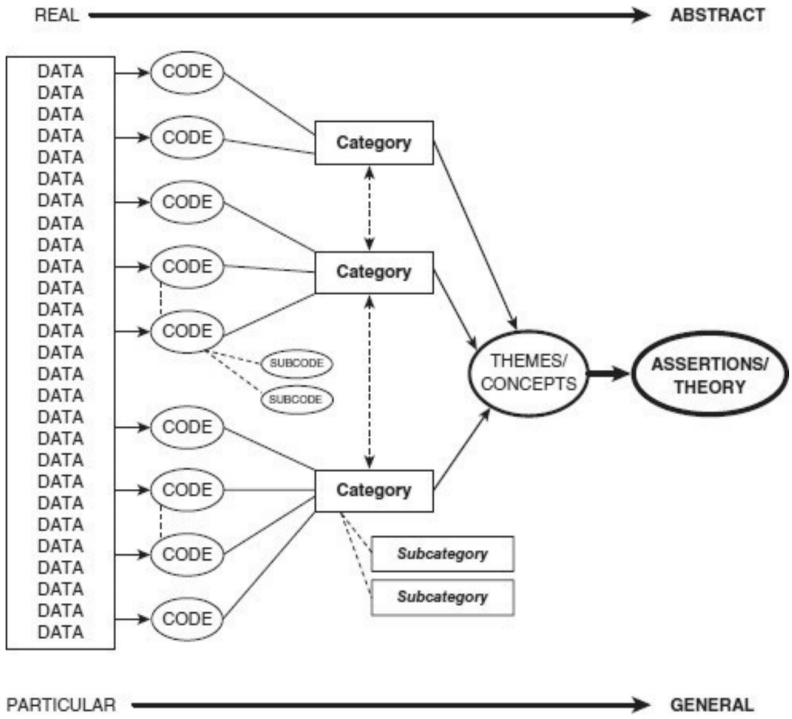

Figure 6. **Coding schemes used**
(adapted from Saldana, 2016, p. 14)

APPENDIX G

Sample questions:

a) *Interviews*
   1. What is your opinion about using failure analysis tools to address and mitigate STB failures?
   2. How do you value the new construct/process – BFMEA – to increase the probability of STB survival? What are the strengths/weaknesses you could observe? How did they enhance the value of the business?
   3. What improvements to BFMEA will enhance the probability of preventing STB failures? Any thoughts to improve the probability?

b) *Surveys*
   1. How relevant is the tool (BFMEA worksheet) to your business?
   2. To what extent did your experience using the BFMEA worksheet help you to make informed business decisions?
   3. How would you rate the use of business parameters – financial impact and business value – in calculating the Risk Priority Index (RPI)?
   4. Did the descriptions in the BFMEA worksheet give you a clear explanation of the purpose of each field? Please list the descriptions that need improvement (if any). What type of improvements do you suggest?

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With over 25 years of experience in the technology industry, Nair has held key roles at Lucent Technologies, Motorola Inc., Motorola Mobility LLC (a Google and Lenovo company), the University of South Florida Information Technology, and Humana Inc. His research and publications span multiple disciplines, including engineering management, artificial intelligence, data engineering, cybersecurity, software modeling, and electronic materials.

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