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Adopting the CATALYST Framework: A sociotechnical approach to business intelligence in agricultural SMEs in developing economies

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Abstract

Small agribusiness SMEs in resource-constrained economies cannot extensively utilize BI decision support systems for they pose barriers. This paper provides a theoretical synthesis for building a sociotechnical framework around the multifaceted challenges and opportunities affecting BI adoption in this context. Building up from sociotechnical systems theory, the Technology-Organization-Environment (TOE) framework, dynamic capabilities framework, and resource-based view, we conceptualize the CATALYST (Context-aware Adaptive Technology Adoption for Limited-resource Yet Sustainable Transformation) framework. The framework focuses on how technological capabilities and organizational preparedness, human and social dynamics, and constraints in the environment interrelate. The CATALYST framework promotes the technical and socio-economic alignment of solutions through an adaptive five-step process consisting of Context Assessment, Alignment Strategy Development, Adaptive Implementation, Learning and Evolution, and Transformation Consolidation, beyond mere digital transformation to inclusive and sustainable transformation. This synthesis extends the innovation adoption theory and digital agriculture frameworks, alongside practical considerations for policymakers and stakeholders through whose endeavors BI might be accomplished throughout developing regions.

Keywords: Business intelligence; Sociotechnical systems; Agribusiness SMEs; Resource-constrained economies; Technology adoption; Digital transformation; CATALYST framework; Developing countries

1. Introduction

With changes in data-driven decision-making happening quickly, BI has become a key element for companies that want to improve their competitiveness, run their operations efficiently and react effectively to markets. BI combines technology, processes and different procedures to turn raw information into helpful insights that make decisions at different levels easier. In advanced economies, there is now a smooth fit between BI and enterprise architecture, due to strong investment in infrastructure, training and frameworks for governance. Even so, many SMEs in agribusiness in developing regions still find it tough to start and use BI effectively.

In developing countries, Agribusiness SMEs are fundamental to social and economic life. These businesses give work to a big share of the population and are significant to both the country's food supply and the export industry. Many villagers are employed in farming, processing, shipping and advertising; this puts them squarely in the center of developing rural areas. Although agribusiness SMEs are very important, they often have little access to resources. Such constraints are reduced financial resources, a lack of advanced technological tools and inadequate numbers of skilled workers—all of which keep them from using BI effectively.

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The intersecting constraints coupled with an urgent need to foster a capacity for improved decision-making have, therefore, carpeted a niche inside technological literature for a more nuanced conceptual approach to BI adoption, wherein the social and technical aspects must be given equal weight in organizational change. Traditionally, the perspective usually taken toward the adoption of a new technology in such settings has been technical, emphasizing the deployment of infrastructure and software systems. However, these approaches often neglect the human, cultural, and organizational factors that can be equally critical in the success or failure of BI endeavors. Hence, this brings to the fore the relevance of a sociotechnical approach that calls for a more integrative framework in which social systems of people, structures, and norms are reciprocally interrelated along with technological systems.

There is a present void in scientific literature and practice regarding how resource-constrained agribusiness SMEs experience these socio-technical dynamics. The bulk of current BI adoption models are formulated either within the context of big enterprise scale environments or too narrowly focus on technological readiness so that they do not accommodate the peculiar challenges faced by smaller enterprises in emerging markets. There is, therefore, a pressing challenge to characterize and develop frameworks that will be viable in view of theory and applicable in practice to these environments.

The attempt, therefore, is to seek to fill this gap by proposing the CATALYST (Context-aware Adaptive Technology Adoption for Limited-resource Yet Sustainable Transformation) framework-a socio-technical model tailor-made for BI adoption for agribusiness SMEs in developing economies. Ultimately, the idea is to bring into focus and enlighten the socio and technical elements that come into play in either enabling or constraining the smooth integration of BI tools and practices. In that pursuit, the question then evolves: What are critical factors influencing BI adoption? These subfactors include culture, leadership support, user competence, and the adequacy of technological infrastructure. The study also intends to integrate knowledge from established theories, such as the Technology-Organization-Environment (TOE) framework, sociotechnical systems theory, dynamic capabilities framework, and resource-based view, to develop a sound conceptual viewpoint toward which BI adoption in these enterprises could be better understood and nurtured.

From this, a few crucial research questions emerge. Prominent among them is which are the socio technical factors most relevant in influencing the adoption of BI in agribusiness SMEs. In a similar vein is the issue of how resource constraints, especially those related to finance, human resources, and infrastructure, affect the capacities of BI deployment and sustainability. Hence, it is imperative to examine which theoretical models are most explanatory and practically instructive in BI adoption under the given peculiar institutional and environmental context found in developing economies.

With an integrated approach to these dimensions, the study intends to provide an enriching perspective toward the academic discourse on technology adoption, as well as produce pragmatic guidance at the policymaking level, for development agencies, and for SME managers working to apply data-driven strategies in agriculture-based industries.

2. Literature Review

Business Intelligence (BI) has seen many major changes since it was introduced. What began as decision support systems and data warehousing has become a collection of tools, technologies and visual techniques aimed at helping with business decisions. New definitions of BI underline both the technology and the process of gathering, reviewing and delivering information for better results in both regular operations and the company's strategy [1]. While it was often large businesses that adopted BI given their advantage in technical tools and specialists, there has been an increase in SMEs exploring BI, mainly in areas such as agribusiness, where good organization and sound decisions greatly impact both productivity and sustainability.

For SMEs, using BI means handling both opportunities and difficulties that are not the same as what larger companies face. Because many small and medium-sized businesses can't afford an IT department or trained analysts, BI solutions are often too complex for them to put in place. The problem is especially noticeable in agriculture in developing countries, where agribusiness SMEs endure structural shortages, uncertain markets and variable government policies. Even so, BI brings important benefits to those working in agribusiness. BI tools are useful for better predicting crops, improving supply chains and making progress in market access and correctly distributing resources [2]. While there is strong potential for BI to work well in agribusiness, this benefit can be reached by using tactics developed for resource-constrained SMEs.

Getting a clear picture of technology such as BI, in these settings depends on looking at the main characteristics of agribusiness SMEs there. Most of those enterprises are privately owned, often by a family and usually depend little on outside capital. Marketers normally rely on their intuition and past knowledge instead of information from data when

making choices. Additionally, these firms are rarely digital, since most have poor internet access, old computer systems and their workers often lack digital skills. Because of these difficulties, adopting advanced tech is a big challenge for most people [3]. Even so, they make clear that adopting a new ERP includes more than checking the technical preparedness of the company. Implementation of BI is most likely successful when there is support from organizational culture, leadership and when employees interact well at work and with the community.

This idea is given support by the Sociotechnical Systems (STS) theory, which provides some good ways of looking at how technologies get used. The main underpinnings with STS theory-were developed by Trist & Bamforth (1951) and Emery & Trist (1965)-that organizational effectiveness is a matter of social-technical matching in the system through joint optimization, that is, where one subsystem cannot be optimized independently from the other. STSs stress that the adoption of a technology occurs as a result of people, companies, job tasks and devices collectively working together. The theory works well in the case of agribusiness SMEs, where informal linkages, sharing of community knowledge and flexible life strategies are key activities in daily life. STS further put forth the idea that when using BI tools, it is necessary to use appropriate strategies suited to the users and their environment.

For the purpose of enhancing the theoretical framework for analysis in this research, several proven models of technology adoption are also considered. First, the TOE framework (Tornatzky & Fleischer, 1990) is considered a classical framework for examining the adoption decision from an assessment-based point of view: Technological, Organizational, and Environmental. From this point of view, it is very imperative to understand how external pressures influence internal workmanship with respect to technology adoption. The Dynamic Capabilities Framework, which was elucidated by Teece et al. (1997) and Eisenhardt & Martin (2000), allows one to understand how companies reconfigure resources in an environment of change through their sensing, seizing, and reconfiguring capabilities. The Resource-Based View (RBV) was developed by Wernerfelt (1984) and Barney (1991) and explains how firms use their internal resources and capabilities to capture competitive advantage, thus particularly relevant to resource-constrained environments as expounded by Prahalad & Hart (2002) and frugal innovation literature by Radjou & Prabhu (2015).

In general, the DOI theory observes and analyzes how innovation undergoes change during given time intervals within a social system while accounting for certain dimensions: attributes of innovation, communication channels, and types of adopters. The UTAUT further specifies the distinctions with regard to performance expectancy, effort expectancy, social influence, and facilitating conditions [4]. Institutional Theory, as stated in DiMaggio & Powell (1983) and Oliver (1997), explains how the adoption behavior is forced through coercive, mimetic, and normative pressures--the institutional environment.

Bringing these traditional perspectives together allows for a more holistic comprehension of BI adoption in agribusiness SMEs. Each model offers an insight or two but none fully grasps the complex mesh of social, technical, and lurking contextual forces that typically characterize an adoption setting in the resource-constrained environment. For example, TOE and RBV, focusing on firm-level readiness and capabilities, may give less importance to the social forces influencing user behavior. Conversely, such theories as STS and Institutional deemphasize those social forces but may not sufficiently include strategic and competitive issues in the actual use of technology. Hence, this study offers an integrative model that merges the strengths of these specified models to overcome the identified weaknesses. By rooting the analysis in a sociotechnical perspective, the research endeavors to propose a nuanced, context-dependent framework for steering effective BI adoption in agribusiness SMEs in emerging economies [5].

3. The CATALYST Framework Development

The systems perspective takes into consideration both the environment and the internal character of the organization so that the correct combination of research insights and real-world operating conditions can be developed for the BI adoption procedure among agribusiness SMEs in resource-constrained economies. Systems theory posits the CATALYST (Context-aware Adaptive Technology Adoption for Limited-resource Yet Sustainable Transformation) framework, deriving from a systematic synthesis of the existing literature, complementarily supported by other theoretical perspectives.

4. Core Theoretical Foundations

CATALYST is developed largely out of Sociotechnical Systems Theory, which presupposes that an adoption of technology needs to align both social and technical subsystems through joint optimization. While the technical subsystem refers to the BI tools, infrastructure, and data systems, the social subsystem encompasses people, relationships, culture, and practices. Supplemented by three other theoretical frameworks, the base is well grounded:

the TOE framework provides a three-contextual analysis of adoption decision; Dynamic Capabilities elucidate how resource reconfiguration abilities work; and the Resource-Based View looks into how internal resources create a competitive advantage, despite constraints.

5. Framework Dimensions

The CATALYST framework functions through three cardinal dimensions steering the adaptability and capability for business intelligence adoption:

5.1. Dimension 1: Contextual Constraints and Enablers

This dimension deals with context-and environment-specific challenges and opportunities. Financial Resource Dynamics admit the existence of the resource scarcity paradox, where limited resources demand innovations, more efficient solutions, investment through incremental mechanisms, and all SMEs putting their money together to buy resources. Human Capital Considerations recognize digital divide challenges as they simultaneously stress the need to synthesize indigenous knowledge with data analytic techniques and community-based learning processes. From Infrastructure Realities, the focus stays on leveraging leapfrog technology through mobile-first BI solutions, offline-capable systems, for lands with intermittent connectivity, and precedence over shared infrastructure stands.

5.2. Dimension 2: Organizational Adaptation Mechanisms

Cultural Alignment Factors, based on Hofstede (1980) and Straub et al. (2002), look at how cultural orientations of collectivism and individualism, power distance structures or hierarchies, and uncertainty avoidance patterns might impact BI adoption within agricultural communities. Leadership and Governance emphasize transformational leadership for setting the vision, participatory decision-making involving all stakeholders, and wide-ranging approaches to change management. Organizational Learning Capabilities emphasize building absorptive capacity for knowledge sharing and sharing experiential knowledge gained from implementation.

5.3. Dimension 3: Technology-Environment Fit

Based on Rogers (1995) diffusion principles, the BI Tool Characteristics highlight relative advantage against existing approaches, compatibility with present practices, complexity at manageable levels, trialability for experimentation, and observable results. Environmental Pressures further incorporate coercive pressures, such as from regulatory requirements, mimetic pressures, or competitor practices, and normative pressures from professional standards. Market Dynamics delineate competitive intensity needs, volatility management of markets, and supply chain integration requirements.

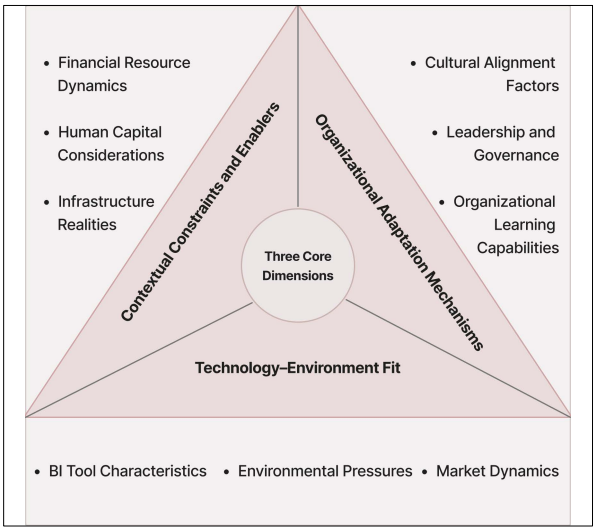

Figure 1 Foundational Dimensions Influencing BI Adoption in Agribusiness SMEs created by the Author using ChatGPT (OpenAI, 2025)

Conceptually, the diagram portrays the three core contextual dimensions—namely, the Contextual Constraints and Enablers, the Organizational Adaptation Mechanisms, and the Technology–Environment Fit—each composed of a set of constructs that shape the extent to which an entity is ready and willing to take on BI adoption.

6. The Five-Phase CATALYST Process

Operationalization of the framework takes place during a dynamic five-step process that serves as a guide for agribusiness SMEs while they embrace adaptive BI:

6.1. Phase 1: Context Assessment

According to Contingency Theory (Lawrence & Lorsch, 1967), organizations consider context factors such as resources at hand and constraints, cultural and societal trends, pressures and opportunities from the external milieu, and technological know-how.

6.2. Phase 2: Alignment Strategy Development

With Strategic Alignment Model (Henderson & Venkatraman, 1993) as its backdrop, SMEs adopt BI into their businesses in such a way as to: align business strategy with BI capabilities; align organizational culture with technology requirements; align resources with scope of implementation; and align timeline with organizational readiness.

6.3. Phase 3: Adaptive Implementation

Adaptivity Structuration Theory (DeSanctis & Poole, 1994), the system provides for the flexible implementation through iterative cycles of technology introduction, feedback and adjustments, slow increases in BI capacity, and learning at each stage.

6.4. Phase 4: Learning and Evolution

Being based on Argyris and Schön's (1978) Organizational Learning Theory, this stage stresses continuous development through single-loop learning for BI tool use improvements, double-loop learning questioning the assumptions in strategies, and deutero learning on learning how to learn BI.

6.5. Phase 5: Transformation Consolidation

As outlined in the Punctuated Equilibrium Model (Gersick, 1991), this phase focuses on stabilizing and institutionalizing BI by embedding it into organizational routines, defining new performance indicators, establishing governance structure, and planning for next transformation cycles.

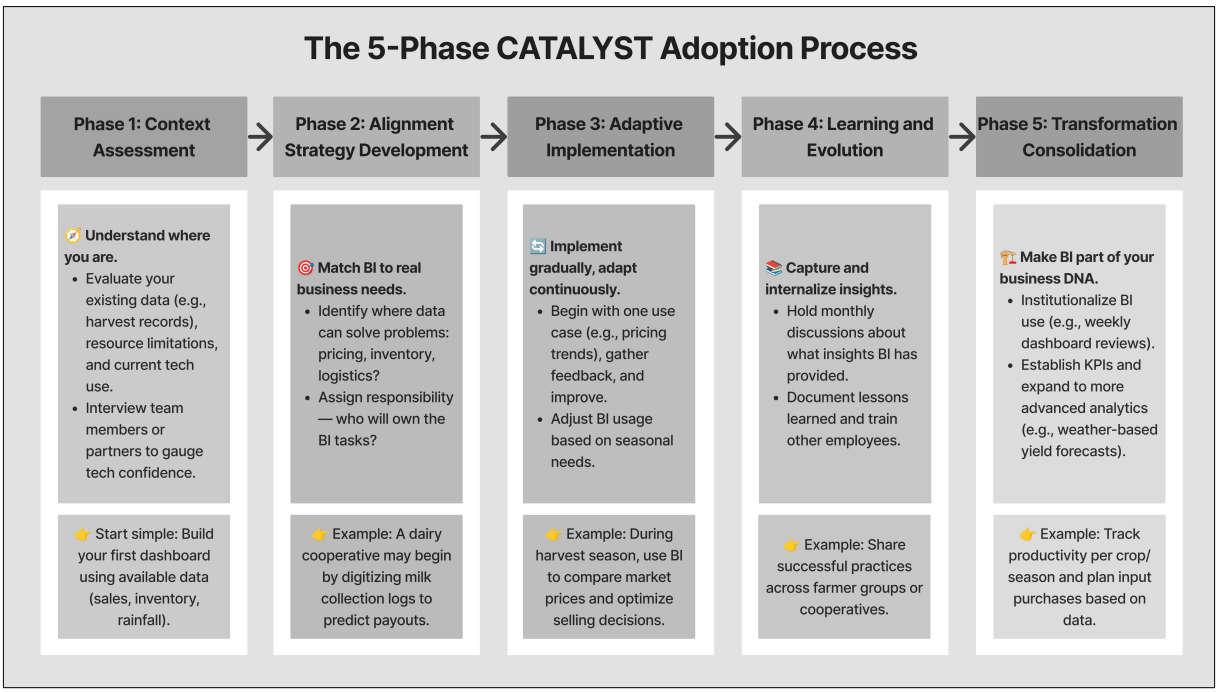

Figure 2 The CATALYST Model: A Five-Phased BI Adoption Process for Resource-Constrained Agribusiness SMEs created by the Author using ChatGPT(OpenAI, 2025)

This flowchart depicts the five adaptive phases Context Assessment, Development of Alignment Strategy, Adaptive Implementation, Learning and Evolution, and Consolidation of Transformation, through which agribusiness SMEs move toward sustainable BI integration.

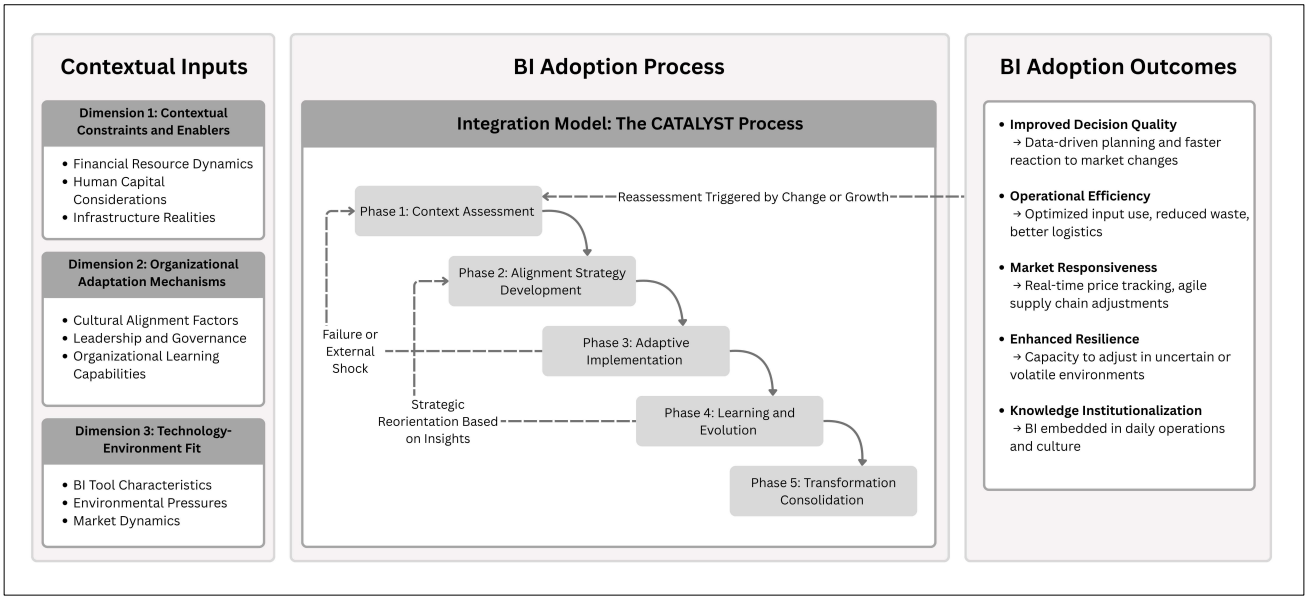

Figure 3 The CATALYST Framework Integrated: Contextual Dimensions, Adaptive Phases and BI Adoption Outcomes created by the Author using ChatGPT(OpenAI, 2025)

The framework thus integrates the contextual dimensions (inputs), CATALYST process (core adoption engine), and BI adoption outcomes (outputs). Feedback loops indicate an additional dynamic and iterative aspect of BI implementations in evolving, resource-constrained realities.

In line with Sociotechnical Systems (STS) theory, the framework aims to explain the interactions between society and technology, supported by attention to the larger environmental factors affecting technological development in these areas.

The key principle of the sociotechnical paradigm is that a technology's impact, including that of BI, depends on both its tools and the way the organization uses them together. Within agribusiness SMEs, the key social areas are commitment from leaders, skills within the team, the work environment and trust among the community. It is important for leadership to influence the plan forward and encourage innovation, mainly where changes are often resisted due to unpredictable risks or earlier setbacks with technology [6]. Lack of access to education and familiarity with technology holds back most people from using BI tools well. What culture exists within the organization also matters—if it allows for innovation, teamwork and data use or if it opposes structure and adapting to new things. Using technology successfully and for a long time is made easier by building trust inside the firm and with outside partners.

Meanwhile, the technical aspects show how well an SME can install and profit from using BI tools. A school being technology ready begins with enough and stable infrastructure like electricity, internet access and computers. BI software has to be efficient, flexible regarding costs and compatible with other systems to help businesses easily move data within the company. It is important that any tool be usable, so designers must think about the needs of users and make sure interfaces are easy to understand and operate for both experts and those less skilled in their field. Because employees at many agricultural businesses handle several tasks at a time, it is important for software to be simple and practical [7].

Having said that, looking at how social and technical parts interact is not enough when you ignore the larger environment that affects these SMEs. Economies that are still developing commonly deal with unsteady economic conditions, disordered policy regulations, poor infrastructure, fewer educational and training offers and weak links to other markets [8]. They can help or block the adoption of business intelligence, greatly shaping how agribusiness SMEs

feel and are able to invest in new data-focused practices. For example, government support—providing digital subsidies, tax breaks or helping industries grow—can encourage more people to adopt these technologies, but without such support, barriers may only get worse. In addition, the quality of nearby roads and internet connection is vital for deciding whether it's possible to use cloud-based BI solutions in these areas [9].

Due to complex dynamics, the CATALYST framework has been developed by synthesizing the basic elements of Sociotechnical Systems theory with some aspects from TOE, Dynamic Capabilities, and the RBV concept, thus thoroughly mapping BI adoption within this special setting. The framework suggests that a great degree of consensus among social agents, advanced skills, environment, and the organization's strategies and capacity for learning are essential for an effective adoption process. It holds the view that leaders' and organizational trust foster user engagement and preparation for change, whereas useful features and the appropriate technology positively influence the adaptive five-phase procedure through its functional operation. Another view is that economic difficulties or governmental regulations may increase or diminish sociotechnical alignment in determining whether organizations acquire these new technologies.

Not only does this observation point out existing needs and specifics, but also the long-term effects, thus emphasizing the need for a changeable, adaptive strategizing process in the digital changes. With all these items combined into a unified framework known as CATALYST, a framework theoretically grounded and created for practical use for organizations in developing countries to actually adopt BI in agribusiness SMEs [10].

7. Literature-Based Propositions for Future Research

The five propositions are key CATALYST framework empirical validation:

- **P1: Contextual Adaptation** - "It is necessary in order for the effectiveness of adoption of BI in agribusiness SMEs with respect to the extent of contextual adaptation of BI solutions to local resource constraints, cultural values, and environmental conditions."
- **P2: Sociotechnical Alignment** - "BI Adoption success within resource-constraint agribusiness SMEs is determined by the synergy between BI technical and social organizational factors, rather than geopolitics."
- **P3: Collective Capability Development** - "Through collective capability development and resource sharing, agribusiness small and medium enterprises in resource-constrained settings will be able to achieve greater BI implementation success than if attempted through ad-hoc efforts of individual enterprises."
- **P4: Incremental Innovation Pathway** - "As environmental pressure faces its restraints of scarcity, the environment is prone to finally diverting the adoption-and-innovation-related approaches of business-interiorizing SMEs in agribusiness."
- **P5: Cultural-Technology Interaction** - "To be valid, a study has to be somewhat general and universal in its approach. However, this study uses culture as an intervening variable between the technical features of BI and the resulting adoption outcomes in agri-communities of developing economies."

8. Research Methodology

For this study, the methodology was chosen to form a framework for BI adoption that matches practical realities in agribusiness SMEs facing resource challenges. Considering the complexity and need for different approaches in the research, the study decided on qualitative and conceptual research design well-suited to synthesizing theory and developing a framework. The approach is to review various sciences and ideas and connect different bits of information to produce new ways of thinking [11]. Such a study is vital because empirical research can be lacking, disconnected or poorly suited to situations like those in developing country agribusiness.

Under this study, the CATALYST framework development followed a systematic literature review protocol as suggested by Webster & Watson (2002) and Kitchenham & Charters (2007). The search strategy included ABI/Inform, ACM Digital Library, IEEE Xplore, and Google Scholar, and keywords such as "business intelligence adoption," "SME technology adoption," "agribusiness information systems," and "developing economy IT" from 1990 to 2024. The selection was limited to peer-reviewed articles in recognized journals pertaining to technology adoption in SMEs or developing economies, especially in the agricultural context, and theoretical contributions to adoption literature.

We use this approach based on the fact that we want to explore new areas in our research. The research is meant to explore how various factors from sociotechnical areas influence BI adoption which is a topic not well explored and exists where information systems, organizational behavior, development studies and agricultural economics overlap. By using

a conceptual methodology, we are able to carefully join knowledge from different fields and examine all aspects, both social and technical, together with their context. This approach works well when exploring the details of technology adoption, as formal data is often not easy to get and the businesses studied often operate informally and are not part of the usual data collection process.

The analysis involved the development of a concept matrix to identify cross-case patterns, theoretical synthesis, and integration, which allowed for the development of the CATALYST framework. Following the Delphi Method (Linstone & Turoff, 1975), expert validation could be reached using 10 to 15 experts from the fields of IS, agribusiness, and development, who would examine and refine the framework for two to three rounds to reach a consensus on the key elements of the framework.

Most of the data we looked at to complete the study comes from secondary resources such as literature, industry studies, policy regulations and relevant case studies. To guarantee that the framework includes both strong theory and real-world use, material is taken from both academic and professional sources. In relevant cases, experts are involved by using methods such as Delphi panels, semi-structured interviews or focus groups that gather feedback from people including BI practitioners, agribusiness owners, development consultants and policy experts. Even though including expert opinions is not always necessary for conceptual studies, it helps validate key points, point out unique problems in each place and show issues that are not included in formal theories.

The results of the study are obtained by blending the data and the theories into groups of similar concepts. The process is to sort and group the main ideas, themes and examples from various sources and then use these groups to shape the proposed sociotechnical framework. The study keeps comparing and responding to these categories, gradually making a model that represents both theory and local relevance [12]. Using this thematic approach, insights are grounded and can be built onto the conceptual framework as the study is repeated and examined further.

The originality of the framework is conceptually validated through theoretical validation, checking logical consistency across integrated theories, literature alignment among existing research findings, and completeness checking of framework coverage. The expert review consists of academic experts in IS, development studies, and agribusiness, practitioner experts in agricultural development and BI implementation, and regional experts from target developing economies. Case study analysis includes the secondary analysis of existing cases for BI adoption in agribusiness, matching between the framework's predicted outcomes and actual observed outcomes, and testing against rival explanations from other alternative frameworks.

In the end, the methodology chosen serves the two-fold purpose of the study: to contribute theoretically by integrating and extending extant models of technology adoption and to provide a practical guide to BI implementation as it exists in the operational reality of agribusiness SMEs in developing economies [13]. By anchoring the framework within a solid conceptual base and validating it with real-world insights, this study intends to bridge the gap between theory and practice in an academically, as well as practically, acceptable manner.

9. Discussion

Developing the final CATALYST framework for BI adoption in bagasse manufacturing enterprises in resource-constrained environments carries significant theoretical and practical implications. Theoretically, CATALYST advances IS research by being the first comprehensive synthesis of STS theory, the TOE framework, Dynamic Capabilities, and the RBV for agribusiness BI adoption-a disciplinary bridging of IS research, development studies, and agricultural economics. Thus, it enriches an ever-growing body of literature calling for contextualized and interdisciplinary approaches towards technology uptake, aside from the conventional large-enterprise emphasis [14]. By insisting on the holistic consideration of social, technical, and contextual aspects through the adaptive process in five phases, the CATALYST framework provides a much more integrated view that fills the void in the literature concerning adoption models for resource-constrained environments as well as questions the universality of adoption models developed in the West. Therefore, this highly contextually enriched theoretical perspective opens major avenues for extending academic comprehension and beckons follow-up research in the further development of STS applied within technology domains.

The CATALYST framework practically provides diagnostic tools for agribusiness SMEs to assess BI readiness and gives guidance on implementation to development organizations. It also offers policy frameworks for governments in their BI promotion programmes. It places an extremely high need for policymakers to prepare a conducive environment that would address both infrastructural deficits and social issues such as leadership development, building trust, and capacity enhancement through the dimension of contextual constraints and enablers [15]. This implies that investments

meant to give only technology provision would not really work unless traceable interventions are put in to build organizational culture along with human capital through the organizational adaptation mechanisms. Regarding agribusiness SME owners and managers, the five-phase CATALYST process acts as a diagnostic measure whereby such actors may identify the internal and external constraints shared in BI adoption and commence plan-making on prioritised interventions. The decision-makers will then design approaches for digital transformation that will increase the chances of sustained use of BI resulting in a better business performance as they come to understand how the technical infrastructure and social readiness interact.

There are some hard limitations that could be drawn for this particular study. First and foremost, there is an overemphasis on theoretical rather than empirical validation. The CATALYST framework is purposefully developed through a synthesis of the literature and supported by secondary data and expert knowledge where suitable; however, its implementation ought to be tested in the field according to the five research propositions proposed here. Because of the very strong theoretical grounding, it has so far never been tested out in the field to 1) assess its performance in various agribusiness settings and 2) identify the possible nuances or variations that arise from context. Another limitation arises from the specificity of the context dealt with, i.e., agribusiness SMEs in developing economies. While the CATALYST framework is indeed designed for this environment, it may struggle with transferability to other sectors or geographic regions without prior adaptation. Whilst such landmarks of contextualization do indeed mark it as relevant, they hence do require ironclad restraint when generalizing and, in turn, call for further refinement in other contexts.

Undoubtedly, there are so many limits to this study; however, it has also created a basis for future research possibilities. Visible therefore is the need for the empirical testing of the CATALYST framework with several agribusiness SMEs in various developing countries through observational and analytical approaches to ascertain the correctness of the five research propositions. This sort of research will prove, improve, and refute the model, uncovering other factors and supplying a strong feedback loop that can enhance theory. A comparative study of the adoption of BI and similar analysis from other sectors, such as that of manufacturing or services, or across economic and culture contexts, will supplement these know-how and help draw the boundaries of the framework. Further longitudinal studies could reveal how the five-phase CATALYST process evolves over time in SMEs, shedding light on sustainability, user adoption, and institutional evolution [16]. Such exploratory trajectories would not only drive the sustenance and more practical amplification of the theory but would also aim at refashioning the framework into a more achievable avenue for the digital transformation of small enterprises worldwide.

10. Conclusion

In this analysis, the CATALYST sociotechnical framework has been considered a pivotal development in meeting challenges and preparing for the opportunities of adoption of BI technology by agribusiness SMEs of resource-constrained economies. Synthesizing insights from the sociotechnical perspectives, TOE, dynamic capabilities framework, and resource-based view and adapting them to the realities of small agribusiness enterprises through a five-phase adaptive process, the study tries to provide greater academic realization, as well as a practical approach, in a traditionally under-explored area. The framework highlights complex interdependencies between the social, including leadership, skills, culture, and trust; and technical, including infrastructure, tools, and usability, elements [17]. Particularly, the CATALYST framework takes into consideration such issues in the larger economic, policy, and infrastructural constraints of the developing regions through its three founding dimensions, thereby offering a holistic view for understanding and facilitating BI adoption.

A major finding of the study when it comes to BI successfully applied is acquiring sociotechnical thinking through the CATALYST model. Joint optimization of social and technical subsystems, contrasted with treating them as separate components, becomes clear in the framework through the five-phase process that views technology as intertwined with people and the ways organizations work rather than some separate answer to problems. This is imperative for agribusiness SMEs as constitutionally their performance is affected by limited resources, informal practices, and culture within which they operate [18]. Using the sociotechnical framework of CATALYST, organizations are therefore able to utilize modern digital technology in an even more contextualized adaptive process.

In essence, this research reiterates that the CATALYST framework strengthens agribusiness SMEs toward operating in environmentally sustainable and efficient manners through structured BI adoption. For companies anywhere, whether faced with shifting markets, threats to climate change, or intensifying competition, it becomes quite necessary that data and insights be utilized through an adaptive five-phase process. A look at BI initiatives from the CATALYST socio-technical perspective will place the stakeholders in such a position that they will be forced to develop and implement strategies that are successful and robust and will, therefore, further the rural development and agricultural value chains

in a healthy manner [19]. The findings assert that there is perhaps a need to propagate the CATALYST framework widely so as to champion development in agriculture and other sectors that are inclusive and responsive to the issues confronted in resource-scarce areas.

Compliance with ethical standards

Disclosure of conflict of interest

We hereby declare that the research presented in this journal/article on "Leveraging Big Data Analytics for Predictive Financial Risk Assessment Using AI Models" has been previously submitted for publication. The study explores the integration of big data analytics and artificial intelligence to enhance the predictive capabilities of financial risk assessment models. The research is conducted with full adherence to ethical standards, and all data utilized in the analysis is sourced from legitimate and reliable channels. We confirm that any conflicts of interest have been disclosed, and all relevant prior works have been properly cited. This work aims to contribute to the advancement of knowledge in the field of financial risk management, showcasing the transformative potential of AI in the financial sector.

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