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Optimizing Operations in Small-Scale Manufacturing Enterprises in Tamil Nadu Through an Enhanced Business Analytics Framework

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ABSTRACT

This study examines the determinants influencing the adoption of business analytics (BA) in small-scale businesses in Tamil Nadu, India. Though SMEs increasingly see the advantages of BA for improved decision-making and operational efficiency, adoption is uneven. Some of the primary impediments are poor technological infrastructure, poor management support, talent acquisition and management issues, environmental factors outside, and a lack of government support. The research points out the special challenges of the Indian situation, where scarce resources and fast-changing market requirements require constant innovation. The research investigates how organizational, technological, and environmental dimensions affect BA implementation, with special focus on the essential roles of management support, workforce skill development, and government programs in achieving successful adoption. A sample size of 221 out of a population of 498 SMEs in Tamil Nadu was chosen for analysis. The results provide significant insights into the drivers and challenges that influence BA adoption for Tamil Nadu's SMEs.

Keywords: Business analytics, infrastructure capability, management challenges, technology adoption, SMEs

INTRODUCTION

Companies today must embrace and implement Business Analytics, or BA, optimally to acquire competitive advantage in the fast-changing business world of today. This is particularly relevant in the case of SMEs, or small and medium-sized enterprises, as they are the backbone of the Indian economy. SMEs, or small and medium-sized enterprises, are increasingly realizing the potential that business analytics holds to convert unstructured data into meaningful knowledge that enhances the operational efficiency and enables more effective decision-making (Atan & Mahmood, 2022).

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Although there are increasing numbers of individuals becoming aware of the benefits of BA, SMEs are yet to utilize these technologies unequally (Bakar et al., 2020)This inequality may be attributed to various organisational factors that help or hinder the effective implementation and usage of BA tools. The extent to which SMEs are able to leverage BA in order to enhance their enterprise depends heavily on aspects such as MS (Management Support), TMC (Talent Management Challenges), EF (Environmental Factors), and TIC (Technological Infrastructure Capabilities).

This study creates and validates a theoretical model that looks at the roles of organisational, environmental, and technological factors (Dubey et al., 2016) in business performance, with innovation capabilities acting as a mediator. The model is based on the TOE framework. According to the study, technological factors like IT infrastructure and information quality have no significant impact on firm performance, but organisational factors—specifically, ACBSA and innovation capabilities—do. (Adzandeh et al., 2024). With increasing focus on big data, companies need to develop the ability of their workforce to manage big data analytics to improve firm performance. While some firms have gained from this ability, others have experienced less than satisfactory outcomes. The effect of big data talent capability on business intelligence infrastructure is examined in this research, which is based on IT capability and knowledge-based literature. Lin et al. (2023) indicates that increased capacity for big data analytics makes a beneficial contribution to business intelligence infrastructures which in turn improves firm finance and marketing performance.

HYPOTHESIS

The research looks to test the following hypothesis:

1. Technical infrastructure capacity does not significantly affect the SME business analytics implementation.
2. Management support is not significant in SME business analytics implementation.
3. Talent development complications are not significant in SME business analytics implementation.
4. Environmental support is not significant in SME business analytics implementation.
5. Government support is not significant in SME business analytics implementation.

DIFFUSION OF INNOVATION THEORY

In 1903, Gabriel Tarde introduced the concept of diffusion in his book ‘The Laws of Imitation’. He proposed that innovations spread through society in a predictable pattern, technology adopters and moving through the population. Ryan and Gross conducted an empirical study of diffusion innovation in 1943. The significant development in diffusion theory came from Everett M Rogers in 1962, who published the book “*Diffusion of*

Innovations" which became the definitive work on the topic. He categorized adopters into five segments: innovators, early adopters, early majority, late majority, and laggards. In the present day, his theory become one of the most used and influential theories in sociology, marketing, and technology adoption (Makhloufi et al., 2023).

Based on this theory, potential adopters evaluate innovations according to their perception and make a decision whether to adopt them or not if they perceive the innovation to possess 1 to 5 traits: RA 'Relative advantage', CLX 'Complexity', CLP 'Compatibility', TRI 'Trialability', OBS 'Observability'. It is description of why and how fast new ideas and technological changes spread throughout societies, touching both individuals and companies (Geetha & Krishna 2025).

This research contributes to the body of knowledge on how entrepreneurial businesses in Jordan apply knowledge management abilities to create new services (Horani et al., 2023). To enable dynamic knowledge capabilities—which impact product and service innovation—it proposes knowledge's infrastructure capability's as a sufficient but not necessary condition. Through establishing the relationship between knowledge management ability and innovation, the empirical findings enlighten us about how the variables affect innovation in Jordanian entrepreneurial firms. The findings indicated that technological and cultural knowledge infrastructure played a greater role in affecting dynamic knowledge capability's compared to structural knowledge infrastructure.

RESEARCH METHODOLOGY

This research used a survey research design to investigate business analytics (BA) adoption among small-scale industries (SMEs) in Tamil Nadu's Madurai district. Using a quantitative approach, the study gathered data on organizational variables and BA applications through a structured questionnaire with two sections: Section A (demographics) and Section B (organizational characteristics and BA usage). The target population includes 498 SMEs, categorized into individual businesses, manufacturing, and leather industries. A sample of 221 SMEs was determined using Taro Yamane's formula and allocated across sectors via Bowley's method: 70 from individual businesses, 78 from manufacturing, and 72 from the leather industries. Systematic random sampling ensured representation. Content and construct validity were established through expert reviews, and reliability was confirmed using SPSS (Cronbach's Alpha). Madurai, a hub of traditional and emerging industries, offered unique setting to study SMEs' challenges and opportunities in adopting BA for operational efficiency and competitiveness.

RESULTS AND DISCUSSION

This section examines data gathered from 221 participants through Google Forms, with 200 (91%) completed responses. Demographics of the participants were age, gender, and

experience. The majority of the age group was 18–24 (37%), followed by 25–34 (26%), and 35–44 (19%). The least represented groups were 45–54 (13%) and 55+ (5%), reflecting a significant percentage of young professionals. Gender distribution was evenwhich 47% men, 48.5% women, and 4.5% others. In terms of experience, 38% had 6–10 years, 22% had 11–15 years, 21% had 0–5 years, 10% had 16–20 years, and 9% had over 21 years, showcasing diverse career stages. The regression analysis used a model summary, ANOVA, and coefficients to assess the relationship between variables influencing business analytics (BA) implementation in Tamil Nadu SMEs. The model summary ($R = .863$, $R^2 = .842$) showed that 84.2% of BA implementation variance was explained by government support, technology infrastructure capability, environmental support, talent management challenges, and management support.

ANOVA results confirmed the model's statistical significance ($F = 45.914$, $p < .001$), indicating a strong fit and significant relationships between predictors and BA implementation. Regression coefficients revealed that the technology infrastructure capability had the highest impact ($B = 1.053$, $p = .005$), followed by management support ($B = .340$, $p = .008$) and government support ($B = .048$, $p = .011$). Talent management ($B = .016$, $p = .004$) and environmental support ($B = .008$, $p = .032$) also influenced the BA implementation. Hypothesis tests confirmed all independent variables significantly affected the BA adoption, with p-values below 0.05.

CONCLUSION

The study on business analytics (BA) implementation in Tamil Nadu's small-scale industries highlighted critical organizational, technological, and environmental factors influencing BA adoption. Key findings indicated that the technological infrastructure, management support, and government aid significantly drived BA adoption, while talent management challenges and environmental support also played vital roles. Management support emerged as a crucial factor, fostering a data-driven culture, providing necessary resources, and ensuring smooth implementation of BA systems. The research emphasized the need for targeted government policies to enhance technological infrastructure and promote BA adoption among SMEs. Addressing talent management challenges through skill development initiatives and providing robust government support can enabled SMEs to harness BA for operational efficiency, innovation, and competitiveness. The study underscored the importance of collaboration between businesses and government entities to create an environment conducive to widespread BA adoption, ultimately driving economic growth and enhancing the competitiveness of Tamil Nadu's small-scale industries.

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