

A Structural Equation Model of Big Data Analytics Capability of Firms Within the Context of Organizational Culture, Agility and Learning Capability

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Abstract:

Organizations continue to invest heavily in big data analytics, yet many struggle to translate these investments into improved organizational culture, learning capability, and agility due to the absence of actionable development frameworks. This study develops and tests a structural equation model to examine organizational culture, agility, and learning capability shape firms' Big Data Analytics Capability (BDAC). Drawing from dynamic capabilities theory and organizational learning perspectives, the model proposes that supportive cultural values, agile structures, and strong learning mechanisms enhance a firm's ability to acquire, process, and utilize big data for strategic decision-making. Using survey data collected from firms across diverse industries, the analysis evaluates both direct and indirect relationships among the constructs. The results indicate that organizational culture and learning capability are significant predictors of BDAC, while agility serves as a mediating mechanism that strengthens the impact of culture and learning on analytics capability. The study contributes to the growing body of research on big data by offering an integrated framework that highlights the complementary role of behavioral, structural, and knowledge-based factors. Practical implications suggest that firms seeking to improve their analytics capacity should invest not only in technology but also in cultivating adaptive cultures, nurturing continuous learning, and enhancing organizational agility.

Keywords— *Big Data Analytics Capability, Organizational Culture, Organizational Agility, Organizational Learning Capability, Dynamic Capabilities*

I. INTRODUCTION

The value of big data analytics in directing organizational decision making has attracted much attention over the past few years. A growing number of firms are accelerating the deployment of their big data analytics initiatives with the aim of developing critical insight that can ultimately provide them with a competitive advantage (Constantiou & Kallinikos, 2015; Mikalef, Krogstie, Pappas & Pavlou, 2020). Organizations continue to invest heavily in big data analytics, yet many struggle to translate these investments into improved organizational culture, learning capability, and agility due to the absence of actionable development frameworks. The new generation of data-driven companies needs to control key resources in order to develop the new data-driven capabilities needed by the organization (Henao-García, Arias-Pérez & Lozada, 2021). For instance, can help companies process the enormous

amounts of available data to identify market opportunities, predict customer needs, and analyze customer purchase decisions (Akter et al., 2016; Mikalef, Pappas, Krogstie & Giannakos, 2018).

Big data analytics capabilities appear to be with significant relationship and a strategic investment that can contribute to organizational agility, especially assisting in the processing of data for knowledge generation that allows a more effective decision making (Côte-Real et al., 2017). While big data analytics capability is widely considered as a game-changing technological advancement in research and business (Davenport, Barth & Bean, 2012), there is ongoing discussion about whether and under what circumstances such technologies may contribute to competitive performance increases (Abbasi, Sarker & Chiang, 2016; Mikalef, Boura, Lekakos & Krogstie, 2019). The study extends existing research by proposing that big data

analytics capability enable firms to generate insight that can help strengthen their dynamic capabilities, which, in turn, positively impact organizational learning capability, organizational culture and agility.

Cognizant of the importance of big data analytics capability, extensive research has been made on this topic to establish correlation between measures. The variables were found to be significant in manner: organizational culture (Reddin, 2011), organizational agility (Wendler and Dresden 2014), organizational learning capability (Jyothibabu, Farooq and Pradhan, 2010) are to be linked with big data analytics capability. The current approaches and frameworks do not give practical instructions on how firms can develop their big data analytics capability. There have also been few attempts of using a performance measurement approach to generate a framework for the development of big data analytics capability within firms. The current state of knowledge with respect to performance management and measurement in firms seems to be also limited to the study of firms from more traditional performance measurement perspectives (Bititci, Garengo, Dörfler & Nudurupati, 2012).

Organizational culture pertains to the beliefs and values of the organization, the beliefs of the staff, and the expected value of their performance that influence their attitudes and behavior (Robbins & Coulter, 2005; Shannon & Estabrooks Carole, 2006; Tsai, 2011). The importance of organizational culture and its correlation with the success of the organization interms of a data driven organization has been stressed by numerous researchers (Azhar, 2003). Hence, it can be deduced that organizational culture is an integrating force that pulls data analytics in the direction desired by management.

Organizational learning capability is one of the organization's strategy to enhance the performance of their employees in order to overcome challenges (Emilisa, 2019) and obtain long-term success when considers data for strategic management (Liao & Wu, 2010). Literature further insinuated that companies need to change and refine their knowledge depending on their environmental conditions, and this may be through the process of organization learning capability (Prieto & Revilla, 2006). Companies must not only establish development-based capabilities and core knowledge, but also strive, adapt data analytics, and incorporate new knowledge, as well as facilitate organizational

learning capability, in order to improve the capabilities and expertise of a beneficial person who can adapt to a changing environment.

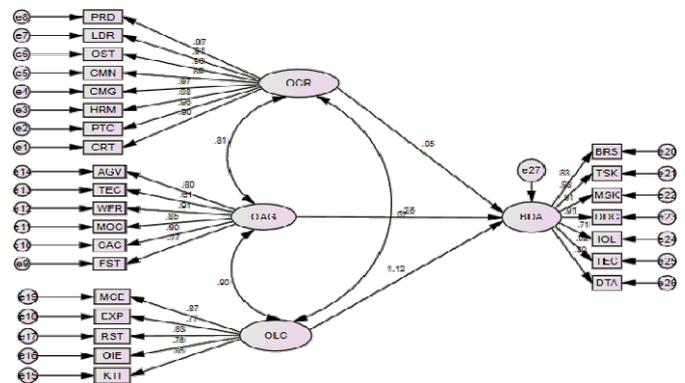


Fig. 1. Conceptual Framework of the Study

In this premise, this study is designed to fill the existing gaps in the entrepreneurship and management context by investigating the structural equation model that best explains big data analytics capability of Davao City firms. More importantly, this undertaking would provide a reference for extensive range of entrepreneurs and organizations in varied conditions. The researcher has not come to a similar study that dealt on conditions of the study in the local setting; therefore, the study generates new knowledge and will be useful on the business organization set up.

The objective of the study is to derive a best fit model that describes data analytics capability among firms in the region. The adoption of data analytics capability will be significantly changing the culture, work system and operation of organizations. Therefore, in literature, it is argued that, to cope with such change with adoption of technologies, organizations need to have a degree of flexibility and agility. Thus, the objective of the current research is to review how the existing data analytics capability perceived by the employees on the different means and practices with respect to organizational culture, organizational agility and organizational learning capability.

The result of this study will guide the owners and managers among Big Business Firms and give

some insights about embedding big data analytics in their operation and making more profit. Also, this study presents through model the importance of big data analytics capabilities in improving the performance and competitive advantage. For business owners, this study will establish an understanding on higher entrepreneurial spirit, optimizing the ability of market analysis, networking with various stakeholders and providing the opportunity for employees to use the authorization decision-making so as to encourage the creation of innovation capabilities that result in increased business performance

II. METHODS

In choosing the respondents, scientific process and stratified sampling were followed. Around 400 owners and managers of different firms in Region XI were the participants in this study. Bagozzi and Yi (2012) assert for sample above 200 is ideal when using Structural Equation Model (SEM). Moreover, SEM deals with large samples to be more effective and to reduce measurement errors (Hair, Ringle, & Sarstedt, 2013). If it is insufficient, the relationship's testability is rejected, and a new model must be generated (Creswell & Garrett, 2008). Thus, securing a sample of 400 is justified and appropriate. On the other hand, non-managers or non-owners were excluded as they cannot truly assess the big data analytics capability of the firm because of the nature of their field of study.

Accordingly, if at any time the participants do not feel comfortable in completing the questionnaire, they are free to withdraw their participation without negatively impacting on their involvement and relationships with the research and the researcher. There is no pressure on those who choose to discontinue answering the questionnaire and explanations are also not required. The data gathering took place from first to second quarter of 2023. The research supports a realism approach as it uses structural equation modelling (Healy & Perry, 2000). The realism paradigm permits building theory and hypotheses through participation of the respondents.

The study conducted in Region XI or the Davao Region. This is in the southern Portion of Mindanao. Davao Region is touted as Mindanao's center for trade and investments, being the home of several

multi-national companies, which opted to establish their hubs and branches in the island region. It comprised of five provinces, these are the Davao de Oro (formerly Compostela Valley), Davao Del Norte, Davao Del Sur, Davao Occidental and Davao Oriental. The respondents of this study are the managers or owners of different firms, particularly, from Davao City, Digos, Mati, Panabo, Samal, and Tagum.

III. RESULTS AND DISCUSSION

The Best Fit Model that Predicts Firm's Big Data Analytics

This section analyzes the interrelationships among the study's latent constructs by comparing the goodness of fit across three structural equation models (SEMs). Each model consists of two key components: the measurement model, which reflects how well observed variables load onto latent constructs, and the structural model, which outlines the hypothesized causal relationships among those constructs. The evaluation of model fit is critical in determining whether to adopt or reject a given model. According to recommended thresholds in SEM (Byrne, 2016; Kline, 2015), the following conditions must be met for a model to be considered a good fit: CMIN/DF should be between 0 and 3, p-value should exceed 0.05, RMSEA must be less than 0.05 (with PClose \geq 0.05), and incremental indices such as NFI, TLI, and CFI should each exceed 0.95.

In accordance with the methodological procedures outlined by Bian (2011) and Schumacker & Lomax (2010), modifications were iteratively applied to improve model parsimony and fit—removing non-significant variables and correlating residuals where justified by theory. The progression from Model 1 through Model 3 demonstrates a data-driven refinement process supported by theoretical consistency, culminating in a model that captures the latent structure and inter-variable dynamics effectively. Therefore, based on the comparative fit indices, Model 3 is accepted as the best-fitting structural model for describing the relationships among organizational culture, agility, learning capability, and big data analytics in MSMEs.

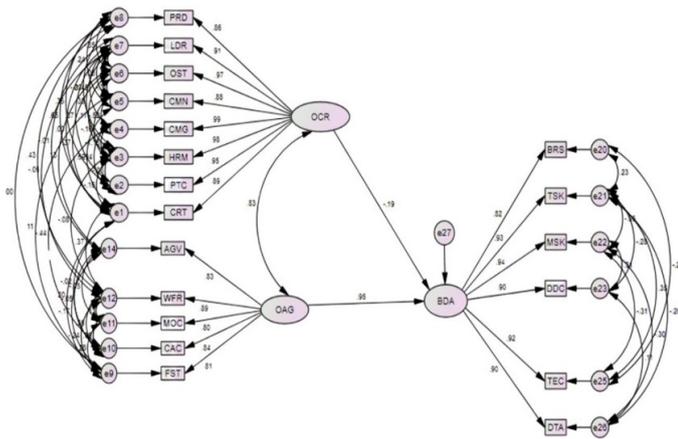


Fig. 2. Structural Model 3 in Standardized Solution

Figure 2 shows the structural model 3 reveals significant insights into the relationships among organizational culture (OCR), organizational agility (OAG), and big data analytics (BDA). The measurement model demonstrates strong reliability, with high factor loadings (mostly above 0.80) across all observed indicators, suggesting that the constructs are well represented by their respective measures. In the structural model, organizational culture exerts a strong positive influence on organizational agility ($\beta = 0.83$), indicating that a supportive, collaborative, and adaptive culture promotes agile behavior and practices. This supports the view of Denning (2018), who emphasized that agile transformation is deeply rooted in cultural adaptability and openness.

Although Organizational Learning Capability (OLC) initially emerged as the most significant predictor of Big Data Analytics Capability ($B = 0.76$, $\beta = 0.732$, $t = 17.599$, $p < .001$), its exclusion from the final structural equation model is theoretically and methodologically justified. In SEM, variables that demonstrate strong bivariate or initial structural effects may become statistically redundant when entered alongside closely related constructs due to multicollinearity, shared variance, or mediating effects (Hair et al., 2019; Kline, 2016). Prior research suggests that organizational learning often functions as an underlying or embedded mechanism within organizational culture and agility rather than as an independent direct predictor, thereby causing its explanatory power to be absorbed by these constructs in a fully specified model (Easterby-Smith & Lyles, 2011; Teece, 2014).

Moreover, SEM refinement emphasizes model parsimony, where paths or constructs that do not significantly improve overall model fit or theoretical clarity are removed to enhance explanatory efficiency and robustness (Byrne, 2016; Hair et al., 2022). Thus, the elimination of OLC in the final model does not diminish its importance but instead indicates that its influence on big data analytics capability is indirect and synergistic, operating through organizational culture and agility rather than as a standalone driver.

IV. CONCLUSION

The findings of the study led to the following conclusions. Among the latent constructs examined, organizational agility emerged as the most influential predictor of big data analytics capabilities, as indicated by its strong direct effect ($\beta = 0.95$) in the structural model. The correlation analysis further revealed significant associations among all variables, with particularly high relationships between organizational learning capability dimensions and big data analytics constructs, supporting the premise that learning-oriented organizations are more likely to adopt data-driven strategies. These results reinforce the dynamic capabilities perspective, wherein the integration of cultural values, agile practices, and organizational learning underpins technological adoption and innovation performance (Teece et al., 2016; Rialti et al., 2020). The final structural equation model met the criteria for a good model fit (CMIN/DF = 0.972; CFI = 0.972; RMSEA = 0.02), confirming the robustness of the hypothesized relationships. Hence, the null hypothesis suggesting no model best fits the relationship among organizational culture, agility, and big data analytics was rejected.

In light of the study's conclusions, several recommendations are presented. First, MSMEs should prioritize enhancing organizational agility, as it has the strongest impact on developing big data analytics capabilities. This includes investing in flexible structures, promoting a culture of experimentation and adaptation, and fostering cross-functional collaboration. Given the indirect effect of culture on analytics through agility, enterprise leaders should cultivate an organizational culture that supports open communication, creativity, and participative decision-making to strengthen their firm's adaptive capacity. Also, capacity-building programs focused on data literacy, technical skills,

and data-driven decision-making should be institutionalized to further support BDA integration. These programs must target both managerial and technical personnel to ensure organization-wide competence in analytics adoption.

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