Data Analysts' Commitment to the Implementation of Big Data Analytics: A Cognitive Appraisal Perspective

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Research-in-Progress

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Abstract

Firms are adopting big data analytics (BDA) systems to obtain and sustain their competitive advantage. However, BDA's real value cannot be realized unless its key executors show commitment to its implementation. Given the critical role of data analysts in this organizational change process, this research-in-progress study investigates the cognitive mechanisms through which data analysts' commitment to BDA implementation is shaped and affected. The study, specifically, draws on the premises of the transactional theory of stress and the literature on the commitment to organizational change and answers to this question that how uncertainties perceived by data analysts during this technological transition impact their commitment to the implementation of BDA through their threat, challenge and control appraisals. Accordingly, a research model is proposed to be tested following an experimental methodology. Finally, the potential contributions and recommendations to theory and practice are also discussed.

Keywords

Big data analytics implementation, commitment to change, perceived uncertainty, cognitive appraisal

Introduction

Firms are adopting new information technologies to obtain and sustain their competitive advantage in the dynamic market environments (Davenport 2006; LaValle et al. 2011; Verma and Bhattacharyya 2017). They use these technologies for divergent purposes, including to improve their capabilities to make informed decisions. Big data analytics (BDA) has become one of the essential tools which enable firms to achieve this goal through capturing and analyzing data sets characterized by their large volume, velocity, and variety (Gandomi and Haider 2015). However, big data technologies' revolutionary nature caused firms to face many challenges in realizing their potential benefits. Surveys show that roughly 85% of big data projects *fail* in the early stages (Asay 2017). A considerable failure rate in which a lack of users' (i.e., data analysts) commitment has been one of the core reasons. Indeed, as a significant source of changes in all firms' major elements (Brown et al. 2011; Galbraith 2014), BDA implementation requires much effort and commitment by its executors. Notwithstanding the critical role of commitment to an organizational change (Hayes 2018; Meyer et al. 2002), however, little attention has been focused on how commitment is affected during the implementation of information systems (IS). Given that, in this study, we attempt to delineate a clear picture of commitment to BDA projects from data analysts' perspective.

According to the survey conducted by "NewVantage Partners," only 37% of senior business and technology executives of the world's largest companies reported their big data initiatives successful (NewVantagePartners 2017). This study's key finding was that the executives insisted on human actors' vital role rather than technology per se. The findings of this study are in line with the stream of research on organizational information-based initiatives like BDA, where humans are located at the center (e.g., Davenport et al. (2012), Marchand and Peppard (2013), and LaValle et al. (2011)). These studies' arguments are based on the fact that, unlike conventional IT projects, information-based initiatives are not restricted to technology deployment, but they also focus on exploring information that humans make valuable (Marchand and Peppard 2013). Of all the human actors contributing to the implementation of BDA are the data analysts whose knowledge and skills are critical in shaping firms' ability to leverage BDA's potential benefits. From the BDA implementation perspective, these analytics experts are mainly supposed to be at the center of organizational decision processes (Galbraith 2014). A significant change in their responsibilities, which, along with other changes to the firms' structure and vision, entails data analysts contributing to this transition process significantly. Commitment is rather crucial in this context as it can predict the extent to which the data analysts are willing to sacrifice and support BDA's implementation in this change process. Daryl Conner (a leader in organizational change) emphasizes the role of commitment in organizational change success and maintains that "commitment is the cement that provides the critical bond between people and the change process." However, there is still a lack of understanding of the mechanisms which impact data analysts' commitments to BDA implementation. In this study, we address this unknown in the literature.

Commitment to an organizational change initiative is a dynamic state affected by an employee's experience during the change process. Specifically, significant changes like BDA implementation can challenge the way things have been done in the workplace and lead data analysts into experiencing endless uncertainties in their relationship with the new situation (Cohen et al. 2013). Data analysts are likely to experience uncertainty concerning various organizational issues, including the rationale behind the change, the implementation process, and the change's expected outcomes (Allen et al. 2007). These uncertainties associated with BDA implementation are workplace stressors that can have divergent impacts on data analysts' work experience, including their commitment. Notwithstanding the extensive research on the relationship between stressors and how they are appraised in different contexts (Armenakis et al. 1999; McHugh 1997), there is a paucity of research on how they shape and impact an individual's commitment to an organizational change. Besides, a large body of research on organizational change has conceptualized commitment as a macro or systems-oriented approach (Judge et al. 1999), neglecting the implications of commitment on a personal level. Moreover, to the knowledge of the authors, there is no empirical research testing the causal relationships between uncertainty, cognitive appraisals, and commitment to change in the context of BDA or other types of information technologies. This identified research gap led us to raise the question of how and to what extent the uncertainty data analysts perceive during the implementation of BDA impacts their commitment to this technological change.

To address this research question, we develop a conceptual model based on the postulates of the transactional theory of stress proposed by Lazarus and Folkman (1984). This theory primarily insists on

cognitive appraisals' role in realizing how a person interprets and copes with a stressful encounter. A central aspect of this theory is that a stimulus can be appraised as a threatening factor or an opportunity. This cognitive duality allows us to analyze both positive and negative mechanisms triggered by change-related uncertainty, a factor often viewed as aversive in prior literature. Accordingly, this study's first research question is how data analysts' perceived uncertainty during the BDA implementation impacts their cognitive appraisals. Another important aspect of this theory is identifying how individuals cope with stressful situations based on the appraisals' results. This aspect brings up the second research question of how the mediating cognitive appraisals impact data analysts' commitment to BDA implementation (the psychological coping response to the change process).

To test the model, we will follow an experimental methodology in which uncertainty will be manipulated to evaluate the data analysts' level of commitment through their cognitive appraisals. We believe that the findings of this study contribute both to theory and practice. This study contributes to the IS implementation body of knowledge by empirically testing a theoretical model focusing on the psychological mechanisms of shaping users' commitment to the implementation process. Besides, this study helps change management practitioners develop appropriate intervention practices to maintain employees' commitment to change initiatives.

Theoretical Background

The Transactional Theory of Stress

In their salient work "Stress: Appraisal and Coping," Lazarus and Folkman (1984) discussed the importance of cognitive processes, vis-à-vis appraisals in realizing how humans interpret stressful situations in a wide range of phenomena. For Lazarus and Folkman, cognitive appraisals are central to the process of understanding how people translate environmental stimuli to suitable coping responses. They specifically identify two cognitive processes, namely primary and secondary appraisals, that concurrently occur in all the human-environment encounters. Whereas the primary appraisal process concerned with the evaluation of what is at stake and the extent to which the stimulus is relevant to one's well-being, the secondary appraisal explores the available coping options, the probability of a specific coping option to fulfill the expectations, and whether the individual can effectively apply the coping options. This theory's second component comes after the cognitive appraisal phase. It focuses on the interactive cognitive processes' outcomes and answers to the question of what coping strategies are suitable to be applied. Folkman (1984) defines coping as "the cognitive and behavioral efforts to master, reduce, or tolerate the internal or external demands that are created by the stressful transaction." The transactional theory suggests that various coping strategies may be utilized due to primary and secondary appraisals' outcomes.

The stimulus-appraisal-coping structure of the transactional theory of stress forms the foundations of our conceptual framework. The transactional theory of stress has been used as a framework to study the causes and influences of cognitive appraisals on users' adaptation to information technology (Bala and Venkatesh 2016; Beaudry and Pinsonneault 2005; Pirkkalainen et al. 2017). However, most information systems adaptation literature analyzes users' interaction with the technology without considering the context. BDA implementation is a source of significant change in all aspects of an organization. Thus, it should not be seen as a human-technology interaction problem without including the impacts of users' implementation process. Therefore, considering the vital role of context-related appraisals in implementing a new information technology like BDA, this study assumes that faced with the uncertainties caused by the implementation process, data analysts go through a similar cognitive process pattern during the BDA implementation.

The Research Model and Hypotheses

This section has proposed a research model to answer the research questions identified in this study (see Figure 1). As shown in the figure, how data analysts appraise uncertainty plays a mediating role in linking data analysts' perception of uncertainty and commitment to BDA implementation. Moreover, data analysts' perceptions of their analytics competence (i.e., domain knowledge and analytical skills) moderate the relationship between job-related uncertainty and the resulting appraisals. Below, the research model and the hypotheses will be explained in more detail.
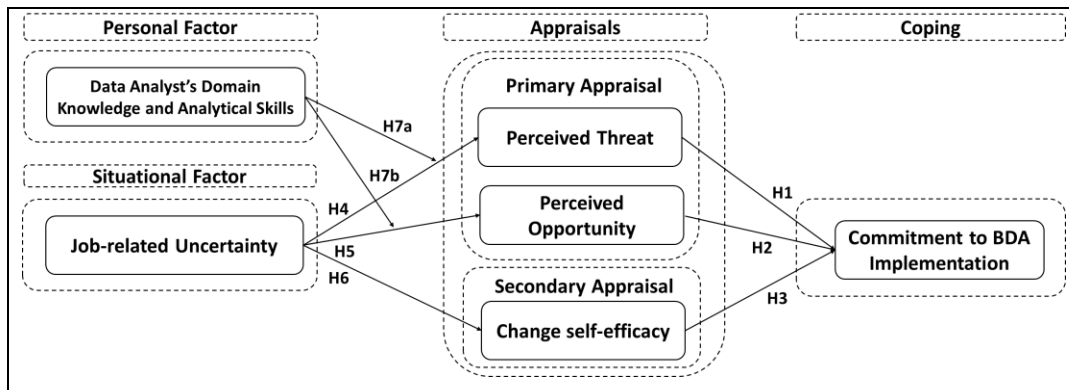
Figure 1. Research Model

Perceived Threat and Opportunity

Harm, threat, and challenge appraisals are the three primary appraisal types in a stressful person-environment encounter. Since harm reflects the existence of some damage to the person that has already been experienced and that no anticipatory coping is conceivable, we only focus on threat and challenge appraisals in this study. Threat appraisal concerns potential harms or losses that have not yet occurred, but a person can anticipate them. The primary adaptational significance of the threat is that it allows for anticipatory coping. Challenge, the other type of stressful cognitive appraisals, manifests similar characteristics to threat in that it too requires the mobilization of coping efforts. However, the main difference between these two is that, unlike threat appraisals, challenge appraisals seek the potential opportunities in the person-environment encounter whereby a person may turn the stressful situation into a positive, amenable one (Lazarus and Folkman 1984).

Cognitive appraisal theories argue that these two primary appraisals are not mutually exclusive, and they cannot be viewed as poles of a single continuum (Lazarus 1991; Lazarus and Folkman 1984; Lazarus and Folkman 1987). That is, although they are separate constructs, they can coincide. For example, a data analyst may appraise BDA implantation as an opportunity to enhance her skills and knowledge or to be recognized and admired for her ability to effectively using the new technology. In the meantime, she also may perceive BDA implementation as risky due to its potential to cause work overload, implausible expectations from the executives, and role conflicts with parts of the firm whose positions will be undermined by the capabilities of BDA.

Change Self-Efficacy

The secondary appraisal in the transactional theory of stress refers to an individual's perception of her control over the situation when she encounters a stimulus. Following Bandura (1977)'s distinction between general and situation-specific control beliefs, transactional theory identifies the secondary appraisal as the later whereby a person evaluates her ability and options to cope with or impact a particular stressful person-environment relationship (Lazarus and Folkman 1984). This conceptualization of the situational appraisals of control is too much similar to that of Bandura's self-efficacy. Bandura et al. (1999) defined self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments." In the context of an organizational change, self-efficacy should be viewed in the change event domain. Thus, change-specific self-efficacy should be a better representative than should other kinds of self-efficacy (e.g., general self-efficacy) (see, for example, Jimmieson et al. (2004)). Therefore, in this study, we conceptualize and study the vital role of secondary appraisal in data analysts' perceived self-efficacy related to BDA implementation.

Cognitive Appraisals and Commitment to BDA Implementation

Commitment to [an organizational] change is a form of commitment directed to a course of action. Commitment to change is different from other types of commitment. Unlike the comparatively static nature of the entities characterized by other commitments, commitment to change typically shows a person's

attachment level to a dynamic process. Commitment to implementing new technologies, policies, plans (e.g., adopting a new accounting information system, merger, and acquisition) are examples of organizational changes that commit to change concerns in the organizational context (Neubert and Wu 2009). Commitment to organizational change has been defined in several manners. However, all these conceptualizations rest on the idea that an employee's commitment to an organizational change manifests her conscious motivation to be involved in the change initiative. Researchers have insisted on the critical role of commitment in evaluating employees' support for organizational change initiatives (see, for example, Armenakis and Bedeian (1999) and Meyer et al. (2007)). Conner (1993) views commitment to change as "the glue that provides the vital bond between people and change goals." Commitment to change should be distinguished from organizational commitment in that it is a situational mindset rather than a general attitude. Unlike the organizational commitment that takes its root from the employee's historical memory of the organization, commitment to change is the product of the ongoing cognitive appraisals and reappraisals within the change initiative's boundary (Oreg et al. 2013).

Although cognitive appraisals of threat, challenge, and control have not been considered the antecedents of commitment to change, the transactional theory of stress supports this relationship (Lazarus and Folkman 1984). According to the transactional theory, after a stressful situation is appraised as a threat or an opportunity, secondary appraisals assess how to cope with the situation. If the stimulus is appraised as potentially positive (i.e., an opportunity) and controllable, an individual follows an active coping style, increasing her efforts to meet the situation's demands (e.g., intention to sacrifice for a course of action). Suppose the situation in which the encounter is appraised as being potentially malicious (i.e., a threat) and stable. In that case, however, a passive style of coping is likely to result where an individual tries to minimize the negative impacts of the stressful situation (e.g., only meeting the requirements and lack of intention to further contribution).

Since the employee who appraises the situation as an opportunity feels that the situation is favorable, she will probably try to cope with the stressful situation by contributing more resources to the change initiative (increased commitment to BDA implementation). Suppose a data analyst perceives BDA implementation as positive and controllable. In that case, she will become more attached to the change process because she believes that in this way, she will finally pass through the difficulties of the technological transition and leverage the advantages of working in an organization supported by state-of-the-art technology (e.g., new learning and growth opportunities). Conversely, an analyst who appraises the BDA implementation as negative and uncontrollable will tend to cope by allocating less effort to the project (decreased commitment to BDA implementation).

Moreover, suppose an employee feels confident about her ability to handle the organizational change demands (i.e., having high self-efficacy). In that case, it is less likely that workplace changes negatively impact her well-being. Thus, this perception of mastery in the change situation will lead her to the state of willingness to support the change compared to those with lower self-efficacy perceptions. Accordingly, we argue that a data analyst with high levels of change self-efficacy will likely be able to rightfully deal with the BDA implementation demands and subsequently become enthusiastic about making contributions to the BDA implementation process. On the other hand, if the analyst perceives herself as unable to deal with the incurred demands, she will be less intended to commit to the BDA implementation and unwilling to support it during the implementation process. Based on the above theoretical argument, we hypothesize that:

H1: There is a negative relationship between data analysts' perceived threat and their commitment to the implementation of BDA.

H2: There is a positive relationship between data analysts' perceived opportunity and their commitment to the implementation of BDA.

H3: There is a positive relationship between data analysts' perceived change self-efficacy and their commitment to the implementation of BDA.

Uncertainty and Cognitive Appraisals

Uncertainty is one of the main characteristics of all the organizational change and transitions (Allen et al. 2007; Bordia et al. 2004a; Cullen et al. 2014; Smollan 2015). Uncertainty is defined as "an individual's inability to predict something accurately due to lack of or ambiguous and contradictory information" (Ashill and Jobber 2010; Milliken 1987). In the context of organizational change, uncertainty has been known for

its influential role in specifying employees' psychological states (e.g., Armstrong-Stassen (2005)). Focusing on the sources of organizational change-related stress, Smollan (2015) inductively explored and classified the stressors in the three phases of an organizational change (i.e., before, during, and after the change) and figured out that in all the transition phases, uncertainty played a significant role.

To contextualize the concept of uncertainty, Allen et al. (2007) developed a taxonomy of uncertainties in the organizational change context. Their taxonomy conceptualizes uncertainty comprised of three factors, namely, strategic, implementation, and job-related uncertainty. The three factors refer to the uncertainties raised from the issues at organization-level, structural or work-unit functional changes, and the threats and opportunities directly related to the employees' jobs. Although employees, at any level, would perceive all the three forms of uncertainties, in this study, we only focus on the role of job-related uncertainty because of its consequences and salience for employees working in functional echelons of an organization like data analysts.

In general, uncertainty is identified as a property of situations that make them harmful or damaging for individuals. However, unlike the conventional aversive view of uncertainty that uncertainty can only lead to perceptions of threat and harm, appraisal theories argue that appraisal of any stressful encounter, including uncertainty, can be appraised positively and negatively (i.e., threat and opportunity). Brashers (2001), in his theory of communication and uncertainty management, similarly insists on this duality and argues that people's appraisal of uncertainty can be both positive and negative. Therefore, uncertainty can lead to both threat and challenge appraisals. More importantly, as Lazarus and Folkman suggested that these appraisals are not mutually exclusive and can co-occur. Thus, we argue that job uncertainty can simultaneously predict perceived threat and perceived opportunity.

Moreover, uncertainty can also impede a person's appraisal of her potential resources for coping with a stressful situation. To make a reliable judgment of one's control over a stressful situation, an individual needs relevant information about the stressor's nature and possible impacts. Such an inability to judge the outcomes of an encounter may lead her to believe that she cannot realize all the aspects of the change and have low control over the stressful situation. Several researchers have studied the relationship between job uncertainty and employees' perceived control over the change situation (i.e., change self-efficacy). Bordia et al. (2004b) proposed and examined a change-related communication, uncertainty, and control model and found a negative relationship between job uncertainty and control. Jimmieson et al. (2004) studied employees' adaptation to organizational change during a regionalization process and found that the presence of change-related information (i.e., reduced job uncertainty) increased employees' perception of self-efficacy during the change process. Paulsen et al. (2005), in their study of downsizing in a public hospital, tested a model of job uncertainty and similarly found a negative relationship.

Accordingly, in the case of implementation of BDA, we argue that a data analyst who may be uncertain about how the introduction of this new technology affects her tasks, the new skills necessary to effectively use the new system, how to deal with a probably new analytics-centered culture that is supposed to be reached after the establishment of BDA, to name but a few, can simultaneously appraise these uncertainties as a threat to their job (for example, losing their job due to recruitment of fresh, highly skilled analysts) or an opportunity for learning or securing and promote her position in the new organizational arrangement. Furthermore, without a clear image of BDA implementation's impacts, the analyst is likely to feel that she cannot cope with BDA's demands and thus lose control over the tasks required by BDA's introduction. Based on the theoretical argument above, we hypothesize that:

H4: Job-related uncertainties during BDA implementation will positively influence the data analysts' perceived threat

H5: Job-related uncertainties during BDA implementation will positively influence the data analysts' perceived opportunity, and

H6: Job-related uncertainties during BDA implementation will negatively influence the data analyst's perceived change self-efficacy.

However, how and the extent to which an individual appraises a stressful encounter not only relies on the situational (i.e., uncertainty) but also on dispositional factors. Generalized beliefs about control are among the major personal factors influencing people's appraisals of a stressful encounter. Such beliefs concern the extent to which individuals presume they can control essential outcomes. Control is defined as "a

psychological construct reflecting an individual's beliefs in his or her ability to affect a change, in the desired direction, on the environment" (Greenberger and Strasser 1986). The transactional theory suggests that an individual's confidence and belief in her proficiency and control over the environment, or her feelings of vulnerability to the dangers and harms of her surrounding environment affects the way she will appraise the encounter, that is, the threat and challenge appraisals (Hilton 1989; Lazarus and Folkman 1984).

Personal control beliefs are related to one's feelings of confidence and competence and have their most significant influence when a situation is ambiguous or novel (Lazarus and Folkman 1984). Ghasemaghaei et al. (2018) identified domain knowledge and analytical skills as the criteria for evaluating data analysts' competence. Following the theoretical argument above, if a data analyst perceives herself as incompetent to deal with the new technology demands (i.e., lack of domain knowledge or analytical skills), she will likely appraise uncertainty as a threat to her job and future position in the organization. However, an analyst with a high self-perception of analytical competence may feel that she can overcome the potential barriers and ambiguities caused by BDA's implementation and appraise uncertainty as an opportunity for her growth and success in the firm. Base on this argument, we hypothesize that:

H7a: *Data analysts' domain knowledge and analytical skills will moderate the relationship between job-related uncertainty and perceived threat such that the relationship is more robust when perceived domain knowledge and analytical skills are low.*

H7b: *Data analyst's domain knowledge and analytical skills will moderate the relationship between job-related uncertainty and perceived opportunity such that the relationship is more robust when perceived domain knowledge and analytical skill is high.*

Methodology

Experimental Design

In this study, we follow the principles of experimental vignette methodology (EVM). Taking this methodological approach is that EVM allows us to include only the situational factor of organizational change (i.e., job-related uncertainty) without considering other factors that might confound the results. In particular, we will manipulate job-related uncertainty (high/low) to develop two scenarios whereby we can assess data analysts' commitment to BDA implementation through their primary and secondary appraisals. To conduct this study, we will ask a market research firm to recruit relevant participants (data analysts working in firms that have currently implementing BDA). Participation in the study will be voluntary, and monetary compensation will be considered for the participants. Experimental procedures and survey instruments will be tested beforehand through a pilot study involving 40 participants. To ensure that the uncertainty levels are realized significantly different, the pilot study's participants will be asked to rate the uncertainty as high or low. The primary experiment process will then be as follows: participants will be provided with information about big data analytics implementation. Having read the memo, they will then randomly read online written vignettes that manipulated job-related uncertainty. Then, a manipulation check for job-related uncertainty will be conducted using scales adapted from (Schweiger and Denisi 1991). Finally, participants will be directed to complete the survey instrument asking about their cognitive appraisals and commitment.

To assess the proposed research model, we will use the Partial Least Squares (PLS) technique (Ringle et al. 2015). First, we validate the instruments by testing them for their reliability and validity (i.e., content, convergent, and discriminant validity). Then, once the quality of the measurement model is assured, we test the structural model. We will also test the standard method bias using Herman's single-factor test since all the measures will be collected simultaneously (Podsakoff et al. 2003). Finally, in our analysis, we will control data analysts' age, industry type, and firm size.

Measurement Instruments

To ensure content validity, measurement scales for all the constructs of this research study will be selected from the extant literature. Commitment to the BDA implementation construct will be operationalized by adapting the 18 measurement items of the three-component model developed by Herscovitch and Meyer (2002). Cognitive appraisal of threat will be assessed using a four-item scale developed by Major et al. (1998), and the perceived opportunity will be measured using four items developed by Drach-Zahavy and

Erez (2002). Finally, change Self-efficacy will be measured by adapting the six-item scale developed by Chen et al. (2001) for the change-specific domain. Notably, we will measure the validity and reliability of all the constructs in the model.

Conclusion

In this study, we view the problem of BDA's successful implementation from data analysts' psychological lenses. We leveraged and drew on the premises of the transactional theory of stress and the literature on the commitment to organizational change to examine the cognitive mechanism through which data analysts' commitment to BDA implementation is shaped and affected. Using an integrative view, this study addresses a gap in the literature on implementing organizational information systems. It will specifically enhance our understanding of the value of studying data analysts' cognitive appraisals in the transition to this generation of information technologies (i.e., big data analytics). We argued that the uncertainty data analysts' experience during the implementation process could be evaluated in two opposing, although concurrent, manners (i.e., threat and challenge appraisals). We also argued that commitment as the most crucial element of any successful change within the organization is tied mainly to the employee's mindset of the change process and includes three unique components. Given the importance of distinguishing between the three components of commitment, particularly for its behavioral implications, we attempt to thoroughly investigate the relationship between data analysts' experience of job-related uncertainty and their commitment to BDA implementation through their cognitive appraisals.

This study's results will also have important implications for middle-managers and organizational leaders engaged in this process. They should particularly pay attention to the mechanisms to manage uncertainty (such as communication, participation, training programs). In other words, managers should view the BDA adoption as a gradual shift in which there is a continuous balance between employees' expectations and change requirements.

Although this study tries to make significant contributions to the theory and practice, it has several limitations. Specifically, the study will be conducted among North American data analysts. Thus, there is a need for similar studies in other geographic regions to verify the generalizability of this study's results. In this study, we only focus on uncertainty as to the only stressor during the transition; however, one can include other situational and individual factors such as relationships and others' stress (e.g., co-workers, supervisors). Finally, in this study, we only focused on the role of cognitive processes in our assessment of an analyst's commitment to BDA implementation. Simultaneously, other factors are contextual and process factors to add to the research model's printability.

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