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The role of artificial intelligence in effective business operations during COVID-19

The role of
artificial
intelligence in
business

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Abstract

Purpose – The pressure to survive in a highly competitive market by using artificial intelligence (AI) has further demonstrated the need for automation in business operations during a crisis, such as COVID-19. Prior research finds managers' mixed perceptions about the use of technology in business, which underscores the need to better understand their perceptions of adopting AI for automation in business operations during COVID-19. Based on social exchange theory, the authors investigated managers' perceptions of using AI in business for effective operations during the COVID-19 pandemic.

Design/methodology/approach – This study collected data through a survey conducted in China ($N = 429$) and ran structural equation modeling to examine the proposed research model and structural relationships using Smart PLS software.

Findings – The results show that using AI in supply chain management, inventory management, business models, and budgeting are positively associated with managers' satisfaction. Further, the relationship between managers' satisfaction and effective business operations was found to be positively significant. In addition, the findings suggest that top management support and the working environment have moderating effects on the relationship between managers' satisfaction and effective business operations.

Practical implications – The results of this study can guide firms to adopt an AI usage policy and execution strategy, according to managers' perceptions and psychological responses to AI.

Social implications – The study can be used to manage the behavior of managers within organizations. This will ultimately improve society's perception of the employment of AI in business operations.

Originality/value – The study's outcomes provide valuable insights into business management and information systems with AI application as a business response to any crisis in the future.

Keywords Artificial intelligence, Business operations, COVID-19, Managers' satisfaction

Paper type Research paper

1. Introduction

Almost all firms worldwide are under pressure to adopt automation to survive in competitive markets (Chou, 2016; Haefner *et al.*, 2021). The COVID-19 pandemic has further demonstrated the need for automation because of its catastrophic impact on healthcare, employment, business operations, and the global economy. The COVID-19 crisis is notably different from previous crises in terms of its intensity, cause, and extent (Chen and Biswas, 2021). Preventive measures such as maintaining lockdowns, advocating social distancing, encouraging people to wear face masks, and promoting



hygiene practices against COVID-19 have forced a number of firms out of business (e.g. airlines, tourism) and compelled others to restructure their operations to stay afloat (Chen and Biswas, 2021; Donthu and Gustafsson, 2020; Piccialli *et al.*, 2021). Similarly, Sharma *et al.* (2020) claimed that firms must shift their business operations (e.g. supply chain systems, business models) in response to social distancing, introduce new goods and services, and reposition existing activities to match the lockdown lifestyle. Consequently, firms have adopted new contactless distribution methods for effective operations. For example, Chen and Biswas (2021) documented that the use of AI in Chinese companies (i.e. JD.com, Lin Qingxuan) transformed the COVID-19 crisis into opportunities. Therefore, re-examining managers' perceptions of using AI in a critical situation such as COVID-19 for business operations presents an opportunity for research.

In recent years, research on investigating managers' psychological and behavioral reactions to AI has increased (Cao *et al.*, 2021; Tong *et al.*, 2021). However, the relationship between the technology used in business and managers' perceptions is still mixed and ambiguous. Some empirical studies find a positive relationship between them (Beare *et al.*, 2020; Beaudry and Pinsonneault, 2010), whereas others find no association (Tarafdar *et al.*, 2010) or even a negative impact (Stam and Stanton, 2010). AI has a substantial moderating effect on managers' job performance, efficiency, and firms' performance (Prentice *et al.*, 2019). In contrast, the promotion, adoption, and acceptance of technology at times, results in a decline in human mobility inside a firm's operations (Stam and Stanton, 2010). In the era of technological advancement, information is referred to as the new oil (Jarrahi, 2018), while AI is being called the new power that is able to extract value from this oil. AI can comprehend and identify rules and patterns in vast amounts of data due to its superior algorithms and computing capabilities (Luo *et al.*, 2019; Tong *et al.*, 2021). Given the leading global firms' (e.g. Alibaba, Amazon, IBM, MetLife) thrust on using AI in business operations (Luo *et al.*, 2021; Tong *et al.*, 2021), managers' perceptions and behavioral outcomes for a positive business impact could be a research area (Cao *et al.*, 2021; Mishra and Tripathi, 2021). Research interest in AI from academics is increasing (Jarrahi, 2018; Mishra and Tripathi, 2021; Toorajipour *et al.*, 2021). The behavioral and psychological reactions of using AI in business in any crisis like COVID-19 are not fully understood from managers' perspectives in contemporary literature.

At the beginning of the COVID-19 pandemic, most businesses faced operational challenges (Chen and Biswas, 2021; Rajak *et al.*, 2021). However, some firms have proved that effective operations are possible with the help of AI during a crisis (Piccialli *et al.*, 2021). In the modern world, AI technologies are translating all tasks into data and taking over business using automation processes (Haefner *et al.*, 2021). As such, firms that adopt robotic process automation have made businesses more effective since the pandemic began (Lee, 2020). The use of AI in business operations has increased during COVID-19 (Chen and Biswas, 2021; Piccialli *et al.*, 2021). An important pillar of a firm's foundation is managers, the most influential internal stakeholder group (Balwant *et al.*, 2020; Mahmud *et al.*, 2021). Managers, a key stakeholder group, have more reliable information about a firm than other stakeholders, and they can use internal resources efficiently for smooth business operations (Boadi *et al.*, 2020; Mahmud *et al.*, 2021). Thus, understanding managers' perceptions of AI is essential. In this setting, AI usage in business operations may reveal further insights into managers' behavior. Thus, the objective of this study is to investigate managers' perceptions of using AI in supply chain management, business models, inventory management, and budgeting for effective business operations during the COVID-19 pandemic. The study also examines the moderating effects of top management support and the working environment on the relationship between managers' satisfaction and effective business operations.

2. Theoretical background and hypotheses

Over the years, global business has moved into a digital space, where AI is seen as a way to the future (Cao *et al.*, 2021; Davenport *et al.*, 2020). AI has already begun to play a significant role in business operations (Agrawal *et al.*, 2019; Jarrahi, 2018; Tong *et al.*, 2021). For example, implementing AI in a warehouse increases employees' work efficiency (Luo *et al.*, 2019), AI-enabled chatbots enhance customers' purchases (Luo *et al.*, 2022), and AI-powered performance feedback systems increase employees' work efficiency and thus create more value for firms (Tong *et al.*, 2021). Besides, AI in medical diagnoses reduces errors (Jarrahi, 2018). AI is certainly establishing itself as a source of competitive advantages (Cao *et al.*, 2021). Many firms switch from remote monitoring to AI-based self-driving systems that optimize and ultimately increase their functionality (Davenport *et al.*, 2020). For example, Amazon's AI capabilities range from forecasting the number of customers likely to buy new goods to operating without cashiers (Luo *et al.*, 2019).

AI is viewed from the perspective of firms' capabilities rather than technology (Davenport *et al.*, 2020). When performing well-defined and structured tasks, AI outperforms humans in terms of data analytics capabilities; thus, AI can generate more precise predictions (Agrawal *et al.*, 2019; Jarrahi, 2018). For instance, when compared to conventional budgets, AI algorithms and machine learning-based budgets are automatically generated, controlled, and monitored. Several leading companies (e.g. Amazon, Airbnb, Alibaba) have begun to recognize the potential of AI and have incorporated it into their operational processes (Luo *et al.*, 2022; Tong *et al.*, 2021). Thus, AI, as a strategic business tool, enables the development of new models, system design, and technological systems in the realm of intelligent business operations in challenging environments such as the COVID-19 pandemic (Chen and Biswas, 2021).

Adopting new technology within a firm is a form of organizational change, which creates stress, uncertainty, and fear among managers (Appelbaum *et al.*, 2018; Dwivedi *et al.*, 2021; Vakola and Nikolaou, 2005). Managers' attitudes toward AI are perceived as influencing the readiness and behavioral intention to adopt AI (Cao *et al.*, 2021). Thus, the key to successful technology adoption is to achieve a positive attitude of managers toward this change. In addition, Chou (2016) claimed that concerns about the social impacts of using technology have recently started featuring in technology research. Most research has focused on social exchange theory to explain the concept of organizational change (Cropanzano and Mitchell, 2005). Thus, we used the social exchange theory behind managers' perceptions of AI usage for effective business operations.

2.1 Social Exchange Theory (SET)

SET is a well-known theoretical framework for studying managers' workplace behavior (Blau, 1964). Although several viewpoints on social exchange have been developed, researchers agree that it entails a sequence of events that result in obligations (Emerson, 1976; Yee *et al.*, 2008). Social exchange interactions are considered independent of another person's actions to generate unspecified obligations (Blau, 1964). For decades, researchers have employed the notion of social exchange to explain the basis of employee behavior and the development of positive attitudes toward employees. In particular, one of the key concepts of SET is that relationships evolve into those of trust, dedication, and mutual commitment, and that exchange rules and norms must be followed by exchangers that serve as guidelines in the exchange process (Cropanzano and Mitchell, 2005; Yee *et al.*, 2008).

According to SET, managers who are committed to a firm are motivated to reciprocate by making voluntary contributions for the firm's benefit (Chou, 2016). The fundamental reason behind this is that an exchange necessitates a bidirectional transaction—something must be given, and something must be returned (Yee *et al.*, 2008). Additionally, based on the principle of reciprocity, managers who receive top levels of support from a firm are likely to feel obliged to repay the firm in the form of their effective commitment and work-related activities. Thus,

managers strive to balance their ties with firms and supervisors with attitudes and behaviors that match employers' involvement.

Chou (2016) showed two types of social exchanges: (1) interactions between a manager and a firm, termed perceived business operational support; and (2) interactions between a manager and a newly introduced information system for business operations. Our study focuses on high-quality social exchange relationships that have beneficial consequences for firms' effective business operations and managers' satisfaction. This study assumes that managers who exchange or provide support to their supervisors feel a sense of gratitude to their firms and display that by showing dedication toward using AI for effective business operations.

2.2 Supply Chain Management (SCM) and AI

For more than a century, management theory has recognized that accurate information on how much and how well employees work is important for increasing productivity and firm value (Taylor, 1911). From this perspective, managers' attitude, in terms of their behavior toward using AI, and their response to boost firms' performance (Cao *et al.*, 2021), is a crucial part of firm management. Managing information regarding supply chains has become increasingly difficult in recent years (Katsaliaki *et al.*, 2021; Rajak *et al.*, 2021). Market volatility caused by the COVID-19 has heightened the importance of stable SCM systems. Increased challenges (e.g. natural disasters) have led to regionalization and flow optimization of supply chains (Kalyar *et al.*, 2020; Shukor *et al.*, 2021). COVID-19 has also disrupted the smooth supply chain system and created various challenges (Chen and Biswas, 2021; Sharma *et al.*, 2020). Consequently, firms are paying more attention to supply chain resilience than earlier, and AI-based SCM is a potential instrument to help companies tackle these challenges (Chen and Biswas, 2021; Toorajipour *et al.*, 2021). Therefore, we would like to investigate how the increasing demand for AI to improve resilience in SCM can significantly impact managers' psychological and behavioral reactions.

The use of modern technology for a positive business change is an important advancement (Cao *et al.*, 2021; Mathiyazhagan *et al.*, 2021). Managers' attitudes and behaviors regarding the use of technology, as a valuable strategic management tool, in a business are still varied (Beare *et al.*, 2020; Tarafdar *et al.*, 2010). For instance, Cascio and Montealegre (2016) argued that using technology in a workplace leads to high satisfaction in managers and thus, increases a firm's productivity (see also, Tong *et al.*, 2021). Similarly, Barley (2015) claimed that using technology in a workplace increases managerial motivation and work speed, which develops resilience in business operations and enhances firms' performance (see also, Bernal, 2016; Stam and Stanton, 2010).

In summary, existing literature demonstrates that technology in business operations is considered a positive stimulus for managers' behaviors. Extensive research on managers' behavioral outcomes demonstrates that their positive perceptions, behaviors, and attitudes toward business lead to effective operations (Cao *et al.*, 2021). Furthermore, based on SET, Chou (2016) found a positive relationship between managers and newly introduced technology in business operations. This study argues that using AI in SCM for effective business operations during COVID-19 may have consequences that affect managers' reactions. Thus, we hypothesize as follows:

H1. AI in supply chain management is positively associated with managers' satisfaction.

2.3 Business models (BM) and AI

The COVID-19 crisis and subsequent economic downturn have provided businesses with a unique opportunity to redefine their BM by using AI (Chen and Biswas, 2021). For example, during the pandemic, consumers turned dramatically to Internet platforms, and companies responded accordingly (Sharma *et al.*, 2020). Similarly, Lee (2020) noted that AI-based BM have helped the Chinese economy become a global leader, even though it has a huge

workforce. Companies that took bold steps to change their BM during the crisis could turn adversity into an advantage (Seetharaman, 2020; Sharma *et al.*, 2020). For instance, the SARS outbreak is sometimes attributed to the establishment of Chinese e-commerce giants such as JD.com and Alibaba (Chen and Biswas, 2021).

Research has shown that business changes result in managers having mixed experiences. For example, Bringselius (2014) argued that managers enjoy organizational change when they contribute to it. Similarly, a business change is implemented for positive reasons, and managers take it positively (Appelbaum *et al.*, 2018; Rana *et al.*, 2017). At the same time, repeated changes in business are associated with adverse effects on managers as well (Dwivedi *et al.*, 2021; Oreg *et al.*, 2011). Furthermore, according to SET, interactions between managers and the newly introduced system in a firm make employees feel a sense of debt to be repaid by displaying their dedication for effective business operations (Chou, 2016). This study argues that digital transformation of AI-enabled BM has led companies to achieve smooth business operations during the COVID-19 crisis and managers consider this positively as vital stakeholders. Therefore, we propose the following hypothesis:

H2. An AI-enabled business model is positively associated with managers' satisfaction.

2.4 Inventory management (IM) and AI

An AI-enabled IM system allows a firm to manage stock easily, predict demand, plan for crises, and even more (Preil and Krapp, 2022; Priore *et al.*, 2019). AI has a variety of applications in IM, including interpreting external data correctly (Logg *et al.*, 2019; Tong *et al.*, 2021), forecasting (Jarrahi, 2018), and supplier selection (Toorajipour *et al.*, 2021), just to name a few. Order policy coordination is a major challenge in IM because several unpredictable factors enhance complexity. AI-embedded analytical approaches can design a policy that minimizes IM's complexity (Preil and Krapp, 2022). Thus, AI is used for improving accuracy because it facilitates data collection, analysis, and inventory management in an effective manner.

Researchers have examined the concept of perceived usefulness, which refers to a user's assessment of the utility of an application system (Chou, 2016). Davis (1989) stated that managers are rewarded for superior performance within an organizational framework through pay increases, promotions, bonuses, and other incentives. However, when managers perceive the usefulness of a system highly, it can assist in reinforcing their high performance (Tong *et al.*, 2021). When COVID-19 started spreading at the beginning of 2020, meeting customer expectations that many suppliers had never anticipated before, particularly when large purchases included vital supplies such as groceries, medicine, and other important things, had become a huge challenge (Chen and Biswas, 2021). Supply chain disruptions, changes in ordering volumes, and transportation challenges have made it significantly more difficult for firms to manage inventory in the times of COVID-19 (Rajak *et al.*, 2021; Sharma *et al.*, 2020). Based on SET theory, this study argues that the COVID-19 crisis further leads managers to adopt an AI-based inventory system, enabling them to smoothen business operations through resilient IM. Therefore, we propose the following hypothesis:

H3. AI in inventory management is positively associated with managers' satisfaction.

2.5 Budgeting (BT) and AI

Although managers often get direction from superiors, the advent of AI has given a boost to the availability of new sources of direction. The superior accuracy of AI direction relative to human direction (Logg *et al.*, 2019; Tong *et al.*, 2021) has led firms to have AI-algorithm driven decision-making power. However, AI has surpassed human capacity for data processing and generated more rational decisions quickly (Dietvorst *et al.*, 2015; Luo *et al.*, 2022). Consequently, modern workplaces are increasingly being controlled and monitored by

both human managers and AI algorithms (Luo *et al.*, 2021). A firm's budget is influenced by a variety of elements, including growth strategies, environment, and social relationships (Donthu and Gustafsson, 2020). With its worldwide impact, the COVID-19 outbreak has brought in a lot of uncertainty in the budgeting exercise of firms. However, Lee (2020) documented that automation occurs when the solution of economic difficulties is linked to advancing technologies, and COVID-19 is the best illustration of an automation-related decision-making event.

The affective events theory of Weiss and Cropanzano (1996) examines the relationship between managers' internal factors and their reactions to workplace incidents. Managers' reactions are an important component of their daily work environment that shapes their experiences and behaviors (Moreno *et al.*, 2002). Prior research has shown that managers' reactions while using technologies at a workplace have both positive and negative impacts on their activities. For instance, Cascio and Montealegre (2016) claimed that an AI-embedded workplace could result in enhanced participation and collaboration, all of which could result in positive feedback from managers (see also, Barley, 2015). In contrast, some researchers argued that technological hurdles and overloading might diminish managers' satisfaction (Dwivedi *et al.*, 2021; Tarafdar *et al.*, 2010). According to SET, managers who perceive organizational change (e.g. using AI) are motivated to reciprocate through voluntary contributions that benefit a firm (Chou, 2016). This study argues that an AI algorithm-based budget for effective business operations during COVID-19 may have consequences for managers' reactions. Therefore, we propose the following hypothesis:

H4. AI algorithms-based budgeting is positively associated with managers' satisfaction.

2.6 Managers' Satisfaction (MS) and Effective Business Operations (EBO)

Firms are currently looking for ways to add new value to their services and enhance service quality to cope with automation pressure, increasingly competitive marketplaces, and fluctuating market dynamics (Jarrahi, 2018; Luo *et al.*, 2021). Companies emphasize optimizing operational efficiency to deliver products and services to customers profitably and meet their expectations (Yee *et al.*, 2008). The success of a firm's operational efficiency largely depends on its managers (Hill, 2008). However, managers' attitudes, including task satisfaction, loyalty, and devotion to their firms, affect operational performance.

Yee *et al.* (2008) claimed that satisfied managers are more inclined to work harder and deliver superior services. Similarly, managers who are pleased with their employers have a greater commitment toward their firms and toward providing high-quality services (Chou, 2016). Additionally, a previous study demonstrated that devoted managers are more interested in and capable of successful business operations (Balwant *et al.*, 2020).

With regard to SET, when a firm provides a favorable working environment to satisfy managers, they are committed to making extra efforts as a sign of gratitude towards their firms (Yee *et al.*, 2008), leading to effective business operations. Based on SET, we believe that managers' satisfaction with AI during the COVID-19 phase leads to effective business operations. Thus, we propose the following hypothesis:

H5. Managers' satisfaction is positively associated with effective business operations.

2.7 Top management support (TMS)

TMS is referred to as senior management's guidance and support to operational managers to ensure smooth business operations (Cruz-Jesus *et al.*, 2019; Rodríguez *et al.*, 2008). A common argument is that managers are influenced more by how their top management treats them emotionally and cognitively than by any other factors (Kanwal *et al.*, 2017). Thus, TMS plays an important role in digitalizing business operations and raising managers' commitment

levels. At the same time, adopting AI in a firm entails a lot of stress, fear, and uncertainty among managers (Beaudry and Pinsonneault, 2010; Vakola and Nikolaou, 2005). TMS could play a positive role in alleviating these negative impressions toward AI, thus improving the likelihood of successful business operations. However, Kanwal *et al.* (2017) proved the moderating role of TMS in the relationship between information system performance and self-control, outcome control, and behavior control. Similarly, Hsu *et al.* (2019) revealed the moderating role of TMS in the relationship between adoption of technology and openness of service innovation. SET argues that managers who receive high-quality firm support from their supervisors feel a sense of gratitude, which they display by showing dedication, affection, and support toward their firms. This study argues that an adequate level of TMS leads to higher manager satisfaction levels toward AI usage for business operations. Thus, we propose the following hypothesis:

- H6.* Top management support positively moderates the relationship between managers' satisfaction and effective business operations.

2.8 Working Environment (WE)

Working environment is described as the setting, social environment, and physical conditions in which managers perform their jobs. Raziq and Maulabakhsh (2015) argued that environmental factors (e.g. infrastructure, job security) help managers find their worth in the value offered by firms. Further, this value can raise managers' motivational levels, which ultimately increase their internal happiness, and leading to satisfaction (Judge and Larsen, 2001; Lee and Brand, 2005). Previous research has shown that development of certain qualities in a workplace leads to satisfaction, which encourages managers to perform better (Matsuo, 2019). An appropriate social working environment should be built to enable managers to fulfil their tasks by fully utilizing their potential and providing superior services. Previous research supports the idea that managers do better at work due to less stress when the work environment is supportive, which leads to successful business operations (Judge and Larsen, 2001; Lee and Brand, 2005; Matsuo, 2019). Raziq and Maulabakhsh (2015) proved the moderating role of the working environment in the relationship between motivation and job performance. According to SET, when a firm provides a favorable working environment, managers are committed to making extra efforts as a sign of gratitude toward the firm. Thus, we hypothesize as follows:

- H7.* Working environment positively moderates the relationship between managers' satisfaction and effective business operations.

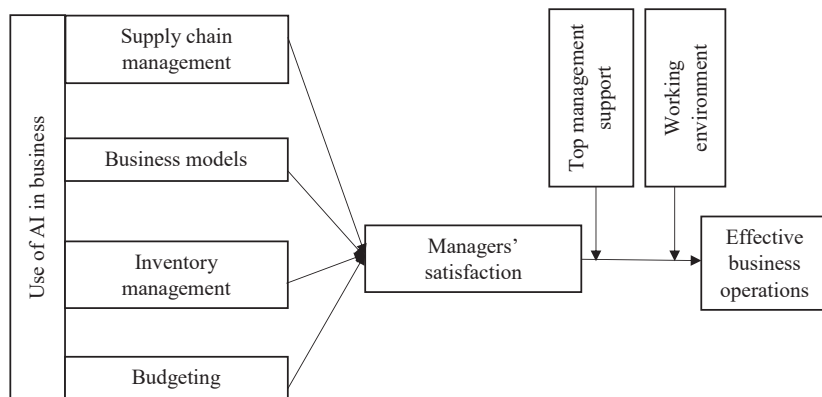
Based on the above discussion and hypotheses, the proposed research model is depicted in Figure 1.

3. Methodology

3.1 Study context

Our study concentrates on the perceptions of different firms' managers from China regarding the use of AI during COVID-19. There were restrictions and constraints on citizens' lifestyle and mobility worldwide during COVID-19. However, firms must carry on their businesses for the diverse needs of people. COVID-19 has further led businesses toward e-commerce and accelerated digital transformation. Although China was already a digital leader before COVID-19, it has further accelerated its adoption of digital technologies in the times of crisis (Lee, 2020). Currently, China is not only the largest exporter nation but also the largest trading nation in terms of the sum of its exports and imports [1].

Figure 1.
Research model



3.2 Data collection

We collected data from managers of different firms in China via an online survey conducted between April 1 and August 31, 2021. After the preliminary questionnaire was prepared, one researcher thoroughly reviewed the survey items to ensure that they were grammatically correct and made sense in the current study context. We modified the items to improve readability and corrected a few grammatical errors based on the feedback. Following this, we asked 21 managers to provide feedback on the final questionnaire regarding how easy or difficult it was to comprehend and respond to the questions. At this stage, we received a few minor suggestions that were taken into consideration. Finally, we sent the survey link to two Chinese universities alumni social media groups (e.g. WeChat, Sina Weibo, Douyin, Bilibili) to respond to the questions. Additionally, we sent the survey link to email/social media inboxes with verbal approval from the concerned offices. We targeted 1,000 managers to respond to this study. After three reminders over three-week delay, we received 449 responses showing a response rate of 44.9%. This response rate is consistent with previous studies on human behavioral outcomes (Cao *et al.*, 2021; Mahmud *et al.*, 2021). We eliminated 20 responses because of missing data. Therefore, our research model was developed using 429 responses.

Male respondents made up 56% of the final respondents, whereas female respondents made up 44%. In terms of education, 202 respondents (47%) had a bachelor's degree, while 227 (53%) earned a master's degree or higher. In terms of organizational hierarchy, 219 respondents (51%) were first-line managers, 176 (41%) were middle-level managers, and only 34 (8%) were top-level managers.

3.3 Measurement of variables

The research model, as depicted in Figure 1, consisted of eight multifactor variables that could not be assessed using a single variable. Thus, we measured each variable in the research model using several observed items. All questions in the study were measured on a seven-point Likert scale, wherein "1" strongly disagree, and "7" strongly agree.

The first four variables were related to the use of AI in business operations. Toorajipour *et al.* (2021) described the use of AI for SCM. Thus, we adopted the measurement items for AI usage in SCM from Toorajipour *et al.* (2021). The measurement items for using AI in BM were taken from Burström *et al.* (2021) and Reim *et al.* (2020). The three items of AI in IM were adopted from Preil and Krapp (2022). The five items for the "use of AI algorithm in budgeting" were modified from the AI algorithm for decision-making in business which was adopted from Logg *et al.* (2019). The measurement items for managers' satisfaction were

adopted from [Munim and Noor \(2020\)](#). The measurement items of effective business operations were taken from a well-known study by [Schmuck \(2012\)](#). The five items for TMS were modified format and adopted from [Cruz-Jesus et al. \(2019\)](#). Finally, the measurement items for the working environment were taken from [Raziq and Maulabakhsh \(2015\)](#). All variables were reflective in nature.

3.4 Data preparation

The proposed research model and structural relationships were examined through partial least squares structural equation modeling (PLS-SEM) using Smart PLS software. This approach is recommended for a situation in which the theory is less developed ([Cao et al., 2021](#); [Gefen et al., 2011](#); [Hair et al., 2010](#)), and the research model is large and complex ([Gefen et al., 2011](#)). While SET is well-developed and empirically explained, managers' perceptions of AI during a crisis are proposed for the first time in our study. Our research model comprised complex interrelationships among eight constructs and thirty-five indicators. Additionally, the SEM analytical approach provided two simultaneous outcomes: factor and regression analyses ([Hu and Bentler, 1999](#)). Thus, we used the SEM analytical approach to evaluate the relationship between dependent and independent variables, which are commonly used to understand the relationship constructs in cross-sectional data. A two-stage SEM approach was employed in this current study. In the first stage of SEM, there were measurement model aspects such as factor loading (FL), average variance extracted (AVE), composite reliability (CR), and Cronbach's alpha (CA). In the second stage of SEM, our research model was tested to validate the proposed research hypotheses.

3.4.1 Multivariate assumptions. We performed several statistical tests to confirm that our data met the multivariate assumptions required for further analysis. We initially checked for skewness and kurtosis by using SPSS to establish normality. As all values were within -2.58 to $+2.58$, the data were normally distributed. Next, we generated variance inflation factor (VIF) values which were below the commonly recognized VIF threshold of 3 ([O'Brien, 2007](#)). Consequently, we concluded that the data had no multicollinearity problems (see [Table 1](#)). Finally, we generated a scatter plot to confirm the homoscedasticity ([White, 1980](#)). We examined the regression of standardized residues of all our relationships and found that they were equally apart from the regression line. As a result, the presumption of homoscedasticity was considered satisfactory.

3.4.2 Validity and reliability. We performed different statistical tests to ensure the validity and reliability of the data. We verified the validity and reliability of our data using the FL, CR, CA, and AVE values, as suggested by [Hair et al. \(2010\)](#). The CR and CA values were both greater than the 0.70 criterion, indicating that all measurements were reliable ([Hair et al., 2010](#)). Similarly, the FL and AVE values were greater than 0.70 and 0.50, respectively, demonstrating the convergent validity of the research instrument (see [Table 1](#)). Next, as indicated by [Hair et al. \(2010\)](#), we validated our data's discriminant validity using the correlation matrix and square roots of AVEs (see [Table 2](#)). This table shows that the inter-construct correlations were less than the diagonally represented square roots of AVEs. Thus, we confirmed discriminant validity. Furthermore, [Henseler et al. \(2014\)](#) proposed that the heterotrait-monotrait ratio of correlations (HTMT) should be less than 0.85 (see [Table 3](#)). Based on these criteria, the model has strong discriminant validity.

3.4.3 Common Method Bias (CMB). CMB refers to measurement errors caused by methodological issues. For example, using a standardized measuring scale (seven-point Likert scale) for all survey items may result in CMB. We employed Harman's single-factor test. We performed an exploratory factor analysis, assuming that all items were loaded onto a single latent factor. The average variance of a single factor was only 39.48%, which is below the threshold of 50%. Thus, we conclude that CMB was not a concern in our study.

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	Construct	Items	Loadings	VIF	CA	CR	AVE
	Business models	BM1	0.86	2.51	0.91	0.93	0.74
		BM2	0.88	2.26			
		BM3	0.88	2.09			
		BM4	0.89	2.85			
		BM5	0.79	1.93			
	Budgeting	BT1	0.78	1.98	0.89	0.92	0.70
		BT2	0.87	2.80			
		BT3	0.87	2.82			
		BT4	0.87	2.66			
		BT5	0.78	1.72			
	Effective business operations	EBO1	0.83	2.31	0.89	0.92	0.69
		EBO2	0.85	2.67			
		EBO3	0.87	2.69			
		EBO4	0.82	2.26			
		EBO5	0.77	1.94			
	Inventory management	IM1	0.87	1.71	0.79	0.88	0.70
		IM2	0.83	1.68			
		IM3	0.82	1.59			
	Managers' satisfaction	MS1	0.85	1.92	0.83	0.90	0.75
		MS2	0.90	2.37			
		MS3	0.85	1.81			
	Supply chain management	SCM1	0.87	2.53	0.92	0.94	0.76
		SCM2	0.90	2.34			
		SCM3	0.91	2.95			
		SCM4	0.84	2.25			
		SCM5	0.84	1.33			
	Top management support	TMS1	0.81	1.97	0.83	0.88	0.60
		TMS2	0.81	1.99			
		TMS3	0.76	1.67			
		TMS4	0.76	1.63			
		TMS5	0.72	1.60			
	Working environment	WE1	0.83	1.94	0.85	0.90	0.69
		WE2	0.87	2.35			
		WE3	0.85	2.15			
		WE4	0.76	1.54			

Table 1.
Measurement model

	Constructs	BM	BT	EBO	IM	MS	SCM	TMS	WE
Table 2. Correlation matrix and the square root of the AVE	BM	0.86							
	BT	0.57	0.84						
	EBO	0.50	0.69	0.83					
	IM	0.46	0.41	0.63	0.84				
	MS	0.45	0.53	0.43	0.65	0.87			
	SCM	0.25	0.68	0.58	0.55	0.69	0.87		
	TMS	0.37	0.58	0.50	0.44	0.63	0.69	0.77	
	WE	0.53	0.63	0.64	0.67	0.68	0.54	0.62	0.83

Table 2.
Correlation matrix and
the square root of
the AVE

4. SEM results

Following the confirmation of the measurement model's appropriate psychometric features, we evaluated the structural model. The predictive capability of a structural model is evaluated using the R^2 (square) value of endogenous constructs (Chin, 1998). The proposed

model explained 68.5% of the variance in managers' satisfaction and 53.5% of the variance in effective business operations. As the percentages of variance explained were significantly greater than 30%, this implies a satisfactory and substantive model (Falk and Miller, 1992). We also considered omission separation to be seven to estimate cross-validated redundancy concerning the corresponding predicting determinants (Cao *et al.*, 2021). We estimated the Stone-Geisser Q^2 value for managers' satisfaction to be 50.8% and for effective business operations to be 36.4%, which is far above the recommended threshold (Geisser, 1975). It helped to know that the results have considerable predictive relevance.

To prove the hypothesized relationships, standardized path coefficients should be significant at the level of $p < 0.05$ (Byrne, 2016). The findings of this study support all seven hypotheses (see Table 4). Among the first four hypotheses, H1 supports that AI in SCM has a positive impact on managers' satisfaction in the context of China. Similarly, H2, H3, and H4 are supported, suggesting a positive association between AI in BM, IM, and BT with managers' satisfaction. The results support H5, suggesting that managers' satisfaction has a positive impact on effective business operations. Finally, H6 and H7 are also supported by results, suggesting that TMS and working environment positively moderate the relationship between managers' satisfaction and effective business operations.

5. Discussion

5.1 Key findings

We relied on SET and examined seven hypotheses to investigate managers' perceptions of using AI in business operations during the COVID-19 pandemic. With respect to the first four hypotheses, this study's findings show that AI usage in SCM, IM, BM, and BT is positively associated with managers' satisfaction. Earlier studies that focused largely on the effects of using technology for business and managers' behavioral and psychological outcomes found managers' perceptions to be mixed and ambiguous (Beare *et al.*, 2020; Stam and Stanton, 2010; Tarafdar *et al.*, 2010). Similarly, managers' attitudes regarding technology as a strategic management tool for operating a business are still debated (Beare *et al.*, 2020; Tarafdar *et al.*, 2010). Researchers have argued that technology can have a negative effect on employees for a variety of reasons, including trust, risk, anxiety, and well-being issues (Beaudry and Pinsonneault, 2010; Cao *et al.*, 2021; Vakola and Nikolaou, 2005). Researchers have also found that technology causes of IT-related technostress, technophobia, and anxiety (Dwivedi *et al.*, 2021). In contrast, we found a direct association between the use of AI in business operations and managers' satisfaction, which is by and large in line with the results of previous research conducted in different IT contexts (Barley, 2015; Bernal, 2016; Cascio and Montealegre, 2016; Tong *et al.*, 2021). Managers enjoy organizational changes when they contribute to them (Appelbaum *et al.*, 2018; Rana *et al.*, 2017). Consistent with the findings of prior research, we argue that AI-embedded workplaces can result in enhanced participation and collaboration, all of which can lead to positive feedback from managers. Additionally, consistent with

Constructs	BM	BT	EBO	IM	MS	SCM	TMS
BT	0.83						
EBO	0.78	0.89					
IM	0.69	0.75	0.87				
MS	0.55	0.54	0.65	0.82			
SCM	0.62	0.56	0.77	0.78	0.81		
TMS	0.58	0.61	0.63	0.70	0.67	0.80	
WE	0.52	0.72	0.73	0.62	0.51	0.64	0.74

Table 3.
Heterotrait-Monotrait
Ratio (HTMT)

Table 4.
Hypothesis results

employees’ satisfaction and firms’ profitability (Hill, 2008; Yee *et al.*, 2008), this study supports the idea that managers’ satisfaction has a direct impact on successful business operations, particularly for managers who want AI-enabled work events for successful business operations. Thus, our study proves that AI usage allows effective business operations during a crisis like COVID-19 and reduces negative feelings in managers toward adopting automation to survive in competitive markets.

The impacts of the moderators, TMS, and WE on the relationship between managers’ satisfaction and effective business operations were also found to be significant. As seen in Figure 2, the impact of managers’ satisfaction on effective business operations is highest among those managers who pay considerable attention to the support and assistance provided by senior management. In fact, the support that managers receive from their top management facilitates the necessity of using AI for effective business operations. Previous research findings confirmed the moderating role of TMS on the relationship between self-control, behavioral control, and openness of service innovation with technology adoption (Hsu *et al.*, 2019; Kanwal *et al.*, 2017), while our study found that TMS pertains to the extent to which managers’ satisfaction impacts their ability to perform business operations effectively with a high level of mutual cooperation with top management.

Working environment positively moderated the relationship between managers’ satisfaction and effective business operations. A high WE level shows a strong positive relationship between managers’ satisfaction and effective business operations. In contrast, a low WE level demonstrates a positive but weak relationship between these two factors, as shown in Figure 3. Previous research supports the idea that managers do better at work because of less stress when the work environment is supportive, which results in successful business operations (Judge and Larsen, 2001; Matsuo, 2019). Previous research findings have confirmed the moderating role of the working environment on the relationship between

Hypothesis	Path	Coefficient (β)	T-values	Supported
H1	SCM → MS	0.195	3.779	Yes
H2	BM → MS	0.176	3.257	Yes
H3	IM → MS	0.320	7.531	Yes
H4	BT → MS	0.211	5.141	Yes
H5	MS → EBO	0.233	5.745	Yes
H6	(MS → EBO) × TMS	0.097	4.236	Yes
H7	(MS → EBO) × WE	0.074	2.506	Yes

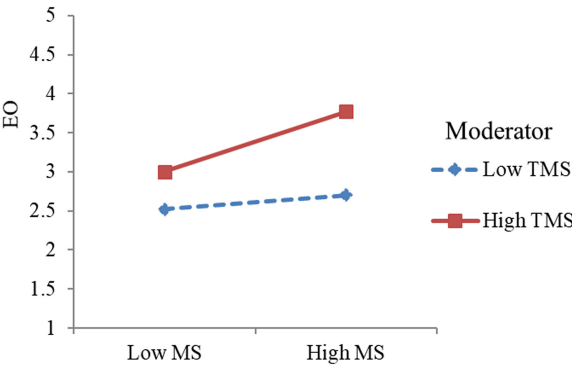


Figure 2.
The moderation effect
of TMS

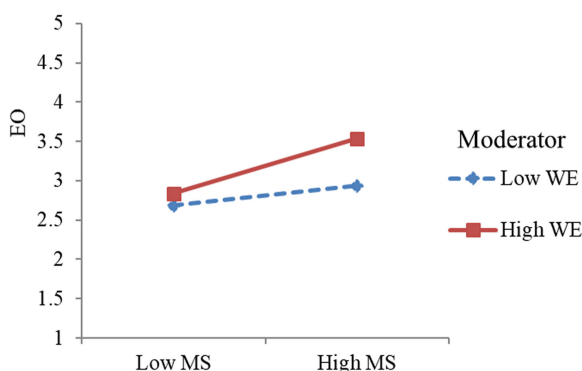


Figure 3.
The moderation effect
of WE

motivation, job satisfaction, and performance (Raziq and Maulabakhsh, 2015). In contrast, our study confirms the moderating role of the working environment on the relationship between managers' satisfaction with using AI in business and effective operations during COVID-19.

5.2 Theoretical implications

Our study adds to the existing literature by linking managers' satisfaction with using AI in business for effective operations during a crisis like COVID-19. Although numerous conceptual studies have been conducted to demonstrate the potential benefits of AI (Luo *et al.*, 2021; Tong *et al.*, 2021), and some of them have even raised concerns about AI (Beaudry and Pinsonneault, 2010), there still seems to be a need for a theoretical model that could facilitate the integration of managers' perceptions of using AI during a crisis with business operations. Our study adds empirical evidence to the body of knowledge regarding the use of AI during COVID-19, which contributes to the creation of a more comprehensive framework for managers' understanding of AI adoption in business operations.

Our study relies on SET to obtain an overall view of managers' perceptions towards using AI during COVID-19 and develop a new theoretical model. Although the current study has indicated that managers have positive perceptions and intentions to use AI when they realize the technology's usefulness and ease of use (Barley, 2015; Cao *et al.*, 2021) or to avoid the threats inherent in technology use (Bernal, 2016), our model provides some insights into how managers' attitudes and behavioral motives can be interpreted and predicted considering the benefits of AI (Cao *et al.*, 2021). The present study extends SET in the existing literature on managers' perceptions and allows AI to strengthen business operations during crises like COVID-19, and thus reducing negative feelings among managers to adopt automation pressure to survive in competitive markets.

The moderating role of the TMS has been validated by different studies as a key antecedence of technology adoption and openness for service innovation (Hsu *et al.*, 2019; Kanwal *et al.*, 2017). However, our study adds to the body of knowledge by supporting TMS as a moderator in the relationship between managers' satisfaction and effective business operations during the COVID-19 crisis. In contrast, the working environment has not been well covered in prior literature on AI usage in business operations. Accordingly, in this context, our study has made a significant contribution by validating the moderation role of the working environment in relation to managers' satisfaction and effective business operations during the COVID-19 crisis.

5.3 Practical implications

Our study has significant managerial implications for existing literature. First, it sheds light on managers' perceptions of businesses run by AI. Previous research had indicated that managers are skeptical about AI in businesses and fear probable violations of their privacy and autonomy (Jarrahi, 2018; Luo *et al.*, 2022; Tong *et al.*, 2021). However, our findings help overcome the managers' negative perceptions of AI. Positive perceptions of managers about AI help firms wishing to adopt AI in effective business operations. Furthermore, AI significantly increases business operations' accuracy (Dietvorst *et al.*, 2015; Logg *et al.*, 2019) and thus helps firms to achieve higher profits. As AI enables managers' satisfaction to increase their work performance and learning, it may benefit all three parties involved: a firm, its employees, and the customers. Additionally, this study reveals a new channel through which AI can become an effective business tool. While previous studies have focused on how AI changes firms' production processes (Jarrahi, 2018; Luo *et al.*, 2019; Mathiyazhagan *et al.*, 2021; Toorajipour *et al.*, 2021), our study reveals a new way for firms to consider AI as just a factor beyond the traditional production process during a crisis.

Second, our research model could help firms adopt AI usage policies to improve managers' satisfaction. Tong *et al.* (2021) claimed that an AI usage policy could mitigate managers' negative perceptions about the deployment of AI, which also enhances their performance. An AI usage policy in business operations can make an employer more attractive from the perspective of prospective and current managers. Furthermore, our findings indicate that managers' perceptions of using AI in favorable conditions have an indirect effect on effective business operations. The significant moderating effect of TMS and working environment on the relationship between managers' satisfaction with using AI and effective business operations should draw the attention of policymakers. Our findings on the moderating effect can be used to influence the behavior of managers inside a firm regarding the adoption of AI to meet current business needs, which will favorably impact both developed and developing countries.

Finally, our findings suggest that firms should employ a combination of AI and human managers to ensure effective business operations. Human managers and AI are not substitutes but rather complement one another. The COVID-19 pandemic has further demonstrated the need for an AI-human combination in business operations. In a combination like this, managers can focus on interpersonal and difficult to automate operations, while AI focuses on big data computing skills (e.g. SCM, IM) and individualized feedback on a scale that can improve managers' relationships with their subordinates. Thus, an AI-human combination can allow firms to achieve targets through effective operations by automating in competitive markets.

6. Conclusions, limitations, and future research

In this study, we extend SET in the literature on the managers' perceptions of AI usage in business for effective operations during COVID-19. No one knows with certainty how AI will shape the future workplace, but our work suggests that digital transformation and strengthening of business operations through AI during a crisis, like COVID-19, and the resulting managers' positive perception could increase firms' value and lessen negative feelings in managers toward adopting automation to survive in competitive markets. Our study contributes to a better understanding of managers' perceptions and behavioral intentions to employ AI in firms for decision-making. Our proposed research can facilitate a more balanced debate on the advantages of using AI for effective business operations. Finally, our findings can help businesses adopt AI usage policies in line with managers' expectations.

The generalization of the study's findings may be questionable because managers from a single country (China) took part in the survey during COVID-19. Although we have confirmed the validity and reliability of our data collected from specific geographical, cultural, and

economic specificities, further studies can replicate our study in other geographical, cultural, and economic contexts to corroborate these conclusions. Our study was performed using cross-sectional self-reported data, which might cause common bias. While common method bias was minimal in the existing findings of our study, future research on longitudinal design should be conducted to test our model over time and generalize the findings. The data in our study were gathered during the COVID-19 crisis; thus, future research should be conducted to capture sector and industry-wise managers' views in a normal situation to generalize our findings. In addition, open discussions with industry experts could refine and validate our results.

Researchers might expand our results by examining the perceptions of other stakeholders (e.g. customers and shareholders) towards the usage of AI in business. Our study covered the use of AI in only four business activities. Thus, our findings can be extended further by examining how managers respond to the use of AI in other dimensions of business activities (e.g. HRM, R&D, staffing shortages during COVID-19) to generalize our findings.

Finally, in contemporary social science research, the examination of borderline situations between an antecedent and its consequences is commonly used to validate the relationship between business stakeholders (Mahmud *et al.*, 2021). Therefore, it can be examined whether potential moderators (e.g. financial stability, job security) reflect managers' satisfaction toward AI usage in effective business operations.

Note

1. <https://www.statista.com/topics/1456/export-in-china/>

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Appendix

Measurement scale of the study

Supply chain management (SCM)

- (1) AI is the most prevalent technique in SCM.
- (2) Employment of AI techniques will improve SCM.
- (3) AI-enabled SCM can improve SCM subfields (suppliers' levels, manufacturing factories).
- (4) AI has a high potential for enhancing SCM subfields.
- (5) AI-based SCM is the best demand forecasting and performing method.

Business models (BM)

- (1) AI-enabled BM can play a vital role in value creation.
- (2) AI-enabled BM has the ability to capture value dimensions (cost-revenue model).
- (3) AI-enabled BM confirm the value delivery system of new technology-based capabilities and employee competencies.
- (4) AI-enabled BM can understand a firm's capabilities and ecosystem.
- (5) AI-enabled BM can develop firm internal competencies.

Inventory management (IM)

- (1) AI, through data analytics, facilitates resilient IM.
- (2) AI-based IM increase forecasting accuracy.
- (3) Entire supply chain benefits from AI-enabled IM by balancing demand and supply.

Budgeting

- (1) AI-algorithm could predict budget properly.
- (2) AI-enabled budgets are developed and updated frequently to respond to changes in the market.
- (3) AI-algorithms-supported budgeting approach can truly improve the allocation processes of assets, revenues, and expenses.

- (4) An AI-enabled budget increases compliance and reduces budgeting costs.
- (5) An AI-enabled budget maximizes employees' efficiency and firms' profitability.

Managers' satisfaction

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- (1) My satisfaction with using AI in business operations has increased.
 - (2) My impression of AI in business operations has improved.
 - (3) I now have a more positive attitude towards the AI in business operations.

Effective business operations

- (1) Integrated value-added service facilitates effective business operations.
- (2) Long-term planning enables successful business operations.
- (3) Connecting operating strategy with business strategy facilitates business success.
- (4) Supply chain integration with automation facilitates effective business operations.
- (5) Operational efficiency enhances successful business operations.

Top management support(TMS)

- (1) TMS the adoption of AI technologies in business.
- (2) TMS the operation of AI technologies in business.
- (3) Top management is willing to face financial and organizational risks associated with implementing AI technologies in a workplace.
- (4) Top management is willing to face financial and organizational risk associated with operating AI technologies in business.
- (5) Top management is actively engaged in developing an AI-enabled business strategy and is capable of connecting it to the firm's objectives.

Working environment

- (1) Physical working condition is satisfactory.
- (2) Training opportunities in the organization are high.
- (3) Assistance from co-workers is satisfactory when necessary.
- (4) Supervisors provided me with sufficient information related to work.

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