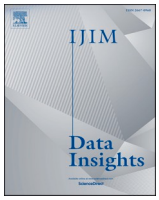
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Factors influencing the adoption of artificial intelligence in e-commerce by small and medium-sized enterprises

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ABSTRACT

The rapid evolution of technology has fundamentally transformed business operations. Therefore, companies are increasingly leveraging technology to enhance their processes and gain a competitive edge. In this context, the adoption of artificial intelligence (AI) in e-commerce has become a crucial area for business development. However, there is currently a lack of understanding regarding the key factors that determine the adoption of AI in e-commerce by small and medium-sized enterprises. Thus, to fill this gap, this study aims to investigate the factors influencing the adoption of AI tools in e-commerce for SMEs. This study will also explore how the adoption of AI by SMEs contributes to the business performance of these organizations. To achieve this, the study proposes an integrated model based on the dynamic capabilities framework, entrepreneurial orientation, and customer-centric systems. Empirical data for the current study were collected using a digital survey, which was disseminated to a purposive sample of SMEs in Saudi Arabia. Analysis of the collected data was performed using structural equation modeling (SEM), and the results support the role of both dynamic capabilities and entrepreneurial orientation in facilitating the adoption of AI in e-commerce. The study confirms of the significant role of AI adoption in enhancing the business performance of SMEs. This study seeks to make several theoretical contributions and implications for practice. This will also provide small and medium-sized companies with valuable insights that help in making decisions and building strategies. However, it is important to acknowledge the limitations of this study, which will be discussed later in the paper.

1. Introduction

Many companies seek to adopt e-commerce to increase sales and services and achieve greater customer satisfaction. E-commerce contributes significantly to increasing the revenues and profits of SMEs if successful strategies and tools are relied upon in e-commerce (Abbas et al., 2023; Ojha et al., 2023). However, the success of adopting such electronic platforms for companies may be affected by the degree of their commitment and reliance of smart technologies and tools that contribute to providing the best technical services to customers (Mishra et al., 2023). The adoption of AI in e-commerce is one of the most important reasons for business success, as AI tools contribute to exploiting the available data for products and customers to find opportunities that help promote goods and services (Bawack et al., 2022; He & Liu, 2024).

E-commerce is defined as all activities of buying, selling, and providing various services via the internet (Leonard, 2012). AI is referred to as a set of actions carried out by the system, similar to those carried out by humans, with more efficient and accurate procedures and methods that help solve problems and make decisions (Saleem et al., 2024). Therefore, AI tools help to exploit and analyze the big data available to many companies and organizations to help speed up business and provide information that contributes to making effective and appropriate decisions in real time (Kushwaha et al., 2021; Sestino & De Mauro, 2022). AI tools analyze customer data to generate valuable information and help make strategic decisions based on a wide range of data (Verma et al., 2021).

There are many scientific studies that have investigated the role of AI in e-commerce with regard to customer services, facilitating sales, and collecting information (Xu & Ruan, 2023; Li et al., 2023). However, there is a dearth of research related to the role of adopting and enhancing AI tools in sustaining e-commerce business performance and supporting the role of entrepreneurship in the performance of SMEs. Therfore, this paper seeks to investigate and research the factors affecting the adoption of AI in e-commerce in SMEs to promote entrepreneurship and increasing and activating the role of these companies in the advancement and development of the country's economies.

North et al., (2020) state that SMEs play a substantial and influential

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role in the high economy, as they have a high share of employment and commercial value. Despite this, these companies face many difficulties and challenges in adopting many new technologies and keeping pace with technological development (Barata et al., 2023; Cheng et al., 2024). Consequently, understanding the factors in adopting AI in e-commerce can provide diverse solutions that contribute to supporting the adoption of AI tools and thus enhance the market value of their products and services. Moreover, SMEs face challenges in making decisions that improve their business performance due to the lack of exploitation of data (Sharma et al., 2022). Thus, this study contributes to learning more about the obstacles and also presenting strategies for adopting AI technology in e-commerce for SMEs.

The limited understanding of how SMEs can leverage AI tools in e-commerce significantly impacts their development and ability to gain a competitive advantage.There is also a need for more in-depth studies in this field in order to address challenges, exploit opportunities, and provide effective recommendations through AI tools (Salah & Ayyash, 2024). Likewise, Bawack et al. (2022); Kumar et al., (2021); and Chung et al., (2022) mentioned that there is a scarcity of research in studies related to the adoption of AI in e-commerce for SMEs. This requires further collection and analysis of relevant data to meet research needs as well as support for SMEs.

Over the context of SMEs in Saudi Arabia, Fakieh and Wali (2024) pointed to a number of factors that support the adoption e-commerce in Saudi Arabia in SMEs. The factors included the importance of knowledge awareness, the lack of understanding of the technology, and the lack of skilled IT personnel. Baabdullah et al., (2021) also state that the significance of designing AI solutions in the e-commerce websites is to be more suitable for the end user's preferences when communicated with SMEs. Despite the technical and commercial prosperity in Saudi Arabia, there are some challenges facing SMEs to take full advantage of e-commerce opportunities. Challenges include lack of digital skills, funding sources, and intense competition between companies (Ballerini et al., 2023). Data privacy is also considered an important and influential factor in building trust with shoppers and customers in Saudi Arabia (Gull et al., 2022). Therefore, this study gives high additional value and accurate data that contributes to supporting the aim of the study and related topics.

In the light of the above-mentioned discussion, and to comprehensively explore the adoption of artificial intelligence (AI) in e-commerce by small and medium-sized enterprises (SMEs), this study aims to address several critical aspects that drive and influence this adoption. The following key research questions have been formulated to guide the investigation and provide a structured approach to understanding the various factors involved::

1. *What factors influence the adoption of AI in e-commerce by SMEs?*
2. *To what extent do dynamic capabilities and entrepreneurial orientation contribute to the adoption of AI in e-commerce for SMEs?*
3. *To what extent does a customer-centric system contribute to the adoption of AI in e-commerce within SMEs?*
4. *To what extent does an entrepreneurial orientation play in affect the adoption of AI in e-commerce among SMEs?*
5. *To what extent does the adoption of AI in e-commerce impact SMEs' Business performance?*

This study aims to make several theoretical contributions and implications for practice. It will contribute to the development of an integrated model that includes dynamic capabilities, entrepreneurial orientation, and customer-centric systems. This model will explain in-depth the impact of AI adoption on e-SMEs in the field of commerce. The findings of this study will provide valuable insights to SMEs, assisting them in making informed decisions and developing effective strategies. Additionally, the model will help in leveraging AI tools within e-commerce operations to enhance customer experience and satisfaction. By integrating the framework of dynamic capabilities, entrepreneurial orientation, and customer-centric systems, this study will provide a comprehensive theoretical basis for analyzing the adoption process and its effects in the context of e-commerce.

The results of this study will have practical implications that contribute to identifying the key factors influencing the adoption of AI in e-commerce among SMEs. This will help stakeholders understand the critical determinants of successful implementation of such emerging systems. This knowledge can guide small and medium-sized companies in various procedures and help address obstacles that hinder the adoption of AI. Understanding the role of dynamic capabilities in AI adoption will enable companies to assess and enhance their internal and external capabilities. Examining and studying entrepreneurial orientation in depth is an important parameter for AI adoption, as it provides insight into the importance of enhancing the role of entrepreneurship and encouraging innovation in the context of applying AI in e-commerce.

This paper contributes to identifying the advantages and opportunities of adopting smart systems in the field of e-commerce for SMEs. Additionaly, exploring additional methods for implementing and adopting the best strategies for entrepreneurship development, while selecting the most effective tools. The findings of the research provide valuable insights for companies to learn about the role of AI tools and how to achieve a competitive advantage.

The rest of the current paper is structured as follows: In Section 2, a careful review of the main body of literature related to AI and SEMs is provided. Section 3 discusses the theoretical background, the proposed conceptual model, and hypothesis development. Section 4 elaborates on the main research methodology employed in the current study. Data analysis and empirical results are presented in Section 5. Finally, Section 6 provides an in-depth analysis of the main findings with sufficient practical and empirical justification. In this section, theoretical contributions and practical implications are also discussed and presented.

2. Literature review

Artifical Intelligence plays a crucial role in providing accurate and highly efficient information while processing data without human intervention (Cubric & Li, 2024). This not only saves time but also helps customers meet their needs and preferences, leading to increased satisfaction with the website. This includes supporting various aspects of e-commerce, including product marketing, payments, and shipping, ensuring smooth and effortless operations. This can enable organizations to gain valuable insights into the market, customer behavior, and business performance over specific periods (Qi et al., 2023). By analyzing customers' clicks on products, AI tools can provide solutions and suggestions based on their preferences and needs (Sharma et al., 2021). It can also assist in addressing customer inquiries through chat platforms, enhancing the company's ability to respond promptly (Gupta et al., 2024) (Table 1).

According to Pallathadka et al. (2023), AI in the field of e-commerce helps increase sales, forecast sales, achieve a higher level of safety, combat fraud, manage business, and manage key services on the site. AI can perform human actions that require intelligence in its procedures, such as visual recognition of people or language translation. Therefore, it is imperative for SMEs to leverage AI tools to obtain maximum value and competitive advantage, which includes reducing human errors, analyzing customer data, and providing highly efficient services. AI also contributes to providing new and smart innovations that serve both institutions and customers, such as forecasting sales and attracting more customer (Dwivedi et al., 2023). Furthermore, AI tools in e-commerce help to find ways that contribute to the acceptance of specific products, such as presenting offers that suit customers' desires, finding promotional solutions, and answering customer inquiries in easy, accurate, and fast ways.

Wei and Pardo (2022) and Alalwan et al. (2023) pointed out that many SMEs face challenges in financial, as well as technical resources, which is considered a challenge that needs to be addressed in order to

Table 1
Studies of AI and SEMs.

Study	Methodology and Data Instrument Used	Factors Tested	Theory Adopted	Context	Limitations and Future Direction
Alalwan et al. (2022)	Self-administered online questionnaire	RMO; entrepreneurial alertness; system quality; and service quality; entrepreneurs' engagement in e-equity crowdfunding, which in turn, predicts both knowledge acquisition and innovation performance	Relationship marketing orientation (RMO); Kirzner's alertness theory; and the DeLone and McLean model of information systems	e-crowdfunding in Saudi Arabia	This study has explored the aspects of e-equity crowdfunding primarily from the perspective of entrepreneurs, rather than supporters. Therefore, it would be valuable for future research to investigate the relevant aspects of e-equity crowdfunding from both viewpoints: those of the entrepreneurs and the supporters.
Upadhyay et al. (2023)	Quantitative survey methodology	Business innovativeness; affordances, culture; flexible design, entrepreneurial orientation, generativity, openness and technology orientation; adoption intention of AI;	Digital entrepreneurship and entrepreneurship orientation	This study examines contributing factors explaining the adoption intention of AI in the context of family businesses.	Further studies could explore contextual factors and their contributions, such as infrastructure, change, risk, trust, leadership, governance, politics, and ownership type.
Salah and Ayyash	Survey	business partner pressure; AI Integration; customer tech-savviness; innovation culture; competitive pressure. SMEs' E-Commerce adoption and Marketing performance	The Technology-Organization-Environment (TOE)	SMEs in Palestinian	The generalizability of the study is another notable limitation. The findings mainly apply to Palestinian SMEs and, to a lesser extent, to countries with similar conditions and cultures. However, this study did not encompass all SME industry sectors within the Palestinian context. Consequently, there is considerable scope for future research to investigate the adoption of e-commerce across different industries, sectors, and even other countries, thereby paving the way for a more comprehensive understanding.
Octavia et al. (2020)	Survey	Entrepreneurial Orientation; Marketing orientation; E-Commerce adoption and business performance.	Entrepreneurial Orientation	Entrepreneurial business in Indonesia	Governments, academics, and related institutions must play a role in assisting SMEs in adapting to the use of technology. Programs should be designed to provide support and reinforcement from the technological side.
Alalwan et al. (2023)	Online Survey	entrepreneurial orientation and marketing orientation entrepreneurial finance-based digital transformation (EFDT), which in turn, is expected to predict both innovation entrepreneurial finance (IEF) and SMEs' entrepreneurial performance (SMEEP)	Kirzner's alertness theory	Entrepreneurial Businesses/ Saudi Arabia	This study focused solely on entrepreneurial financial alertness as a key capability predicting digital transformation. However, other capabilities such as human capital, social capital, financial condition, and information capital may also play significant roles and should be assessed in future research.
Kwarteng et al. (2023).	Survey	performance expectancy (PE), effort expectancy (EE), facilitating conditions (FC) and competitive pressure (CP)	structural equation modeling (PLS-SEM) techniques	Competitive pressure for SMEs digitalization adoption in two European nations	The study recommends that future researchers adopt a mixed approach, allowing for the triangulation of findings between the two approaches.

adopt AI. Barata et al. (2023) pointed out, there are perceived concerns among some SMEs that include operational efficiency, concerns about job displacement and ethical implications as factors in the adoption process. For a smooth and successful implementation, SMEs need training programs for end users to remove any ambiguity and empower them by acquiring the necessary skills to utilize AI tools effectively (Chung et al., 2022; Wei & Pardo, 2022).

Salah and Ayyash (2024) conducted a study on the impact of the role of marketing through e-commerce with the integration of AI in small companies, where 305 small companies participated. The study results indicated that AI and business innovation positively affected the adoption of e-commerce. In addition, the adoption of e-commerce has a positive impact on supporting the marketing aspects of SMEs. In another study by Qi et al. (2023), the focus was on establishing a sustainable supply chain through the support of AI tools for e-commerce business, facilitating interactions between companies and customers. The results of the study identified four main enabling results for AI, including the role of AI in improving work performance and assisting in decision-making. It was also found to play a significant role in obtaining trust by providing recommendations, in addition to analyzing consumer behavior and feelings, and providing various theories of AI with technologiesThe knowledge and skills of the human element in companies play a role in the successful management of information systems. Wei and Pardo (2022) identified that knowledge in information technology matters in SMEs and plays an important role in the level of their operation and their provision of business intelligence tools.

There are various smart tools commonly used by SMEs on their commercial websites to enhance the customer experience and streamline tasks. One of these tools frequently utilized on e-commerce sites is chatbots (Dwivedi et al., 2023). Chatbots are employed to address

customer inquiries and requests, check order statuses, provide technical support, facilitate payment procedures, and offer shipping details (Gupta et al., 2024). Another commonly employed tool is the recommendation system, which plays a significant role in analyzing customer behavior, predicting sales, and influencing customer decisions (Bawack et al., 2022).

3. Theoretical background, proposed conceptual model, and hypotheses development

This study will rely on the theory of dynamic capabilities in enhancing the role of AI in supporting e-commerce and knowing the entrepreneurial role in providing more efficient products and services (Teece, 2010). Dynamic capabilities are among the theories commonly used in studies that are interested in investigating how companies obtain competitive advantage by focusing on the role of changes in the external environment (Yáñez-Valdés & Guerrero, 2024). Dynamic capabilities also refer to the competencies and capabilities of the company to obtain opportunities and reshape and exploit internal and external resources in rapidly changing work environments (Gao et al., 2024; Karimi & Walter, 2015; Wang et al., 2023).

Dynamic capabilities are the companies' capabilities to integrate, develop, and build internal and external competencies in order to better perform in dealing with rapidly changing environments (Teece, 2010). It is also the ability of companies to strengthen, expand, and modify their resource base in a way that contributes to achieving the goals (Daniel & Wilson, 2003). Dynamic capabilities approaches are valuable frameworks that emphasize how businesses can cultivate the essential capabilities, including HR capabilities, to maintain a competitive advantage amidst changing external environments (Yáñez-Valdés & Guerrero, 2024). They can also be used to study how companies could improve and develop their capacity (Gao et al., 2023).

Aloulou's (2023) study focused on the relationship among entrepreneurial orientation, attitudinal dimensions, and company performance through a sequential mediation framework involving innovation capability and company resilience capability. Data collection was conducted through a survey involving 225 SMEs in Saudi Arabia. The results of the study show that the behavioral dimension of entrepreneurial orientation has a positive influence on firm performance. Furthermore, the study indicates that entrepreneurial orientation dimensions significantly influence innovation capability. Additionally, innovation capability positively influences firm performance. Another study by Daniel and Wilson (2003) about investigating the dynamic capabilities that support and develop electronic business while identifying different practices that develop effective capabilities to improve corporate performance. The results of the study indicated that companies need to find and activate innovative services that improve the way they do business and how to improve communication and interact with stakeholders. In addition, they pointed out the importance of working in the company as one coherent and cohesive entity in order to achieve and reach a high degree of synergy and provide consistent service.

In an Indonesian study conducted by Nasution et al., (2021) examined the dimensions of entrepreneurial orientation and the process of knowledge management and the dynamic ability to adopt e-commerce for SMEs. The results of this study indicated that innovation and proactivity have an important relationship with the adoption of e-commerce, and risk was considered insignificant. While it was found that dynamic capabilities have a very significant relationship with e-commerce.

The dynamic capabilities approach provides methods and tools that contribute to the analysis of operations in order to support organizations in adapting their resources and plans to adapt to changing environments (Daniel et al., 2014). Teece (2007) indicated that dynamic capabilities can be divided into three capabilities, which include sensing, seizing, and transforming. Dynamic capabilities help to adapt to rapidly changing environments by drawing on the formation of internal and external experiences, resources, and job competencies (Wu et al., 2024).

Integrated dynamic capabilities, combined with effective and good strategies, enable organizations to become more market-oriented and enhance the role of entrepreneurship (Liu et al., 2023). Laguir et al. (2022) stated that dynamic capabilities work to improve and develop the performance of organizations and work to adapt, rebuild, and modernize them in a way that helps and enhances competitive advantage.

It shows the importance of accreditation and activation of dynamic capabilities in the field of e-commerce in order to improve and develop businesses and obtain a competitive advantage (Nasution et al., 2021). In a study by Sunday and Vera (2018), the adoption of information and communication technology in SMEs was examined using the framework of dynamic capabilities. The study employed a qualitative approach, specifically in-depth interviews, to gather data. The results of the study indicate that using the dynamic capabilities approach to examine the process of adopting information technology helps identify the iterative nature of the process and that the factors differ in each of the individual stages. In addition, the study highlighted several factors that influence the adoption of information and communication technology such as return on investment, ease of use, managerial time, and adoption cost, which were all found to consistently impact all stages of ICT adoption. Additionally, factors like openness to change, shared support, competition, and customer focus were found to have an influence on at least two stages of the adoption process. These factors significant impact in the decision-making process of small business managers and other stakeholders when considering the adoption of emerging ICT solutions

Relying on the dynamic capabilities approach is considered appropriate for this study because it helps to adopt and investigate advanced information systems and contributes to business restructuring and modification in order to reach a competitive advantage (see Fig. 1). This approach is very compatible with the situations of SMEs, as the concept of dynamic capabilities is considered flexible and not difficult, and there are many changes in their conditions due to the external environment. Therefore, dynamic capability helps support these institutions in developing, coordinating, integrating, reshaping, and exploiting their technologies (Sunday & Vera, 2018).

3.1. Entrepreneurial orientation

Entrepreneurial orientation is considered one of the important strategies that companies adopt in order to develop entrepreneurship, which contributes to achieving higher efficiency in their work and obtaining a competitive advantage for the company (Cherbib, 2024). Entrepreneurial orientation is one of the important methods that companies follow to obtain advantages and benefits that help create new opportunities (Anderson et al., 2015). Moreover, the entrepreneurial orientation contributes to finding new ideas and methods that enhance and improve the organization's various products and services (Kamal et al., 2016).

This proactive orientation is also reflected in a company's ability to adapt to evolving consumer demands and competitor strategies, as noted by Majali et al. (2022) and Fitriani et al., (2023)). Firms that embody this entrepreneurial spirit are constantly on the lookout for both obvious and hidden opportunities to advance their goals, as discussed Peretz-Andersson et al., (2024) and Xin and Ma (2023). This mindset is crucial in enhancing a company's capacity to respond to new opportunities and innovations, a viewpoint supported by various researchers (Khodor et al., 2024; Salah et al., 2024; Shore et al., 2024; Upadhyay et al., 2022; Yang & Xiao, 2024).

In examining the relationship between a company's entrepreneurial approach and its outcomes, Annosi et al. (2023); Kusa et al. (2024); and more recently, Upadhyay et al. (2023); Upadhyay et al. (2022) suggest that entrepreneurial orientation is intrinsically linked to a company's readiness to identify and capitalize on hidden opportunities through the development of essential competencies. Notably, the ability to seek

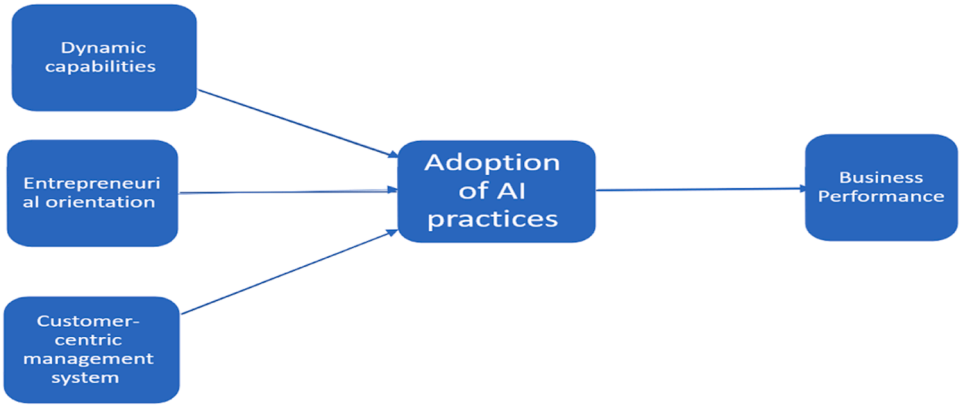


Fig. 1. Conceptual model.

opportunities, a critical competency highlighted by Avlonitis and Salavou (2007); Fernandes et al. (2022), is central to this orientation. Entrepreneurial orientation, therefore, is fundamentally about maintaining a proactive and vigilant stance in the pursuit of opportunities, along with the willingness to embrace the risks involved, as explained by Avlonitis and Salavou (2007).

In a study by Octavia et al. (2020) on the role of the impact of entrepreneurial orientation on the business performance of SMEs in e-commerce, the findings revealed a significant and positive impact between entrepreneurial orientation and e-commerce. Another study on the dimensions of entrepreneurial orientation towards the adoption of e-commerce for SMEs, Nasution et al. (2021) found that innovation in entrepreneurial orientation had a positive relationship with the adoption of e-commerce, but it was not significantly related to risk in entrepreneurial orientation.

The key outcome of this entrepreneurial orientation, as posited in this study, is the adoption of e-commerce solutions powered by AI. This relationship is underscored by findings from (George & Marino, 2011; Han et al., 2024; Upadhyay et al., 2023; Zaheer et al., 2019). Furthermore, empirical evidence from reinforces the significant influence of entrepreneurial role on the ability of SMEs to adapt operationally to new opportunities, particularly in the realm of AI-driven E-commerce. This leads to the proposed hypothesis:

H1. *Entrepreneurial orientation positively influences the adoption of AI-enhanced e-commerce in SMEs.*

3.2. Dynamic capability

Dynamic capability refers to the effectiveness, efficiency, and amount of capabilities that a company possesses in order to identify new opportunities and the ability to shape the resources available to it and adapt to rapidly changing business environments (Teece, 2010). Many studies have been conducted applying the dynamic capability theory in the field of e-commerce (Zhang et al., 2022; Nasution et al., 2021; Wu & Hisa, 2008). Dynamic capabilities are important for enhancing organizational flexibility and finding innovative solutions to improve business performance and increase competition (Teece et al., 2010). In a study by Drydakis (2022) on AI's support for SMEs companies in their business operations. The results indicate that AI contributes to and enhances their dynamic capabilities by exploiting technology to process many requests, accelerate the performance of business operations, and enhance efficiency, which is beneficial in reducing risks. In another study, Priyono et al. (2020) found that digital transformation enhances dynamic capabilities and improved the effectiveness and productivity of SMEs during the Covid-19 pandemic.

Dynamic capabilities are considered essential in implementing innovations that help achieve greater efficiency, integration, and business restructuring. In Nasution et al. (2021) study on investigating the dimensions of entrepreneurial orientation and dynamic ability towards adopting e-commerce, the results of the study confirmed that dynamic ability has a significant relationship with adopting e-commerce.

H2. *Dynamic capabilities will positively influence the adoption of AI-enhanced E-commerce in SMEs.*

3.3. Customer- centric management systems

Customer-centric management systems improve and develop processes in addition to developing structural changes in the organization (Jayachandran et al., 2005). There are many studies that have discussed that a customer-centric management system is organizational software that was created to support customer relationship management processes (Bahri-Ammari & Nusair, 2015; Shao et al., 2023). In a study by Bahri-Ammari and Nusair (2015) investigating the contributions of the customer-centric management system, in evaluating the performance of customer relationship management. This was achieved by distributing a questionnaire to a number of users of the customer relationship management system. The results confirmed that the customer-focused management system significantly affects the use of the customer relations system.

H3. *Customer-centric management system positively influence the adoption of AI-enhanced E-commerce in SMEs.*

3.4. Adoption of AI-enhanced E-commerce

Modern innovations in information technology and AI tools used in e-commerce have contributed greatly to finding solutions in how to market products, improve business performance, and learn more about customer behavior. AI offers many tools that help meet many requirements and businesses in e-commerce (Qi et al., 2023).

H4. *The adoption of AI-enhanced E-commerce will positively influence SMEs Business Performance.*

4. Methodology

The study adopts a quantitative approach using questionnaires to obtain data from officials in SMEs. This aim is to explore factors related to AI adoption in the e-commerce context, while considering the relevant literature to enhance the study's results. The questionnaire is designed to identify factors relating to the current level of AI adoption, perceived benefits and challenges. In addition, identifying the factors influencing the adoption of AI in the e-commerce context.

Data for this study were collected by distributing an internet questionnaire to a sample of 183 decision makers and officials in SMEs in

Saudi Arabia who work in e-commerce. The sample focused on store owners and supervisors regarding their primary jobs. The owners of electronic stores were contacted through visits to SMEs, as well as through calls, WhatsApp, and email, to encourage participation in the survey. A digital questionnaire was designed and distributed to decision makers and officials in SMEs Saudi Arabia who work in e-commerce. The questionnaire included many different aspects required for the purpose of the study which included entrepreneurial orientation, dynamic capability, customer-oriented management systems and adoption of AI enhanced e-commerce. This contributed to collecting in-depth and accurate data that helped test hypotheses and obtain results that support the aim of the study.

The questionnaire was designed to get more details regarding the current level of AI adoption, perceived benefits and challenges. In addition, the factors influencing the adoption of AI in the e-commerce context. The quantitative approach is considered appropriate and effective for this study, as the questionnaire results contribute to providing accurate and efficient quantitative results in a short time with a large sample size. In addition, questionnaires provide a unified and similar method in the way of collecting data from study participants, which allows consistent results to be given and easily compared and analyzed.

Quantitative research provides generalizability, which helps support scientific research by providing more knowledge on the subject and providing valuable information that is applicable to SMEs in the field of e-commerce. There is also better cost effectiveness compared to other methods such as interviews and observations in terms of effort, time, and material cost (Gable, 1994). Accessibility is considered an additional advantage for quantitative research to access the large sample faster and more accurately in diverse geographical locations (Venkatesh et al., 2013). This helps provide more diverse results, which contributes to achieving more validity and accuracy.

All key factors measured in the study were derived from various sources of valid and established studies. Regarding the sensing (SNS) factor, it was measured using four items (Bianchi et al., 2022). Likewise, coordinating (CRD) was measured through four items extracted from (Yeow et al., 2018; Stornelli et al., 2024). Also, four items were derived regarding the learning component (LRN) test based on studies (Hernández-Linares et al., 2021; Huang et al., 2022). In addition, the integrating factor (INT) was tested through four dimensions that were taken from a number of studies (Hernández-Linares et al., 2021; Mikalef et al., 2019, 2021). The reconfiguring factor (RCF) was tested on 6 items derived from (Mikalef et al., 2019, 2021). As for the customer-centric management system, six items were identified in order to be tested based on studies (Albert et al., 2004; Jayachandran et al., 2005). Five items were also derived from the items for the entrepreneurial orientation (EO) test (Alshanty & Emeagwali, 2019). Finally, adoption e-commerce powered by AI was measured through five items derived from studies (Baabdullah et al., 2021).

This study made a significant contribution by collecting data and testing hypotheses, leading to important results that enhance the understanding of the factors influencing the adoption of AI in e-commerce within SMEs. The results of the study benefit many beneficiaries in this field, researchers, professionals, employers and technicians. The quantitative approach was adopted in this study by analyzing questionnaires submitted by those responsible for e-commerce in SMEs, where accurate results were obtained that supported the objectives of the study. Collecting data from a large number of SMEs is considered a major challenge due to the inflexibility of some companies in responding to questionnaires, but in this study an appropriate number of participants in the questionnaire was obtained, which contributed to providing more important and relevant information for the purpose of the research. Moreover, this study will contribute to increasing knowledge and awareness among investors in SMEs of the importance of using AI tools in e-commerce, which helps in achieving a competitive advantage and efficiency in business performance.

5. Data analysis

Structural Equation Modelling was employed to analyze the data collected from the questionnaires and test the hypotheses. SEM is considered one of the popular techniques for conducting statistical analysis that gives more accurate results than simpler statistical techniques such as linear regression (Benitez et al., 2020). SEM is a technique that combines aspects of factor analysis and multiple regression by testing several measured variables and latent constructs (Hair et al., 2010). In addition, it enables researchers to analyze many complex relationships through more modeling between multiple dependent and independent variables (Hair et al., 2010).

5.1. Demographic profiles of sample participants

The majority (63.4 %) of the individuals in this sample were male. This suggests a gender imbalance in favor of males. As for age distribution, the largest age group was 18–25 years (60.7 %), indicating a predominantly younger demographic. The 26–35 years age group was also significant (25.1 %). The representation decreases notably for older age groups, with those above 35 years collectively constituting less than 15 %. In terms of educational level, a large majority (72.7 %) have a university education (either diploma or bachelor's degree). Only a small fraction (16.9 %) had an education level of secondary school or below. This indicates a highly educated population, with postgraduate degree holders (Master's/PhD) accounting for 10.4 % (see Table 2).

The data shows diverse employment sectors. The most significant are Retail Trade (23.5 %) and Agriculture (19.1 %), followed by 'Other' categories (36.1 %) which could include various unspecified industries. The most represented functional area is Marketing (38.3 %), followed by 'Other' (25.7 %) and Operations and Sales (15.3 %). This indicates a strong focus on marketing activities within these organizations (see Table 2).

A significant portion (46.4 %) are Operations Managers, suggesting a

Table 2
Demographic profiles of participants.

Category	Frequency (%)	Category	Frequency (%)
Gender		Human Resources	10 (5.5 %)
Male	116 (63.4 %)	Finance	5 (2.7 %)
Female	67 (36.6 %)	Marketing	70 (38.3 %)
Age		Operations and Sales	28 (15.3 %)
18–25 years	111 (60.7 %)	Other	47 (25.7 %)
26–35 years	46 (25.1 %)	**Role/Nature of Work Inside the Organization**	
35–26 years	18 (9.8 %)	Executive Director	22 (12.0 %)
36–45 years	4 (2.2 %)	Head of Information Department	11 (6.0 %)
45–55 years	4 (2.2 %)	General Manager	12 (6.6 %)
Educational Level		Mentor Manager	2 (1.1 %)
Secondary or below	31 (16.9 %)	Marketing Manager	35 (19.1 %)
University (Diploma/ Bachelor's)	133 (72.7 %)	Owner	13 (7.1 %)
Postgraduate (Master's/ PhD)	19 (10.4 %)	Operations Manager	85 (46.4 %)
Nature of Work and Activity		**Duration of Employment in the Organization**	
Food Industries	2 (1.1 %)	Less than 2 years	96 (52.5 %)
Retail Trade	43 (23.5 %)	2–5 years	54 (29.5 %)
Services	19 (10.4 %)	6–10 years	19 (10.4 %)
Agriculture	35 (19.1 %)	More than 10 years	14 (7.7 %)
Wholesale Trader	4 (2.2 %)	**Number of Employees in the Company**	
Pharmaceutical Industry	8 (4.4 %)	1–50	128 (69.9 %)
Detergent Industry	6 (3.3 %)	51–100	20 (10.9 %)
Other	66 (36.1 %)	100–200	15 (8.2 %)
Functional Area		More than 200	20 (10.9 %)
Information Technology	21 (11.5 %)		

focus on operational aspects in the organizations. The next largest group is Marketing Managers (19.1 %), aligning with the high representation in the Marketing functional area. Executive Directors form 12.0 % of the dataset, indicating a considerable number of high-level decision-makers. Over half of the individuals (52.5 %) have been employed for less than 2 years, suggesting either a high turnover rate or recent growth in employment. Those employed for 2–5 years make up 29.5 %, indicating a moderate level of employee retention. A majority of the companies (69.9 %) are small-sized (1–50 employees), which might indicate a large number of small businesses or startups. Only a smaller fraction of the companies have more than 100 employees (see Table 2).

Table 3
Descriptive Statistics of Measurement Items.

Construct	Items	Mean	Std. Dev.
Sensing (SNS)	SNS1	3.311	1.3286
	SNS2	3.749	1.3102
	SNS3	3.738	1.2996
	SNS4	3.596	1.2926
	Average	3.598	1.3078
Coordinating (CRD)	CRD1	3.623	1.2688
	CRD2	3.727	1.2889
	CRD3	3.503	1.2398
	CRD4	3.628	1.3066
	Average	3.620	1.2760
Learning (LRN)	LRN1	3.732	1.2707
	LRN2	3.672	1.2630
	LRN3	3.831	1.2876
	LRN4	3.787	1.3023
	Average	3.755	1.2809
Integrating (INT)	INT_1	3.858	1.3512
	INT_2	3.667	1.3479
	INT_3	3.694	1.2685
	INT_4	3.667	1.2767
	Average	3.721	1.3111
Reconfiguring (RCF)	RCF_1	3.568	1.2815
	RCF_2	3.803	1.2290
	RCF_3	3.492	1.3337
	RCF_4	3.388	1.2913
	RCF_5	3.519	1.2173
	RCF_6	3.661	1.2021
	Average	3.572	1.2591
Customer-centric management system	CCMS1	3.716	1.2342
	CCMS2	3.694	1.2555
	CCMS3	3.798	1.2348
	CCMS4	3.497	1.3337
	CCMS5	3.716	1.2562
	CCMS6	3.683	1.2395
	Average	3.684	1.2590
Entrepreneurial orientation (EO)	EO1	3.552	1.2163
	EO2	3.689	1.2431
	EO3	3.716	1.1608
	EO4	3.333	1.2329
	EO5	3.519	1.2218
	EO6	3.464	1.3250
	EO7	3.607	1.3002
	Average	3.554	1.2429
Adoption of e-commerce powered by AI	BDA-AI1	3.186	1.3336
	BDA-AI2	3.579	1.3148
	BDA-AI3	3.497	1.3419
	BDA-AI4	3.667	1.3149
	BDA-AI5	3.508	1.4137
	BDA-AI6	3.519	1.3170
	BDA-AI7	3.279	1.3603
	BDA-AI8	3.508	1.4020
	BDA-AI9	3.503	1.3419
	Average	3.472	1.3489
Business Performance	BP1	3.760	1.2912
	BP2	3.803	1.2858
	BP3	3.754	1.2578
	BP4	3.836	1.2114
	Average	3.788	1.2790

5.2. Descriptive statistics of measurement items

Table 3 presents a summary of survey-based metrics across several model constructs, each evaluated through multiple items. The constructs include Sensing (SNS), Coordinating (CRD), Learning (LRN), Integrating (INT), Reconfiguring (RCF), Customer-centric management systems (CCMS), Entrepreneurial orientation (EO), Adoption of E-commerce powered by AI (BDA-AI), and Business Performance (BP). For the Sensing construct, item scores vary from 3.311 to 3.749 with a relatively moderate overall average of 3.598, indicating that respondents generally sense environmental factors to a reasonably high degree. The standard deviation across these items is 1.3, pointing to a moderate spread in perceptions among respondents (see Table 3).

Coordinating activities score slightly higher on average (3.620) with individual item scores ranging from 3.503 to 3.728. This suggests a consistent level of coordination efforts perceived by the participants, underscored by slightly lower variability in responses as reflected by the standard deviation. Learning within organizations, as assessed by the LRN items, shows higher agreement among participants with scores stretching from 3.672 to 3.831 and an average of 3.755. This indicates a strong inclination towards learning practices. The standard deviation remains moderate, signaling a general consensus in responses (see Table 3).

The INT process has an average score of 3.721, with individual items ranging from 3.667 to 3.858, suggesting that integration mechanisms are well perceived by the respondents. The standard deviation is a bit higher for some items, especially INT_1, indicating more diversity in how respondents view these integration practices. Reconfiguring capabilities have the broadest range of item scores, from 3.388 to 3.803, and the lowest overall average of 3.572 among the constructs, which may indicate varying degrees of agility in organizational structures and processes. The standard deviations are in line with other constructs, pointing to a moderate level of agreement among the responses (see Table 3).

The CCMS scores consistently, with an average of 3.684 and individual items scoring between 3.497 and 3.798. This consistency is also reflected in the standard deviation, which is narrow, suggesting a uniform perception of the customer-centric approach among respondents. EO displays a slightly lower average of 3.554, with item scores ranging from 3.333 to 3.716. The spread of the standard deviation is fairly consistent, although EO6 shows more variability, indicating a diverse view on this specific aspect of entrepreneurship among participants (see Table 3).

Adoption of e-commerce powered by AI shows moderate agreement with an average score of 3.472. The scores for individual items vary from 3.186 to 3.667, reflecting the evolving nature of technology adoption and its impact on the surveyed individuals. The standard deviation is a bit higher, suggesting that experiences with AI-powered e-commerce are not uniform across respondents. Lastly, BP is rated the highest among all constructs with an average of 3.788. The scores for this construct are quite high, ranging from 3.754 to 3.836, reflecting a positive perception of business performance among the survey participants. The lower standard deviation indicates a strong consensus on this positive view (see Table 2).

5.3. Structural equation modelling analysis

A two stage SEM method was applied by AMOS 22 in the current study to validate what was proposed in the current study model and to assure an adequate level of reliability and validity of the main latent constructs and their corresponding scale items (Byrne, 2013; Fornell & Larcker, 1981; Hair et al., 2010). It is also worth mentioning that DYC has been treated in the current study as a second order factor while five dimensions (SNS; CRD; LRN; INT; and RCF) were tested as first order factors (see Fig. 2).

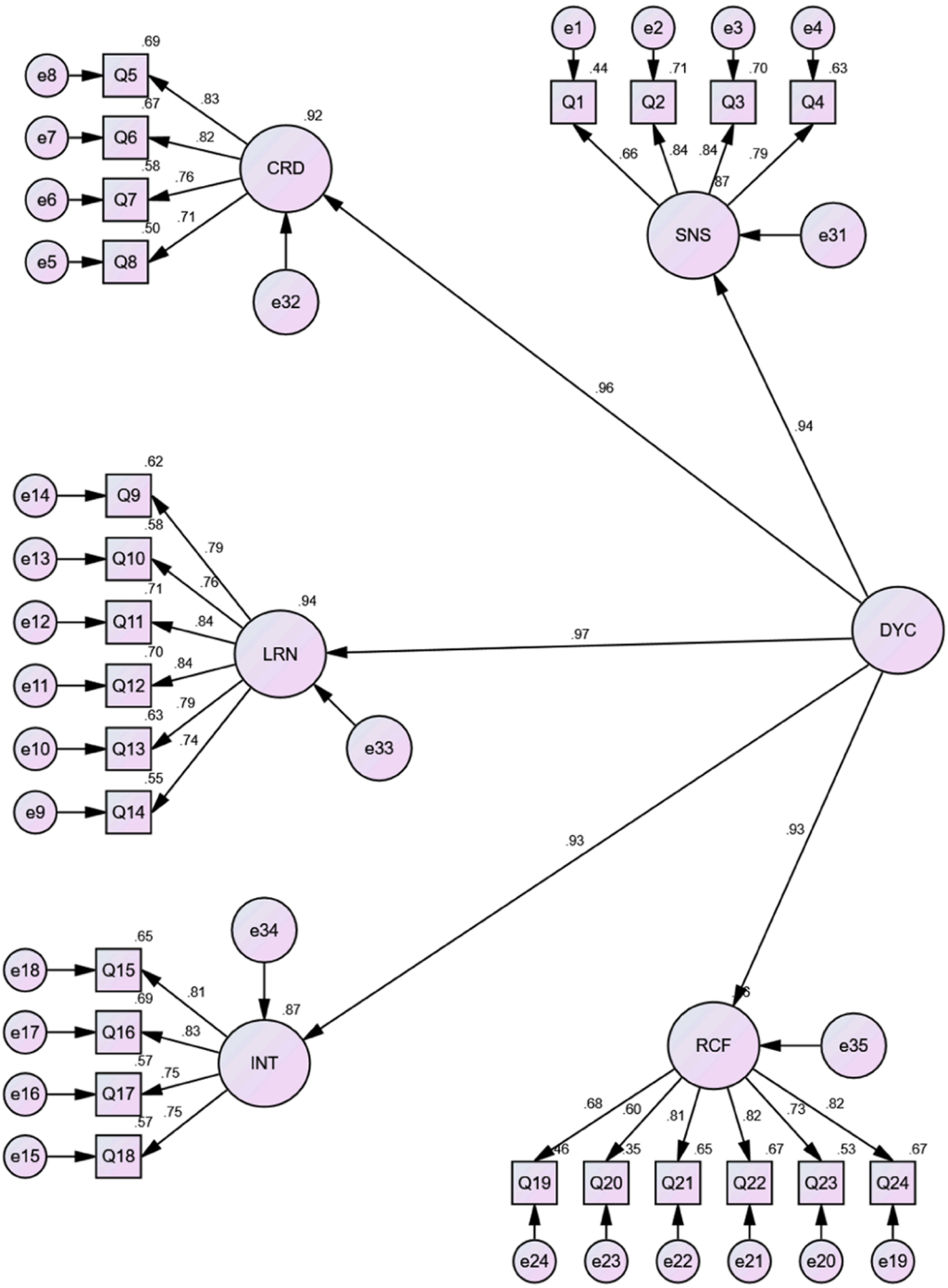


Fig. 2. Validation of DYC Dimensions.

5.4. Measurement model of DYC dimensions

Fig. 2 illustrates that each primary factor demonstrated an adequate and significant loading on DYC. The standardized regression weights for these factors did not fall below 0.50, with values ranging from 0.93 (contributed by RCF and INT) to 0.97 (contributed by LRN). Additionally, the measurement model's fit indices for DYC were observed to be within acceptable limits, as follows: CMIN/DF= 2.370; GFI= 0.935; AGFI = 0.907; RMSEA= 0.035; NFI = 0.964; CFI = 0.974 [84, 87, 88]. Scale items used to measure the first order factors also account for a standardised regression weight value not less than 0.50 as seen in Fig. 2. Furthermore, aspects related to CR and average variance extracted (AVE) were attained by first order factors of DYC. For example, with value not less than 0.50, all first order factors have a CR value ranging from 0.865 (SNS) to 0.911 (LRN) (Fornell & Larcker, 1981; Hair et al., 2010). Likewise, AVE values were noticed to be above their threshold level (0.50) and ranged from 0.557 (RCF) to 0.630 (LRN) (Fornell & Larcker, 1981; Hair et al., 2010). The squared root of AVE calculated for each latent first order factor of DYC was higher than the intercorrelation values with other corresponding factors as well. This, in turn, supports the discriminant validity of DYC dimensions proposed and tested in the current study (Kline, 2005) (see Table 4).

5.5. Measurement model of all constructs

A measurement model was then tested for all latent constructs

Table 4
Construct validity and reliability of DYC first order factors.

	CR	AVE	INT	SNS	CRD	LRN	RCF
INT	0.866	0.617	**0.786**				
SNS	0.865	0.619	0.604	**0.787**			
CRD	0.863	0.612	0.674	0.730	**0.782**		
LRN	0.911	0.630	0.727	0.620	0.728	**0.794**	
RCF	0.882	0.557	0.717	0.672	0.684	0.673	**0.746**

*Diagonal values indicate the square roots of the Average Variance Extracted (AVE), while the off-diagonal values show the estimated inter-correlations among the latent constructs.

proposed in the current study model. Fit indices adequately support the goodness of fit of the full measurement model as all indices exist within their suggested level as such CMIN/DF= 2.847; GFI= 0.919; AGFI = 0.887, RMSEA= 0.039; NFI = 0.955; CFI = 0.961 (Anderson & Gerbing, 1988; Bagozzi & Yi, 1988; Byrne, 2013) (Anderson & Gerbing, 1988; Bagozzi & Yi, 1988). An inspection of AVE values suggests that CCMS; BDA; BP; and DYC were able to have a value not less than 0.50 as suggested by Fornell and Larcker (1981); Hair et al. (2010). However, the AVE value of EO was 0.47 which is less than the threshold value 0.50. Thus, a careful inspection of the standardised regression weight of EO scale items was conducted and identified that EO1 and EO6 have a factor loading value less than 0.50; and therefore, both were removed from the revised version of the measurement model. The AVE value of EO after revision was 0.52 which is within the recommended level (Hair et al., 2010). As seen in Table 5, CR values for all latent constructs were found to be above the suggested value of 0.50; ranging from 0.812 (EO) to 0.977 (DYC) (Fornell & Larcker, 1981; Hair et al., 2010). Finally, the discriminant validity of full model was attained in the current study as the squared root of AVE calculated for all latent constructs were found to be above the intercorrelation values with other corresponding factors (see Table 5).

5.6. Common method bias

To validate the absence of common method bias in the recent study, the data underwent a comprehensive review using Harman's single-factor approach. This technique scrutinizes nine key constructs - SNS, CRD, LRN, INT, RCF, a CCMS, EO, the utilization of AI-driven e-commerce, and business performance - as well as 46 specific scale items. These procedures are grounded in the methodologies of Harman (1976) and further developed by Podsakoff et al. (2003). All scale items were analyzed through exploratory factor analysis using an unrotated factor solution. The outcome of this analysis revealed that no solitary factor emerged as predominant. The foremost factor explained only 48.029 percent of the variance, staying below the 50 % benchmark set by Podsakoff et al. (2003). This result indicates the dataset is free from the risks associated with common method bias.

5.7. Structural model results

In the second stage of SEM, a conceptual model and the research hypotheses were tested. Initially, fit indices yielded were close to those reported in the first stage of SEM and were found as follows: CMIN/DF = 2.888; GFI = 0.915; AGFI = 0.881, RMSEA = 0.041; NFI = 0.951; CFI = 0.959 (Anderson & Gerbing, 1988; Bagozzi & Yi, 1988; Byrne, 2013). As seen in Fig. 2, between 0.58 and 0.65 of variance (R^2) was accounted for by BDA and BP, respectively. This, in turn, supports the predictive validity of the current study model. Further, DYC (γ=0.70, $p < 0.000$) and EO (γ=0.19, $p < 0.039$) were able to significantly predict BDA. However, CCMS does not have an impact on BDA (γ=0.038, $p < 0.734$). In line with what has been proposed in the conceptual model, a strong significant relationship was identified between BDA and BP (γ=0.806, $p < 0.000$) (see Table 6).

An examination using variance inflation factors (VIF) was conducted to determine the presence of multicollinearity among independent variables and their relation to dependent variables. The data in Table 6 reveals that the VIF scores for each causal link remained below the crucial threshold of 10. This result confirms that there were no multicollinearity issues in this study, consistent with the guidelines suggested by Brace et al. (2006) (see Fig. 3).

Table 5
Construct validity and reliability of full model.

	CR	AVE	EO	CCMS	BDA	BP	DYC
EO	0.812	0.520	**0.721**				
CCMS	0.884	0.561	0.620	**0.749**			
BDA	0.920	0.563	0.671	0.665	**0.751**		
BP	0.910	0.771	0.586	0.699	0.612	**0.878**	
DYC	0.977	0.893	0.589	0.691	0.655	0.742	**0.945**

* Diagonal values indicate the square roots of the Average Variance Extracted (AVE), while the off-diagonal values show the estimated inter-correlations among the latent constructs.

6. Discussion

This study was designed to investigate the factors influencing the adoption of AI in e-commerce within SMEs. The study's approach and findings are structured around a conceptual model, formulated research hypotheses, and empirical evidence. The core finding of the study is that dynamic capabilities and EO are significant predictors of AI adoption in e-commerce among SMEs. This is supported by a substantial R^2 value of 0.58, indicating a strong degree of variance in AI adoption explained by these two factors. Moreover, the study reveals a strong link between the adoption of AI in e-commerce and enhanced business performance among SMEs. This relationship is numerically supported by an R^2 value of 0.65, suggesting that a significant proportion of the variance in business performance can be attributed to how effectively these enterprises adopt AI technologies. The research highlights the pivotal role of dynamic capabilities and EO in driving the adoption of AI in the e-commerce sector of SMEs, which in turn can substantially contributes to improved business performance. This highlights the importance for SMEs in the e-commerce sector to develop these capabilities and orientations to effectively leverage AI technologies for their growth and success.

Dynamic capabilities are defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 2007). This concept is crucial in understanding how companies adapt to technological innovations like AI. Teece, Peteraf and Leih (2010) emphasize the importance of dynamic capabilities in enhancing organizational flexibility and innovating to improve business performance and competitiveness.

Logically, the application of AI in business operations, as highlighted by Drydakis (2022), directly aligns with the definition of dynamic capabilities. AI enables firms to process large amounts of data efficiently, enhancing their ability to identify new opportunities and reshape resources swiftly. This capability is particularly beneficial in reducing risks and improving decision-making, which are core elements of dynamic capabilities.

Study by Salah and Ayyash (2024) confirmed that the integration of

Table 6
Hypothesis testing.

			Estimate	S.E.	C.R.	p-Value	VIF
BDA	←	CCMS	0.038	0.092	0.340	0.734	1.025
BDA	←	DYC	0.702	0.137	5.259	***	4.122
BDA	←	EO	0.195	0.105	2.060	0.039	2.145
BP	←	BDA	0.806	0.106	9.848	***	4.273

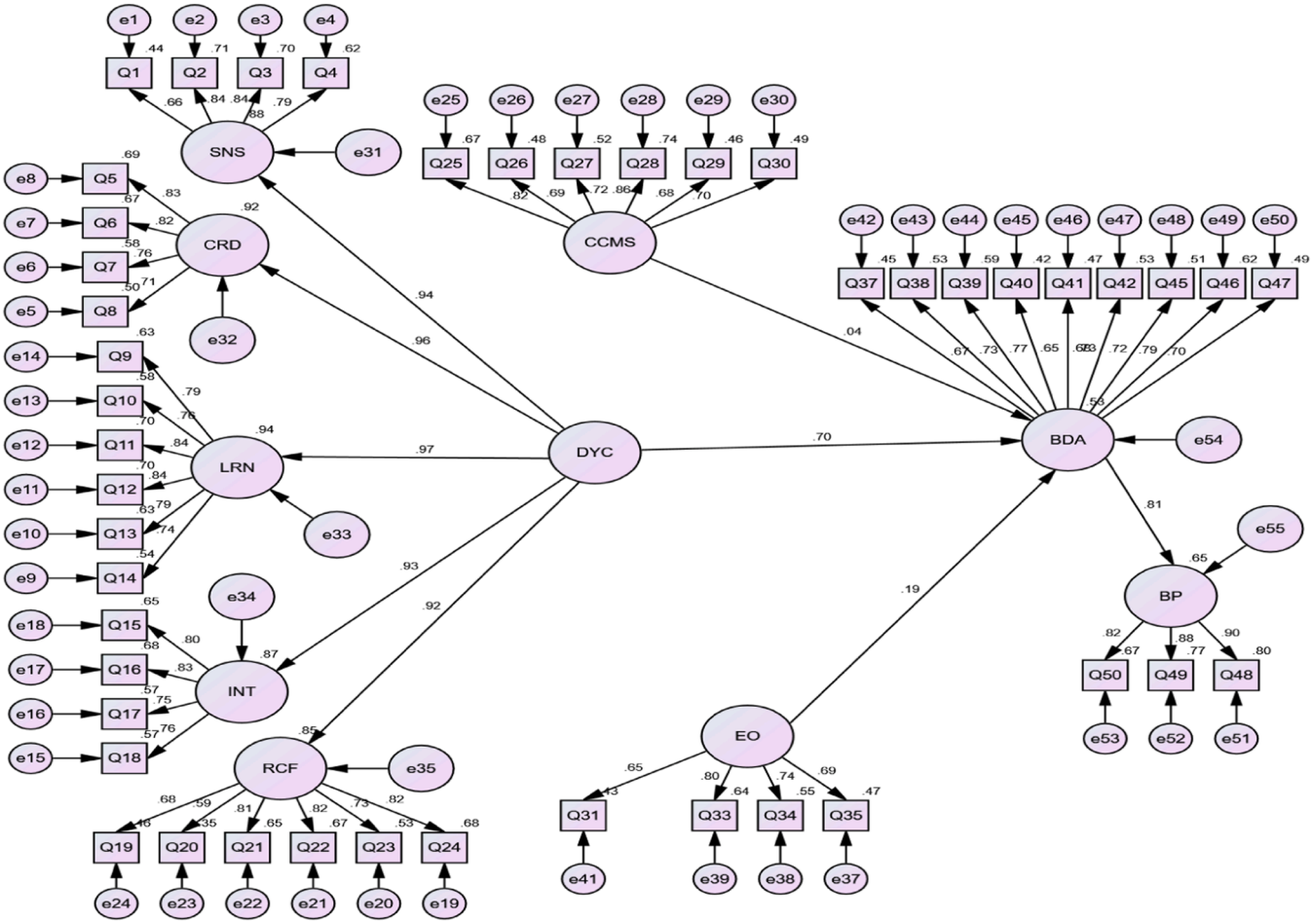


Fig. 3. Validated conceptual model.

AI and an innovative culture has a significant positive impact on the adoption of e-commerce. Moreover, Fonseka et al. (2022) examined management's perception of the impact of e-commerce adoption on the business performance of SMEs through the use of AI. The study's results recommend the adoption of e-commerce as a marketing strategy and utilizing AI to automate functions that may be challenging for employees to manage effectively. Also, Digital platforms contribute to enhancing business opportunities and improving the performance of SMEs by integrating and utilizing AI in their business processes (Wei & Pardo, 2022). AI capabilities and tools have a positive impact on companies' business performance and this contributes to making informed decisions based on AI (Li et al., 2024).

In the context of e-commerce, the rapid evolution of digital technologies demands a high degree of adaptability and responsiveness from businesses. Studies by Nasution et al. (2021), and Wu and Hisa (2008) illustrate the application of dynamic capabilities theory in e-commerce, highlighting the importance of these capabilities in adopting new technologies and approaches in this sector. During the COVID-19 pandemic, the role of dynamic capabilities became even more pronounced. Priyono et al. (2020) found that digital transformation, a key aspect of dynamic capabilities, was instrumental in enhancing the effectiveness and productivity of SMEs. This transformation was not just about adopting new technologies but also about rethinking business processes and models – a core aspect of dynamic capabilities.

Helfat and Winter (2011) further expand on this by suggesting that dynamic capabilities are essential in implementing innovations for greater efficiency, integration, and business restructuring. This is particularly relevant in e-commerce, where the ability to swiftly adapt to market changes and technological advancements is crucial for survival and growth. The theoretical and empirical evidence supports the notion that dynamic capabilities play a crucial role in the successful adoption and utilization of AI in e-commerce, especially for SMEs (Helfat & Winter, 2011; Zhang et al., 2022). These capabilities enable firms to navigate the challenges of a rapidly evolving digital landscape, harnessing AI's potential to enhance efficiency, innovation, and competitiveness

Entrepreneurial Orientation is characterized by the propensity to identify, evaluate, and exploit opportunities. This concept, central to the works of (Kusa et al., 2024), and Fernandes et al. (2022), is fundamentally about maintaining a proactive and vigilant stance in the pursuit of opportunities, along with the willingness to embrace the risks involved. Upadhyay et al. (2023) and Upadhyay et al. (2022) further expand on this by linking EO to a company's readiness to develop essential competencies that enable the identification and capitalization of hidden opportunities. As highlighted by Avlonitis and Salavou (2007) and Fernandes et al. (2022), seeking opportunities is a critical competency of EO. Firms with a strong EO are adept at spotting both evident and latent opportunities in their market, a trait that is crucial for identifying and leveraging new technologies like AI in e-commerce. Majali et al. (2022) and Preda (2013) note the importance of adaptability in EO. This involves adjusting to evolving consumer demands and competitor strategies, which is essential for the effective integration of AI into business processes and customer engagement strategies.

The entrepreneurial mind-set is crucial in enhancing a company's capacity to respond to new opportunities and innovations. Shore et al. (2024) and Khodor et al. (2024) support this viewpoint, emphasizing that firms with strong EO are more likely to be innovative and responsive to changes, such as those brought about by AI in e-commerce. These

EO traits, as discussed by Wang and Ahmed (2009), involve not only recognizing opportunities but also taking calculated risks to capitalize on them. This aspect is particularly relevant in the context of AI adoption, where firms must be willing to invest in new technologies despite uncertainties. Firms with a strong EO, as suggested by Salah et al. (2024) and Chung et al. (2022), are committed to continuous learning and improvement. This approach is vital for leveraging AI effectively, as it requires ongoing adaptation and refinement of strategies and processes. Peretz-Andersson et al. (2024) and Xin and Ma (2023) discuss the significance of market awareness in EO. Firms that are constantly monitoring market trends are more likely to recognize the potential of AI in enhancing their e-commerce strategies and customer engagement. In conclusion, EO plays a pivotal role in a firm's ability to successfully adopt and leverage AI in e-commerce. This orientation, characterized by opportunity seeking, adaptability, innovation, risk-taking, continuous learning, and market awareness, equips firms to not only recognize the potential of AI but also to effectively integrate it into their business models and processes for improved performance and competitive advantage.

6.1. Theoretical contributions

The study's findings empirically support its conceptual model and research hypotheses, providing a strong foundation for the theoretical relationship between dynamic capabilities, EO, and the adoption of AI in e-commerce for SMEs. The significant R^2 values (0.58 for AI adoption and 0.65 for business performance) offer quantitative validation of these relationships, enhancing the robustness and credibility of the theoretical framework.

The study also contributes to the dynamic capabilities theory by empirically demonstrating its applicability in the context of AI adoption in e-commerce. This extends the theory's relevance beyond traditional business strategy and innovation, situating it firmly within the domain of digital transformation and technology adoption in SMEs. The finding that entrepreneurial orientation significantly predicts the adoption of AI in e-commerce among SMEs adds a new dimension to the entrepreneurship literature. It suggests that the characteristics associated with entrepreneurial orientation – such as innovativeness, proactiveness, and risk-taking – are critical in the context of technological adoption and digital transformation.

The strong predictive relationship between AI adoption and business performance ($R^2 = 0.65$) offers theoretical insight into the tangible benefits of technological innovation in SMEs. This finding highlights the theory that integrating advanced technologies like AI can lead to substantial improvements in business performance, a key consideration for both academic researchers and business practitioners. By linking dynamic capabilities and EO with AI adoption in e-commerce, the study bridges two important areas of business research: technology adoption and strategic management. This integration offers a more comprehensive understanding of how strategic business capabilities influence technological adoption and subsequent performance outcomes. The study's findings have specific implications for SMEs in the e-commerce sector, suggesting that these businesses can enhance their competitiveness and performance through the strategic adoption of AI. This contributes to a deeper theoretical understanding of how SMEs players in the digital economy can leverage technology for business success.

6.2. Practical implications

Based on the study's findings regarding the significant roles of dynamic capabilities, EO, and the impact of AI adoption on business performance in SMEs, several practical implications for practitioners. For example, businesses, especially SMEs, should focus on developing and enhancing their dynamic capabilities. This involves being agile, adaptable, and able to reconfigure resources and strategies in response to changing market conditions. Practitioners should invest in training and development programs that foster these capabilities, enabling their organizations to be more responsive to technological advancements like AI.

SMEs should also foster an entrepreneurial culture that values innovativeness, proactiveness, and a willingness to take risks. This orientation will not only facilitate the adoption of AI but also encourage a mindset that is open to exploring new technologies and business models. Workshops, leadership training, and incentive structures can be designed to promote and reinforce these entrepreneurial values. The strong correlation between AI adoption and business performance suggests that SMEs should strategically incorporate AI into their business models. This involves identifying areas where AI can bring the most value, such as customer service, data analysis, and operational efficiency, and investing in suitable AI technologies.

Given the impact of AI on business performance, SMEs should invest in training their staff in relevant AI technologies and data analytics. This not only prepares the workforce to work effectively with new technologies but also helps in leveraging AI to its full potential. Since adopting new technologies involves risks, SMEs need to develop robust risk assessment and management strategies. This includes evaluating the financial, operational, and security risks associated with AI technologies and implementing appropriate mitigation strategies.

While the study did not find a significant role for customer-focused systems, practitioners should still consider the potential of AI to enhance customer experiences. This involves using AI for personalized marketing, improved customer service, and better understanding of customer needs and behaviors. SMEs should view AI adoption not just as a technological upgrade but as a strategic move to gain a competitive edge. This involves using AI to improve product/service offerings, streamline operations, and create new value propositions for customers. Continuous monitoring and evaluation of AI implementations are crucial. This helps in assessing the impact of AI on business performance and in making necessary adjustments to strategies and operations.

6.3. Limitations and future research directions

The study centers on understanding how dynamic capabilities (the ability to adapt and reconfigure business strategies and operations) and EO (a firm's strategic posture characterized by innovativeness, proactiveness, and risk-taking) influence the adoption of AI in SMEs. Interestingly, it also considers customer-focused systems, which typically involve leveraging technology to better understand and cater to customer needs.

The study's scope is restricted to the adoption of AI in SMEs. This focus provides valuable insights into how SMEs, which often have different resources and constraints compared to larger companies, approach and integrate AI into their operations. However, the findings may not be fully generalizable to larger companies or different sectors that might have distinct dynamics and challenges in AI adoption.

The results could be influenced by the specific economic, cultural, and technological landscape of Saudi Arabia, which might differ significantly from other regions. This geographical focus provides valuable insights into AI adoption in this specific context but may limit the generalizability of the findings to other regions.

An interesting outcome of the study is that it did not find significant support for the role of customer-focused systems in the adoption of AI. This might suggest that, for SMEs in Saudi Arabia, other factors (like dynamic capabilities and entrepreneurial orientation) are more critical drivers for AI adoption, or it could indicate that customer-focused approaches are not being effectively integrated with AI technologies in these SMEs.

The study's methodology did not account for potential mediation or moderation factors. Mediation factors could explain the relationship between the main variables (e.g., how entrepreneurial orientation leads to AI adoption), while moderation factors could influence the strength or direction of these relationships (e.g., how certain industry

characteristics might strengthen or weaken the impact of dynamic capabilities on AI adoption). The absence of these considerations might limit the depth of understanding of the complex interplay between the variables studied.

CRediT authorship contribution statement

Soliman Aljarboa: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

In relation to my submission titled "Factors Influencing the Adoption of Artificial Intelligence in E-Commerce by Small and Medium-Sized Enterprises" to the International Journal of Information Management Data Insights, I declare the following:

I do not possess any financial interests that could potentially create a conflict of interest or give the appearance of such a conflict concerning this work.

This work has not received any significant financial support that could have influenced its outcome.

I affirm that there are no known conflicts of interest related to this publication, and no significant financial support has influenced the results of this work.

No party with a direct interest in the research outcomes has or will provide any benefit to me or any organization with which I am affiliated.

To the best of my knowledge, I have no conflicts of interest, financial or otherwise, that might affect the results or interpretation of the manuscript's contents.

I acknowledge the importance of this declaration and understand the potential repercussions of any future indiscretions.

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Appendix: Scale Items

IT-enabled dynamic capabilities (ITDC): Mikalef and Pateli (2017)		
Please indicate how effective your company is in using AI-enabled IT systems for the following purposes:		
Sensing (SNS)	SNS1	Scanning the environment and identifying new business opportunities
	SNS2	Reviewing our product development efforts to ensure they are in line with what the customers want
	SNS3	Implementing ideas for new products and improving existing products or services
	SNS4	Regularly check the quality of our functional capabilities compared to competitors
Coordinating (CRD)	CRD1	Providing more effective coordination among different functional activities
	CRD2	Providing more effective coordination with customers, business partners and distributors
	CRD3	Making sure from synchronization Outputs the job with a job Units Functional The other or partners the job
	CRD4	Reducing redundant tasks, or overlapping activities performed by different operational units
Learning (LRN)	LRN1	Identify, evaluate, and import new information and knowledge
	LRN2	Transform existing information into new knowledge
	LRN3	Assimilate new information and knowledge
	LRN4	Use accumulated information and knowledge to assist decision making
	LRN5	Gain new abilities to learn new things successfully
	LRN6	Easy to obtain external knowledge very quickly
Integrating (INT)	INT_1	Easily accessing data and other valuable resources in real time from business partners
	INT_2	Aggregating relevant information from business partners, suppliers and customers. (e.g. operating information, business customer performance)
	INT_3	Collaborating in demand forecasting and planning between our firm and our business partners
	INT_4	Streamlining business processes with suppliers, distributors, and customers
Reconfiguring (RCF)	RCF_1	Adjusting for and responding to unexpected changes easily
	RCF_2	Easily adding an eligible new partner that you want to do business with or removing ones that you have terminated your partnership
	RCF_3	Adjusting our business processes in response to shifts in our business priorities
	RCF_4	Reconfiguring our business processes in order to come up with new productive assets
	RCF_5	Employees combine existing methods with new ways of doing things without losing their efficiency
	RCF_6	Successfully integrate new acquired knowledge with our existing knowledge
Customer-centric management system (Trainor et al., 2014)		
	CCMS11	We focus on customer needs while designing business processes
	CCMS2	In our organization, employees receive incentives based on customer satisfaction measures.
	CCMS3	A key criterion used to evaluate our customer contact employees is the quality of their customer relationships.
	CCMS4	In our organization, business processes are designed to enhance the quality of customer interactions.
	CCMS5	We organize our company around customer-based groups rather than product or function-based groups.
	CCMS6	In our organization, various functional areas coordinate their activities to enhance the quality of customer experience.
Entrepreneurial orientation (EO) (Matsuno et al., 2002)		
	EO1	Firmly believe that a change in market creates positive opportunity for us
	EO2	Company emphasizes taking risks .
	EO3	Risk-taking Value the orderly and risk-reducing management process much more than the leadership initiatives for change []
	EO4	In the past five years, our company has introduced many new products or services to the market.
	EO5	Our company focuses on research and development, technology leadership and innovation rather than trusting only those products and services that we have traditionally found good.
	EO6 NO	Innovativeness When it comes to problem solving, we value creative solutions more than the solutions of conventional wisdom
	EO7 NO	Top managers encourage the development of innovative marketing strategies, knowing well that some will fail
Adoption E-commerce powered by artificial intelligence: To what extent your organisation implemented ECA-AI in each area: (Chen et al., 2015)		
	BDA-AI1	Suppliers analysis
	BDA-AI2	Customer behavior analysis

(*continued on next page*)

(*continued*)

IT-enabled dynamic capabilities (ITDC): Mikalef and Pateli (2017)		
Please indicate how effective your company is in using AI-enabled IT systems for the following purposes:		
	BDA-AI3	Inventory planning
	BDA-AI4	Process/equipment monitoring
	BDA-AI5	Transportation planning
	BDA-AI6	Demand forecasting
	BDA-AI7	Human resource management
	BDA-AI8	Costing
	BDA-AI9	Warehouse operations improvements
Business Performance (Baabdullah et al., 2021)		
	BP1	E-commerce powered by artificial intelligence will help us to gain strategic advantages over our competitors.
	BP2	E-commerce powered by artificial intelligence will help us to retain existing clients and to attract new ones.
	BP3	Using E-commerce powered by artificial intelligence will increase the levels of business customer satisfaction.
	BP4	Using E-commerce powered by artificial intelligence will generate a high volume of sales.

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