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Understanding business model development through the lens of complexity theory: Enablers and barriers

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ABSTRACT

A winning business model is the key to business success in today's fragmented market environment. However, businesses need to develop their business models overtime to meet the requirements of environmental uncertainties and shifts surrounding the business. Drawing on complexity theory and its related concept of hierarchy, this study advances a systematic approach to theoretically investigate the factors that favourably or adversely affect business model development (BMD), in a hierarchical order. In particular, multiple fuzzy multi-criteria decision making techniques were applied to develop the list of enablers of and barriers to BMD, to determine the priorities among enablers, and to determine the significance of barriers with respect to the main enablers of BMD. The results reveal that organizational form is the most salient enablers of BMD, while type II barriers are the most significant barriers, challenging the development of business models. Implications and future research directions are also provided.

1. Introduction

Given the environmental shifts and uncertainties, firms are likely to confront unexpected events that require them to change their business models (BM). Actualizing potentials inherent in external shifts (Davidsson et al., 2020) and gaining subsequent competitive advantages in sustainability (Zott & Amit, 2015) and profitability (Saebi et al., 2017), necessitate converting BMs to more innovative and adaptive ones (Parida et al., 2019). With this increased emphasis being placed on the essence of a BM and its dynamism, literature has also witnessed growing research from a static understanding of BMs (e.g., Osterwalder & Pigneur, 2010) to a more dynamic perspective (e.g., Climent & Haftor, 2021) over the last two decades (Ramdani et al., 2019).

However, despite the growing interest, this area still suffers from a lack of theoretical as well as empirical accumulation of knowledge (Hollebeek et al., 2022). Concerning the lack of construct clarity, Foss and Saebi (2018) stress the systematic and architectural aspects of the BM phenomenon laying emphasis on the complexity approach and the importance of a theoretical treatment. BM development (BMD) refers to strategic changes (Loon & Quan, 2021) in BM components and/or interdependencies among those components (Foss & Saebi, 2017). Yet, while change either in components of BMs or their architecture might face numerous challenges and scholars have attempted to identify factors that favorably or adversely affect BM dynamism (Bocken & Geradts, 2020) the literature has yet to reach its full potential to determine key elements of successful BMD (Budler et al., 2021; Foss & Saebi, 2017).

This state of affairs is unfortunate for several reasons accounted for in the present study to advance the debate. First, inconsistency in various concepts trying to capture the dynamic aspect of BMs (e.g., BM innovation, transformation, adaption, evolution, etc.) (Balboni et al., 2019) hinders existing understanding of enablers and barriers. More precisely, due to the difference between drivers of disruptive change in BM innovation and of imitative change in BM adaption (Saebi et al., 2017), it can be concluded that various approaches to BMD can be severely affected by various types of enablers and barriers. Borrowing a lens from the entrepreneurship domain, the present study will distinguish between opportunity seeking (i.e., exploration) and advantage-seeking (i.e., exploitation) views to mitigate the challenge of construct clarity (Foss & Saebi, 2018). Second, moving from descriptive research to theory-driven research and understanding how BMs change through

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their mechanisms (Ramdani et al., 2019), primarily requires answering to the core question of why some firms are able to successfully change their BMs while others fail (Zhao et al., 2021).

Since answering the question of "how" is the fruit of answering the question of "why" (Krueger, 2003), illuminating on "why" BMD emerges and what factors promote or inhibit successful BMD becomes paramount for an understanding of "how" it emerges and occurs. It is widely accepted that a BM has characteristics shared with what complexity researchers refer to as a complex system (e.g., Anderson, 1999). Yet systems differ in terms of complexity and understanding systems with greater complexity and nested levels and sub-structures necessitates more sophisticated theoretical tools (see, Kast & Rosenzweig, 1972). On these grounds, complexity theory and the attendant concept of hierarchy provide a congenial theoretical lens to help unpack the black box of why BMs as complex systems organized into hierarchies can dynamically function (Massa et al., 2018) and ultimately develop.

Moreover, by applying this fresh theoretical perspective to the proposed framework, this study illustrates the enabling and hindering effects of various factors in a hierarchical order. Additionally, this perspective can shed light on "How" BMs successfully change by accounting for interdependencies within and among the hierarchies of a complex system. And finally, despite the context-dependency nature of BM and its related concepts (Silva et al., 2020; Spieth & Schneider, 2016), there is still a lack of empirically-robust research (Bhatti et al., 2021; Clauss, 2017; Schneider & Spieth, 2013) within various contexts such as the airline industry (Breier et al., 2021; Reinhold et al., 2019; Vatankhah et al., 2019). Given the industry-specific challenges such as complex supply chain with a few equipment manufacturers (Richter & Walther, 2017), personalized and experience-based customer demand (Taneja, 2016), dramatically fierce competition (Rothkopf & Wald, 2011), and the emergence of digital technologies (Richter & Walther, 2017), airlines are scarcely capable of successfully develop their businesses (Taneja, 2016) and impose radical change to their BMs (Nair et al., 2013; Rothkopf & Wald, 2011).

The choice of the airline sector as a context for this study is particularly opportune and timely also given the huge impact the Covid-19 pandemic had on the airline industry worldwide. The crisis has forced many airlines to look for alternative strategic paths and innovations, but also presents them with opportunities to develop new BMs that will allow them to successfully operate during the post-Covid recovery and thereafter. Against this backdrop, knowledge of hierarchically ranked enablers of and barriers to BMD, is of paramount importance to airlines. This study fills these gaps by identifying salient enablers of BMD and the significant barriers to BMD. In doing so, three major contributions to the literature are made.

First, although investigating the theoretical foundations of BM dynamism is quite rare, this study analyses the phenomenon through the lens of complexity theory and the concept of hierarchy. Second, this study contributes to the BMD literature by integrating factors that impede or improve successful change in a BM (Hollebeek et al., 2022). Indeed, this study develops a comprehensive framework that identifies and ranks the key enablers of and barriers to BMD. Third, due to idiosyncratic factors that can threaten and/or strengthen BMD in a specific industry, the proposed research empirically tests the developed framework, treats BMD as a multi-criteria decision-making (MCDM) situation, and identifies the relative significance of barriers to BMD as a less empirically investigated subject in the airline industry. Specifically, the Delphi study is used to validate the identification of factors affecting BMD and the barriers to such development. Moreover, analytical hierarchy process (AHP) is used to unveil the priorities among key BMD criteria.

This methodology is widely used in solving MCDM problems in various fields (e.g., Liu et al., 2012; Yasmin et al., 2020). Finally, the 'technique for order performance by similarity to ideal solution' (TOPSIS) is used to rank the relative significance of each barrier to BMD enablers. TOPSIS is capable of ranking alternatives in business and marketing management (Behzadian et al., 2012) and its implications in business research are well-established (e.g., Boran et al., 2009; Deng et al., 2000; Kahraman et al., 2007; Rouhani et al., 2012). In essence, the application of MCDM is deemed acceptable since the decision about BMD is an MCDM problem, and decision-makers need to consider several impactful criteria that in some cases might be conflicting. Particularly, the fuzzy logic (Zadeh, 1988) has been incorporated into the study to avoid the inherent vagueness in human judgments (Chen, 2000; Dinçer et al., 2019; Kahraman, 2008; Yüksel & Dağdeviren, 2010).

2. Literature review

2.1. Theoretical foundation

Complexity theory is a bright new star in understanding complex entities such as BMs (Foss & Saebi, 2017, 2018; Lanzolla & Markides, 2021; Massa et al., 2018; Snihur & Tarzijan, 2018). The emerging enthusiasm for applying the complexity approach in BM studies stems from its capacity to elucidate on various aspects of a complex system (e.g., BM) in terms of its components, hierarchies, interdependencies, non-linear relations, and boundaries, thus aiding a better understanding of how such systems ultimately work (Cilliers, 2001). Exploring underlying order and structure, complexity theory accommodates the unpredictability of non-linear dynamic systems (Levy, 2000). Simon (1999, p. 468) asserts that the key structural scheme relating to the architecture of complexity is "hierarchy" and a hierarchic system refers to a complex system that is "analyzable into successive set of subsystems". Applying this notion in the context of BM, scholars place an emphasis on activity system perspective (Zott & Amit, 2010) and assume BM as an architecture of interrelated value subsystems (i.e., value creation, delivery and capture) with its lower level of activity subsystems (Teece, 2010).

Accordingly, there is a developing literature in which the complexity approach has been deployed in relation to dynamic aspects of a BM. For instance, linking the concept of complementarity (i.e., interdependency) as one of the aspects of complex systems with the BMD concept, some scholars explore the possible ways to new BMs. They believe that beyond the sheer number of combinations of BM components, the components themselves might be interdependent and, therefore, cannot be changed separately without unintended consequences (Chesbrough & Tucci, 2020). Consistent with this view, Foss and Saebi (2017) suggest a typology of change in BMs based on the degree of interdependency (i.e., scope) and novelty. Other studies propose some attributes of complex systems (e.g., interdependency) as variables that can affect BMD (Albert et al., 2015; Loon & Quan, 2021; Ramdani et al., 2019).

This research stream, as well portray the role of interdependency, claims that while interdependency can help thrive firms' flexibility and exert an influence on BMD (e.g., Martin & Eisenhardt, 2010; Rivkin & Siggelkow, 2003) it can adversely affect BMD through increasing inertia and stability (e.g., Chesbrough, 2010). While emerging literature focuses on interdependency for understanding BMD (e.g., Foss & Saebi, 2018), it tends to overlook 'hierarchy' as a significant part of the structure of a complex system (Simon, 1991). Indeed, despite the importance of hierarchies in understanding dynamic function of complex entities (Cilliers, 2001; Simon, 1991), there is a paucity of research adopting the concept of hierarchical configuration for understanding the black box of BMD (Massa et al., 2018).

In other words, since interdependency within and among subsystems can be distinguished through the lens of hierarchy (e.g., vertical hierarchy) (Rivkin & Siggelkow, 2003; Simon, 1991), stimulating BM and its dynamics as a complex system primarily requires understanding the hierarchical structures (Simon, 1991), rather than interdependency. That is, allowing for hierarchies can mitigate the complexities of a system (Zhou, 2013), and can provide an insight in BMs' dynamic function (Massa et al., 2018). Therefore, this study attempts to theoretically contribute to the existing literature by investigating BMD through the lens of a complex system and its structural aspect (i.e., hierarchy). More precisely, the current research aims to untangle the factors that favourably or adversely affect BMD and illustrate them in a configurational framework with respect to their hierarchical structures.

2.2. Business model development

Encountering the emerging features of volatile environments, businesses are likely to be capable of renewing and aligning their BMs. In doing so, the dynamic aspect of the BM picture can serve as a useful tool for capturing the development of a firm's BM (Cavalcante et al., 2011; Schneider & Spieth, 2013). A review of the academic literature reveals that the concept of BM dynamics has accrued over the last years (Balboni et al., 2019; Saebi et al., 2017). Terms such as "innovation", "adaptation", and "evolution" are mostly used to identify BM dynamics (Denoo et al., 2021; Landau et al., 2016; Osiyevskyy & Dewald, 2015) and in some cases they have overlapping meaning (Balboni et al., 2019). Some other less frequent terms used include BM reinvention (Voelpel et al., 2004), BM renewal (Doz & Kosonen, 2010), BM reconfiguration (Spieth & Schneider, 2016), and BM extension (Cavalcante et al., 2011).

Despite the established attempts in integrating comprehensive typologies (Saebi, 2014; Saebi et al., 2017), Balboni et al. (2019) state that none of these concepts can capture the entire continuum of BM dynamics. Indeed, since BM dynamics vary along a spectrum of radical to imitative changes (Loon & Quan, 2021; Pedersen et al., 2018), typology of BM dynamics based on the degree of change is not possible. Untangling the vagueness around various BM dynamic approaches, this study will follow the concept of change through "entrepreneurship" and "firm growth" perspectives and emphasize the behaviour (mode) which results in change (Osiyevskyy & Dewald, 2015) rather than focus on the degree or frequency of change. As Osiyevskyy and Dewald (2015) correctly note, BMD can be the product of "explorative behaviour" through which businesses try to identify and seize opportunities, and eventually transform into a novel BM (Teece, 2007) as well as a new business logic (Spieth & Schneider, 2016).

Moreover, exploitative behavior would strengthen the existing BMs (Saebi et al., 2017) through acquisition development behaviors (Davidsson & Wiklund, 2006; McKelvie & Wiklund, 2010; McKelvie et al., 2006) such as internationalization, market expansion strategies (Landau et al., 2016), recycling and upcycling resources and/or changing supply relationships (Hjalager & Madsen, 2018). Indeed, BMD can be an explorative or an exploitative process. BMs exploratively develop when businesses recognize entrepreneurial opportunities and consequently change their design elements (i.e., content, structure, and governance) into new ones (Amit & Zott, 2015; Zott & Amit, 2015), while, exploitatively developing through the strategic improvement of the current elements without exerting change in the core business logic. From this viewpoint, and regarding the aim to bring consistency to BMD literature, this study initially delineates enablers that nourish firms' ability for BMD through explorative and/or exploitative behaviours. This is done by developing a framework of enablers/barriers through the lens of complex system and its hierarchies.

Due to the hierarchical order of complex systems (Simon, 1991), the following section clarifies that why enabling factors can strengthen the lower level of elementary subsystems (e.g., alertness) which might successively affect the higher order subsystems of activities (e.g., opportunity identification), and value-related mechanisms (e.g., value creation), and ultimately improve BMD. Table 1 presents the summary of the literature reviewed conferring the explorative and exploitative enablers of BMD. From an entrepreneurial perspective, the explorative approach to BMD, like other types of innovation (e.g., product and process), requires entrepreneurial processes. Consistently, perceiving and sensing opportunities as critical drivers of value proposition and creation subsystems of BMD (Osiyevskyy & Dewald, 2015; Teece, 2010) can be reinforced through specific underlying activities/behaviours.

Indeed, some behaviour such as search behaviour are more likely to provide information and knowledge which can lead to opportunity

Table 1
Approaches to successful BMD.

Approaches to BMD	BMD enablers
Explorative Approach (New BM) (Bhatti et al., 2021; Chesbrough, 2010; Doz & Kosonen, 2010; Futterer et al., 2018; Harms et al., 2021; Iheanachor et al., 2021; Khaddam et al., 2021; Leih et al., 2015; Loon et al., 2020; Loon & Quan, 2021; Osiyevskyy & Dewald, 2015; Pucihar et al., 2019; Snihur & Wiklund, 2019; Teece, 2010; To et al., 2019; Ulrich & Fibitz, 2020)	Strategic agility (strategic sensitivity, leadership unity, resource fluidity) Higher pursuit of digital technologies and digital strategy Constant alignment between businesses' resources and customer needs Capabilities for BM innovation (e.g., analogical reasoning, sense-making, dynamic capabilities, organizational ambidexterity and organizational learning) Extra-generative cognition, systems perspective, dynamic ambidexterity, modularization for reconfiguration and exaptation, paradox heuristic, cooperative mutuality alliances Experimentation and effectuation, leadership of organizational change Search behavior (broad external search: Elating to the number of divers external stakeholders from which a firm seeks knowledge) Enterprise innovativeness, business environment innovativeness Knowledge absorptive capacity, organizational agility, top management mindfulness Opportunity perception, perceived performance-reducing threat, and prior successful risk experience Opportunity-driven search Entrepreneurial logic (i.e., effectuation and causation) Organization design (higher degree of delegation), vertical structure (communication), culture affect dynamic capabilities (managerial action, organizational routine) Sensing, seizing new opportunities, reconfiguring resources Strategic orientation (i.e., pre-commitment and flexibility), configuration of entrepreneurial logic (i.e., "planning soloist" and "hedging networker") Contextual enablers (e.g., business eco-network, business actors' behavioral orientation, mastery of technology, rule and governance, business complexity)
Exploitative Approach (Existing BM) (Osiyevskyy & Dewald, 2015; Saebi et al., 2017)	Strategic orientation (i.e., market development strategy rather than strategy toward defending existing market position) threat perception BM adaptation (negatively associated with perceived critical threat and industry tenure and positively related to risk experience) Local search behavior and problematic threat-based search Incremental innovation (i.e., incrementally augmenting products/services by adding sophisticated features that up-market clients should appreciate)
Both Modes of BMD (Hock et al., 2016; Hofmeister et al., 2022; Reymen et al., 2017; Ricciardi et al., 2016)	Adaptive innovation via resilient dynamic capabilities (sensing and alertness, rapid activation, deactivation, recombination, collaboration of resources and capabilities; durable bearing of possible cost and risks of organizational learning and change)Paradoxical management (i.e., ambidexterity or vacillation-based) Decision-making logics in terms of "effectuation" used to generate viable value proposition and then "causation"

(*continued on next page*)

Table 1 (*continued*)

Approaches to BMD	BMD enablers
	which is used to define the other BM components in relation to the value proposition and customer segment Organizational culture (e.g., novelty-oriented culture value)

identification and subsequent BMD. In other words, knowledge as a key predictor of opportunity identification (Arentz et al., 2013; Shepherd & DeTienne, 2005) in BMD, might be provided through broad external search behaviour (Snihur & Wiklund, 2019) as well as opportunity-driven search behaviour (Osiyevskyy & Dewald, 2015). Knowledge absorptive capacity as an ability to recognize and use new knowledge for commercial ends can also provide firms with new ideas on how to change their current BMs (Bhatti et al., 2021). Experimentation may as well facilitate the creation of data (knowledge) and the identification of eventually new BMs (Chesbrough, 2010). Moreover, the cognitive perspective clarifies the underlying mechanisms of opportunity recognition, and subsequently BM changes, at an individual level. Consistent with the mechanism-based approach, entrepreneurial opportunities which trigger BMD (Osiyevskyy & Dewald, 2015) might occur through basic mechanisms such as analogical reasoning and sense making (Loon et al., 2020), extra-generative cognition, and paradox heuristics (Loon & Quan, 2021), entrepreneurial logic and decision-making (effectuation and causation) (Chesbrough, 2010; Futterer et al., 2018; Harms et al., 2021), as well as manger's mindfulness (Bhatti et al., 2021).

Even though opportunity recognition during BMD is necessary, however, this is not sufficient for a proper BMD. Precisely, pursuing and exploiting those opportunities can truly change the current BM to a new one. In this vein, scholars state that strategic agility (Bhatti et al., 2021; Doz & Kosonen, 2010), leadership (Chesbrough, 2010), dynamic capabilities (Loon et al., 2020; Loon & Quan, 2021; Teece, 2010), and organizational characteristics (Harms et al., 2021; Leih et al., 2015) exert significant influences on seizing and exploiting opportunities, therefore a novel change in value mechanisms (value proposition, creation, and capture) might take place. Additionally, a review of the relative literature reveals that BMD thrives in many contexts such as innovative business environments (Pucihar et al., 2019), technological contexts such as digitalization (Ulrich & Fibitz, 2020) as well as business-related contextual factors (To et al., 2019).

Also, some behaviour such as aligning the resources of firms with the demand conditions at the customer end (Iheanachor et al., 2021) can highlight the need to change BMs. On the other hand, while the explorative approach to BMD insists on the aggressive aspect of change, the exploitative approach is assumed as a response to external causes and emphasizes the adaptive role of change. In other words, based on the exploitative approach, changing BM is a necessity that obliges firms to align their business with the environment (Saebi et al., 2017), and survive. In this vein, this approach highly concentrates on the perception of a threat rather than an opportunity (Saebi et al., 2017), on threat-based search rather than opportunity-driven search (Osiyevskyy & Dewald, 2015), and incremental innovations (Osiyevskyy & Dewald, 2015) rather than disruptive ones. Consequently, it is assumed that identifying the enablers of BMD (both exploratively and exploitatively) would pave the way to avoiding the bottlenecks in the development process.

2.3. Criteria and sub-criteria identification of BMD

As provided in Table 1, several components are considered saliently as successful firm-specific factors. Building on the synthesis of identified enablers with respect to their hierarchical order, three key criteria were developed as manifested by organizational form, organizational dynamism, and organizational capabilities and competencies. While organizational form is represented by its subsystems of organizational structure, culture, and strategy, organizational dynamism includes organizational learning, organizational decision-making, and organizational search in its lower level. Lastly, organizational capabilities and competencies are classified into two subcategories as manifested by cognitive and non-cognitive capabilities and competencies. Consistent with organizational change and innovation literature, there is a dynamic relationship between organizational forms and innovativeness (Lam, 2004).

In this line, and based on a hierarchical aspect of complex system approach, three lower-level components of "organizational form" including structure, strategy (Lam, 2004), and culture, are widely investigated in BM literature (e.g., Bashir & Verma, 2018; Bock et al., 2012; Doz & Kosonen, 2010; Harms et al., 2021; Hock et al., 2016; Saebi et al., 2017) . Findings reveal that underlying elements of these three subsystems such as strategic orientations, specific strategies such as modularity and digitalization, deregulation of organizational design, and horizontal structure significantly influence BMD (De Mattos et al., 2021). Indeed, organizational forms such as structure might facilitate information flow, better allow to exploit opportunities, and convert to new BMs (Bashir & Verma, 2018) which are all deemed as drivers of BMD (e.g., Sorescu, 2017). Moreover, implementing a developmental culture emphasizes a flexible orientation that, in turn, can foster innovation (Büschgens et al., 2013).

Within the context of the airline industry, Nair et al. (2013) suggest service orientation as a core competency in the industry. Additionally, the digitalization strategy is assumed as a useful tool for simplifying operations and removing the mobility barriers related to airline businesses (Albers et al., 2020). Internationalization strategies, as well as capital and ownership structures, are also vital determinants of BMD in this industry (Albers et al., 2010; Castiglioni et al., 2018). Regarding organizational structure, experimentation of a disruptive BM of long-haul low-cost (LHLC) in airline businesses demands establishing autonomous organizational units or cooperating with LHLC partners (i.e., strategic alignment, pre-commitment strategic orientation) (Albers et al., 2020). Decentralization and greater autonomy can also facilitate operational optimization at the airport and subsequent innovation in BMs (Pereira & Caetano, 2017). Moreover, according to Suifan (2021), organizational culture such as an innovative as well as supportive culture is positively associated with airline organizational innovation.

"Organizational dynamism" has been found as the second components of successful BMD using three key components in terms of organizational learning, organizational decision-making, and organizational search. The focus on organizational learning illuminates the significance of businesses' knowledge structures, capacity for knowledge absorption, experiential learning, and prior experience in the BM change process. Booyens and Rogerson (2017) stress the positive role of networking and learning in reinforcing organizational innovations through accessing knowledge in the travel and tourism industry. On the other hand, organizational decision-making is an integral part of BMD through different stages including the initial phase deciding whether to change or persist (Brenk et al., 2019; Dewald & Bowen, 2010; Wood et al., 2019), decisions made toward a typology of BM design (Zott & Amit, 2010), and decisions made during implementation (Hacklin & Wallnöfer, 2012).

Ultimately, organizational search is identified as the third component of organizational dynamism due to the significance of the search domain (Osiyevskyy & Dewald, 2015; Snihur & Wiklund, 2019) as well as entrepreneurial logic for firm's decision-making (Futterer et al., 2018; Reymen et al., 2017). The third enabler of BMD is "organizational capabilities" categorized into cognitive and non-cognitive capabilities and competencies. It is assumed that BMD within the airline industry heavily depends on the perception of internal change leaders (managerial cognition) (Pereira & Caetano, 2017). While cognitive capabilities include factors such as managerial mindfulness, creativity and innovativeness, paradox heuristics, extra-generation cognition, perceptions, alertness for sensing opportunities, system perspective, and business actors' behavioural orientation (Bhatti et al., 2021; Loon et al., 2020; Loon & Quan, 2021; Pucihar et al., 2019; To et al., 2019), non-cognitive capabilities deal with the managerial actions and skills, resource reconfiguration ability, leadership for change, managing paradoxes and ambidexterity, and the business networks (Loon et al., 2020; Ricciardi et al., 2016; Teece, 2010; To et al., 2019). The proposed configurational structure is represented in Table 2.

2.4. Barriers to BMD

As stated earlier, identification and management of berries to BMD would ultimately result in actual BMD. Hence, in this section, barriers negatively targeting the enablers of higher order and consequent BMD are discussed. As Rüb et al. (2017) claim there are two categories of barriers to BMD including internal as well as external barriers. On one hand, some internal barriers may hinder the positive effects of BMD enablers. Arguably, "path dependency" is one of the considerable internal barriers threatening organizational decision-making (DaSilva & Trkman, 2014) and ultimately BMD (Rüb et al., 2017). This barrier occurs when businesses fall into a competency trap and overreliance on their fixed routines, procedures and experiences (Levitt & March, 1988), with a continued practice based on historical preference or use. In industries related to fossil fuels (such as the airline industry), path-dependent behaviour has a major restrictive impact on BMD (Bohnsack et al., 2014).

Furthermore, in the aviation context path-dependency has traditionally played a role due to the historical, geographic, and operational reasons that in the past led to the formation of national and regional oligopolies in the airline industry. Moreover, Chesbrough (2010) introduces "conflict" as one of the internal barriers to BMD. Conflict with a traditional firm's asset and BM might hinder businesses from experimentation and increase manager persistence (Chesbrough, 2010). "Partner reliance" also deteriorates BMD through decreasing strategic flexibility required for innovation (Bock et al., 2012). Additionally, "organizational inertia" has a significant negative influence on organizational learning (Jui-Chan et al., 2020) and therefore hampers BMD (Huang et al., 2013; Moradi et al., 2021). In addition, challenges with the "legitimacy" of BMD within the ecosystem can also lead businesses toward value appropriation and imitation dilemmas (Snihur et al., 2021).

According to Markides (2013), traditional airlines face ambidexterity challenges when they move to low-cost, point-to-point BMs and as a result, they may cannibalize their existing customer base. Furthermore, the innovative behaviour of airline firms considerably depends on current and past BMs (DaSilva & Trkman, 2014). For instance, it seems LCCs aggressively put the biggest emphasis on innovative new technologies with cost-saving potentials and revenue sides, while other inflexible BMs might severely hinder firms' innovations (Rothkopf & Wald, 2011). On the other hand, some internal barriers are related to the dark side of enablers. In other words, different aspects of BMD criteria can be assumed to be a double-edged sword. For instance, a complex and hierarchical organizational structure can be detrimental to BMD (Bashir & Verma, 2018), while a simplified structure has a positive impact on the phenomenon (Bock et al., 2012).

In the case of organizational culture, the creative and novel-based values of culture strengthen entrepreneurial activity and BMD (Bashir & Verma, 2018; Bock et al., 2012) while strict and tight cultures cannot accept the change and innovation (Rashid et al., 2004). Due to the barriers to disruptive innovation in airlines, Taneja (2016) claims that those organizational cultures that increase the gap between technological capability and organizational capability are deemed as the most significant barriers. Regarding the organizational form context, developing partnerships and strategic alliances are critical for airlines to stand various challenges during their life cycles (Park & Cho, 1997; Taneja, 2016), while complex structures of network carriers such as hierarchy layers are a considerable barrier to renew their traditional BMs (Albers et al., 2020). Unlike the other industries, recent changes in the airline environment significantly depend on legal, institutional and cultural developments rather than technological factors (Cento, 2009).

Therefore conflict and cultural barriers are among the significant factors negatively affecting an airline's performance (Gittell et al., 2004). Review of existing literature revealed a second major category of barriers in terms of external barriers. Industrial structure and industry pressure (Waldner et al., 2015) are among these challenges. Given some unique internal characteristics of the airline industry (e.g., policy, highly capital intensive, structural flaws) (Bruce, 2016; Rothkopf & Wald, 2011) and the intensive leverage of external events (e.g., deep downturns in economies, swings in the price of fuel, bank credit restrictions and structural characteristics of the industry)(De Almeida et al., 2020; Nicolau & Santa-María, 2012; Schneider et al., 2013) , it seems that some barriers of BMD are more prominent in this sector.

From the external view, Joshan and Maertens (2020) found that political tensions, adverse regulations, and low levels of liberalization negatively affect airline development of the LCC business model in MENA. Since Francis et al. (2007, p.394) suggest "… regulatory barriers in the form of bilateral agreements limit the markets in which a new-entrant low-cost airline could start a service", governmental regulations also might restrict BMD. Furthermore, unexpected and unpredictable crises such as Covid-19 can pose enormous challenges to BMD (Breier et al., 2021; Harms et al., 2021; Huang & Farboudi Jahromi, 2021), for example, through negatively affecting value-related subsystems such as value delivery (Raj et al., 2022). The list of identified barriers to BMD is represented in Table 3.

Table 2
Enablers of BMD.

Main criteria	Sub-criteria	
Organizational form	Organizational structure (e.g., organization design, authority delegation, organizational routines, rules and procedures, communication structure, context/business complexity)	
	Organizational culture (e.g., culture for a change)	
	Organizational strategy (e.g., strategic- orientation, level of strategic flexibility/contingency, agility, pre-commitments, alliances, digitalization, modularity)	
Organizational dynamism	Organizational learning (e.g., experimentation, knowledge absorption, mastery of technology, prior experience)	
	Organizational decision-making (e.g., entrepreneurial logic of decision-making in terms of effectuation and causation)	
	Organizational search (e.g., problemistic search, threat-based search, opportunity-driven search)	
Organizational capabilities and competencies	Cognitive	Managerial cognition and mindfulness
		Paradox heuristics
		Extra-generation cognition
		Perception
		Creativity and innovativeness
		Alertness/sensing opportunities
		Seizing new opportunities
		System perspective
		Business actors' behavioral orientation
	Non-cognitive	Managerial action and skills
		Resource reconfiguration ability
		Transformational (organizational change) leadership
		Paradoxical (ambidexterity) management
		Business networks

Table 3
Barriers to BMD.

Main barriers	Sample items
Internal barriers (type I)	Path dependency
	Conflict
	Partner reliance
	Legitimacy
	Organizational inertia
	Managerial cognition
	Ambidexterity challenges
Internal barriers (type II)	Organizational structure
	Organizational culture
	Organizational rigidities
	Organization design
External barriers	Supply barriers (e.g., resistance or lack of support from specific suppliers, selection of inappropriate partners, specific quality of requirements, degree of interdependency)
	Demand barriers (e.g., market limitations)
	Environmental barriers (e.g., governmental regulation, policy action, changing legal rights, undeveloped networks/eco-systems, inappropriate infrastructure, restrictive local culture, industrial structure, industry pressure, unexpected crisis such as Covid-19)

3. Methods

This study aims at identifying and ranking the enablers of and barriers to BMD in the context of the airline industry. Given that BMD is a multi-criteria decision-making situation (Vatankhah et al., 2019), MCDM techniques are plausible decision support systems to aid the evaluation and selection of enablers of and barriers to BMD. As observed by Yasmin et al. (2020, p. 3), "the application of MCDM methods to organizational decision-making problems is burgeoning" and its relevance in business studies is prevailing (e.g., Chen & Chen, 2021; Guitouni et al., 2018; Jafari-Sadeghi et al., 2022; Kougkoulos et al, 2020; Lai & Ishizaka, 2020; Raj et al., 2022) for its ability to handle multiple criteria that could affect the decision-making situation. In essence, MCDM techniques use a deterministic approach to systematically classify, sort, and rank the preferences, interrelationships, and ranking of multiple decision criteria and possible decision alternatives (Ahani et al., 2019; Lai & Ishizaka, 2020).

The current study used an expert-based method to propose an integrated MCDM approach including fuzzy Delphi study to determine the list of possible BMD enablers and barriers, fuzzy AHP to determine the relative priorities among the configurational enablers of BMD, and fuzzy TOPSIS to determine the relative significance of barriers to BMD. Specifically, the fuzzy theory (Zadeth, 1965) is incorporated into MCDM techniques to represent vague data and tackle the inherent fuzziness in human judgment (Vatankhah & Darvishi, 2021). Because crisp values (i.e., 0, 1) failed to properly capture human thoughts and opinions, fuzzy MCDM techniques use linguistic terms (e.g., weak or very strong) to better capture experts' opinions regarding the relative importance of study criteria.

Experts' evaluations based on the linguistic terms can be further assessed with the corresponding triangular fuzzy numbers (TFN). Experts' evaluations based on the linguistic terms can be further assessed with the corresponding triangular fuzzy numbers (TFN). A TFN is a fuzzy set with three key points and can be represented as $\widetilde{M} = (l,m,u)$. While l determines the lowest possible value in the fuzzy set, m represents the most promising value, and u reflects the largest possible value in the fuzzy set (Fig. 1).

A TFN can be determined using equation (1).

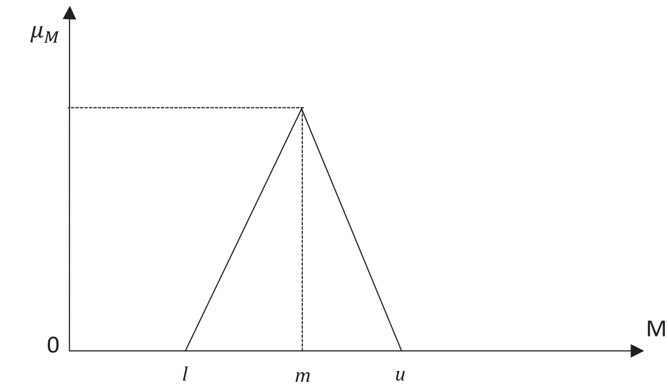

Fig. 1. Graphical representation of a TFN.

$$\mu\left(\widetilde{M}\right) = \left\{\begin{array}{c} 0, x < l \\ \dfrac{x-l}{m-l}, l \le x \le m \\ \dfrac{u-x}{u-m}, m \le x \le u \\ 0, x > u \end{array}\right\} \tag{1}$$

In light of fuzzy operational law, a number of operational functions can be performed on TFNs:

If $\widetilde{M}_1 = (l_1, m_1, u_1)$ and $\widetilde{M}_2 = (l_2, m_2, u_2)$ are two different TFNs, then:

$$\text{Fuzzy addition } (\oplus) \text{ can be performed as}: \ (l_1 + l_2, m_1 + m_2, u_1 - u_2 \tag{2}$$

$$\text{Fuzzy subtraction } (\ominus) \text{ can be performed as}: \ (l_1 - u_2, m_1 - m_2, u_1 - l_2 \tag{3}$$

$$\text{Fuzzy multiplication } (\odot) \text{ can be performed as}: \ (l_1 \times l_2, m_1 \times m_2, u_1 \times u_2 \tag{4}$$

$$\text{Fuzzy division } (\oslash) \text{ can be performed as}: \ (l_1, m_1, u_1)^{-1} = (\frac{1}{u_1}, \frac{1}{m_1}, \frac{1}{l_1}) \tag{5}$$

3.1. Fuzzy Delphi study

The Fuzzy Delphi study (Murray et al., 1985) integrates the evaluation methods of fuzzy set theory to derive a fuzzy, enhanced extension of the Delphi study group decision-making technique that enables decision-makers to solve the decision-making problem by reaching a consensus about the significance of decision criteria via anonymous responses and controlled feedback (Ishikawa et al., 1993). The fuzzy Delphi study is a stepwise approach that determines the importance of criteria initially identified through literature. According to Ishikawa et al. (1993), fuzzy Delphi study starts with the initial identification of study criteria (i.e., Table 2 and Table 3). Once the list of all criteria has been determined, the second step requires experts' judgments to be captured using linguistic terms displayed in Table 4.

The weight-based importance of each criterion can be calculated using the geometric mean and the Max-Min method (Ma et al., 2011). Ma et al. (2011) argue that, if $\widetilde{a}_{ij} = (a_{ij}, b_{ij}, c_{ij})$ is a TFN to be the j^{th} criteria (j=1,2,3,. . ..m) importance of the i^{th} expert (i=1,2,3,. . ..n), then the fuzzy weights of criteria as $\widetilde{a}_j = (a_j, b_j, c_j)$, can be calculated as:

$$\left\{ a_j = \min\{a_{ij}\}, \quad b_j = (\prod_{i=1}^{n} b_{ij})^{1/n}, \quad c_j = \max\{c_{ij} \right\} \tag{6}$$

In fact, the lower possible value (i.e., l) can be determined by the minimum value of the lower possible values judged by all experts, the most promising value (i.e., m) can be calculated using the geometric mean of the most promising values judged by all experts, and the largest possible value (i.e., u) is captured by the maximum value of the largest

Table 4
Linguistic terms and triangular fuzzy numbers for FDM (adopted from Bouzon et al., 2016).

Linguistic scales	TFNs	Description
Very low	(0,0,0.1)	The importance of the criteria to be included in the list is very low
Low	(0,0.1,0.3)	The importance of the criteria to be included in the list is low
Medium-low	(0.1,0.3,0.5)	The importance of the criteria to be included in the list is medium-low
Medium	(0.3,0.5,0.7)	The importance of the criteria to be included in the list is medium
Medium-high	(0.5,0.7,0.9)	The importance of the criteria to be included in the list is medium-high
High	(0.7,0.9,1)	The importance of the criteria to be included in the list is high
Very high	(0.9,1,1)	The importance of the criteria to be included in the list is very high

possible values judged by all experts. The final step includes the determination of the ultimate importance of study criteria by setting the threshold "$\widetilde{z}$" and comparing the weight of each criterion against the threshold level. The threshold value can be finally determined by a simple averaging of the obtained values. Criteria j will be included in the study if its relative weight is greater than or equal to the threshold "$\widetilde{z}$". Otherwise, the criteria weighted lower than the threshold level must be rejected.

3.2. Fuzzy AHP

AHP is the most popular MCDM technique that uses pairwise comparisons to model complex decision-making problems (Ishizaka & Labib, 2011; Vaidya & Kumar, 2006). In fact, AHP tends to help the decision-maker to break down a complex decision-making situation into its building components in terms of goal, main criteria, and corresponding sub-criteria. Weight-based calculations will help the decision-maker to identify the most and the least important criterion in the decision-making process (Vargas, 1990). That is, the criterion with the highest weight will be considered as the most salient factor and the criterion with the lowest weight will be regarded as the least important element. However, the conventional AHP failed to capture the vagueness in human judgments using crisp values. Therefore, fuzzy AHP has been introduced to tackle the aforementioned shortcoming associated with traditional AHP using linguistic variables (Table 5).

Fuzzy AHP extent analysis was developed by Chang (1992) and is among the widely used fuzzy MCDM techniques in organizational studies (e.g., Bozbura & Beskese, 2007; Bozbura et al., 2007; Büyüközkan, 2004; Chen et al., 2015; Cho & Lee, 2013; Ju et al., 2012; Kwong & Bai, 2003; Tang & Beynon, 2005). According to Chang's extent analysis (1992), if $X = \{x_1, x_2, \cdots, x_n\}$ is the object set and $U = (u_1, u_2, \cdots, u_m)$ is the goal set, there can be m extent analysis values for each object:

$$U_{gi}{}^{1}, U_{gi}{}^{2}, \cdots, U_{gi}{}^{m}, i = 1, 2, \cdots, n$$

Table 5
Linguistic terms and triangular fuzzy numbers for fuzzy AHP (adopted from Sun, 2010).

Linguistic scales	TFN	Description
Just equal	(1,1,1)	Criteria A and B share the same importance.
Moderately more important	(2,3,4)	Criterion A is moderately more important than criterion B.
Strongly more important	(4,5,6)	Criterion A is strongly more important than criterion B.
Very strongly more important	(6,7,8)	Criterion A is Very strongly more important than criterion B.
Absolutely more important	(8,9,10)	Criterion A is absolutely more important than criterion B.

Chang's extent analysis uses TFNs to calculate the value of fuzzy synthetic extent of the i_{th} object for "m" goals as follows:

$$S_i = \sum\nolimits_{j=1}^{m} U_{gi}{}^{j} \otimes \left[\sum\nolimits_{i=1}^{n} \sum\nolimits_{j=1}^{m} U_{gi}{}^{j}\right]^{-1} \tag{7}$$

Equation (7) includes S_i to represent the fuzzy extent analysis for the i^{th} object, the two distinct values are multiplied using the fuzzy multiplication operator. Assuming U_g^j is a TFN represented as (l_{im}, m_{im}, u_{im}), $\sum_{j=1}^{m} U_{gi}{}^{j}$ can be calculated for the m extent analysis values using fuzzy addition operator as $(\sum_{j=1}^{m} l_{ij}, \sum_{j=1}^{m} m_{ij}, \sum_{j=1}^{m} u_{ij})$. Since $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} U_{gi}{}^{j}\right]^{-1}$ is a reversed value, the fuzzy addition operator is used to calculate the values within the brackets and the fuzzy division operator to obtain the reversed value. That is $\sum_{i=1}^{n}\sum_{j=1}^{m} U_{gi}{}^{j} = (\sum_{j=1}^{n} l_j, \sum_{j=1}^{n} m_j, \sum_{j=1}^{n} u_j)$ and $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} U_{gi}{}^{j}\right]^{-1} = \left(\frac{1}{\sum_{j=1}^{n} u_j}, \frac{1}{\sum_{j=1}^{n} m_j}, \frac{1}{\sum_{j=1}^{n} l_j}\right)$. Chang (1992) argues that the weight vector for each criterion can be obtained in light of fuzzy number comparison principles. That is, the calculation of the weight vector is associated with the degree of possibility of one TFN being greater than the other TFN (i.e., $S_i = (l_i, m_i, u_i) \geq S_k = (l_k, m_k, u_k)$) using equations (4) and (5):

$$V(S_i \geq S_k) = sup_{y \geq x}\left[(\mu_{S_i}(x), \mu_{S_k}(x))\right] \tag{8}$$

$$V(S_i \geq S_k) = \mu_{Si}(d) = \left\{\begin{array}{c} 1, if\, m_2 \geq m_1 \\ 0, if\, l_1 \geq u_2, \\ \dfrac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, otherwise \end{array}\right\} \tag{9}$$

The degree of possibility that a convex fuzzy number be greater than k convex fuzzy numbers S_i with $i = 1, 2, \ldots, k$ can be calculated as shown below:

$$V(S \geq S_1, S_2, \cdots, S_k \tag{10}$$

$$= V[(S \geq S_1) and (S \geq S_2) and \cdots and (S \geq S_k)]$$

$$= \min V(S \geq S_i), i = 1, 2, 3, \ldots, k$$

In fact, the minimum values obtained from equation (9) will determine the degree of possibility. Assuming $d'(A_i) = \min V(S_i \geq S_k)$, for $k = 1,2,\ldots,n$; $k \neq i$, then the fuzzy weight vector can be represented as:

$$w' = (d'(A_1), d'(A_2), \cdots, d'(A_n))' \tag{11}$$

Therefore, w' is a weight vector that includes the minimum of the degrees of possibilities calculated in the previous step. 'Defuzzified' weight vectors with "W" as a non-fuzzy number can be calculated by dividing the values of fuzzy weight vector by the sum of all values in the fuzzy vector. The normalization equations are provided below:

$$w_i = \frac{w_i'}{\sum w_i'} \tag{12}$$

$$w == ((d(A_1), d(A_2), \cdots, d(A_n)) \tag{13}$$

3.3. Fuzzy TOPSIS

First introduced by Chen (2000), fuzzy TOPSIS is the second most popular MCDM technique used to solve organizational problems (Behzadian et al., 2012; Junior et al., 2014). According to Junior et al. (2014), fuzzy TOPSIS is capable of identifying the relative importance of different alternatives at the same time with the basic assumption that the optimum alternative is the closest to the positive ideal solution (PIS) while being the furthest away from the negative ideal solution (NIS). Using linguistic variables displayed in Table 6 fuzzy TOPSIS

Table 6
Linguistic terms and triangular fuzzy numbers for fuzzy TOPSIS (adopted from Junior et al., 2014).

Linguistic scales	TFN	Description
Very weak	(0,0,2.5)	Alternative M performs very weakly regarding the assigned criterion.
Weak	(0,2.5,5)	Alternative M performs weakly regarding the assigned criterion.
Moderate	(2.5,5,7.5)	Alternative M performs moderately regarding the assigned criterion.
Strong	(5,7.5,10)	Alternative M performs strongly regarding the assigned criterion.
Very strong	(7.5,10,10)	Alternative M performs very strongly regarding the assigned criterion.

incorporates several calculation steps as follows.

The first step requires the linguistic rating values for the identified alternatives with respect to the study criteria. There will be three principal assumptions:

1) There are m possible alternatives ($A = \{A_1, A_2, \dots, A_m\}$) to be evaluated against n criteria ($C = \{C_1, C_2, \dots, C_n\}$) with identified criteria weights denoted by W_j ($j = 1,2, \dots, n$).
2) The performance ratings of each expert D_k ($k = 1,2, \dots, k$) for each alternative A_i ($i = 1,2, \dots, m$) with respect to criteria C_j ($j = 1,2, \dots, n$) are denoted by $\widetilde{R}_k = \widetilde{X}_{ijk}$($i= 1,2, \dots, m$; $j= 1, 2, \dots, n$; $k= 1,2, \dots$, K).
3) $\mu_{\widetilde{RK}(x)}$ is used to represent the membership function.

Step 2, then requires the aggregation of fuzzy ratings for the alternatives. If experts' fuzzy judgments are obtained using a TFN denoted by $\widetilde{R}_k = (a_k, b_k, c_k)$, k= (1, 2,⋯, k), then fuzzy ratings for the alternatives can be aggregated using the following equation:

$$\widetilde{R} = (a, b, c),\ k = 1, 2, \cdots, k$$

$$a = min_k\{a_k\}, b = \frac{1}{k}\sum_{k=1}^{k} b_k,\ c = max_k\{c_k\}, \tag{14}$$

If there are k decision-makers expressing k fuzzy ratings, therefore, the fuzzy rating of the k^{th} decision maker would be $\widetilde{X}_{ijk} = (a_{ijk}, b_{ijk}, c_{ijk})$, where $i= 1,2, \dots, m$; $j=1,2, \dots, n$ and the aggregated fuzzy ratings ($\widetilde{X}_{ij}$) for all alternatives with respect to each criterion ($\widetilde{X}_{ij} = (a_{ij}, b_{ij}, c_{ij})$ can be obtained as:

$$a_{ij} = min_k\{a_{ijk}\}, b_{ij} = \frac{1}{k}\sum_{k=1}^{k} b_{ijk},\ c_{ij} = max_k\{c_{ijk}\}, \tag{15}$$

with a_{ij} representing the minimum of lower values judged by all experts, b_{ij} representing the average value of the most promising values judged by all experts, and c_{ij} the maximum value of the largest possible values judged by all experts. Having calculated the aggregated fuzzy ratings by all experts, the fuzzy decision matrix for the alternatives ($\widetilde{D}$) and the criteria $\widetilde{W}$ should be assembled in step 3.

$$C_1 C_2 C_m$$

$$\widetilde{D} = \begin{matrix} A_1 \\ \vdots \\ A_m \end{matrix} \left[\widetilde{x_{11}} \cdots \widetilde{x_{1n}} \vdots \ddots \vdots \widetilde{x_{m1}} \cdots \widetilde{x_{mn}} \right] \quad i = 1, 2, \cdots .m; j = 1, 2, \cdots, n$$

$$\widetilde{W} = \left[\widetilde{w}_1 + \widetilde{w}_2 + \cdots + \widetilde{w}_m\right] \tag{16}$$

Using linear scale transformation, normalized fuzzy decision matrix must be constructed at step 4. The normalized fuzzy decision matrix is denoted by $\widetilde{R}$ and would help to bring the various criteria scales into a comparable scale. Assuming $\widetilde{R} = \left[\widetilde{r}_{ij}\right]_{m\times n}$ (i= 1,2, … , m; j= 1,2,… , n), then $\widetilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^+}, \frac{b_{ij}}{c_j^+}, \frac{c_{ij}}{c_j^+}\right)$ with c_j^+ as the $max_i\ c_{ij}$ for benefit criteria (equation 17) such as productivity and $\widetilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}}\right)$ with a_j^- as the $min_j\ a_{ij}$ for cost criteria(equation 18) such as expense. Then, the weighted normalized matrix $\widetilde{V}$ must be constructed during step 5. Using fuzzy multiplication operator, this can be obtained by multiplying the weights ($\widetilde{w}_j$) of evaluation criteria by the normalized fuzzy decision matrix $\widetilde{r}_{ij}$. If $\widetilde{v}_{ij}$ is given by $\widetilde{r}_{ij} \odot W_j$, therefore:

$$\widetilde{v}_{ij} = (\widetilde{a}_{ijk}, \widetilde{b}_{ijk}, \widetilde{c}_{ijk})$$

$$\widetilde{V} = \left[\widetilde{v}_{ij}\right]_{m\times n},\ i = 1, 2, \cdots, m;\ j = 1, 2, \cdots, n \tag{19}$$

As stated earlier, fuzzy TOPSIS determines the optimum alternative based on its distance to the positive ideal solution (PIS) and from the negative ideal solution (NIS). Step 6 defines the fuzzy PIS (I^+) and fuzzy NIS(I^-) using the following equation:

$$I^+ = (\widetilde{v}_1^+, \widetilde{v}_2^+, \cdots, \widetilde{v}_n^+) \text{ where } \widetilde{v}_j^+ = (\widetilde{c}_j^+, \widetilde{c}_j^+, \widetilde{c}_j^+) \text{ and } \widetilde{c}_j^+ = max_j\left\{\widetilde{c}_{ij}\right\} \tag{20}$$

$$I^- = (\widetilde{v}_1^-, \widetilde{v}_2^-, \cdots, \widetilde{v}_n^-) \text{ where } \widetilde{v}_j^- = (\widetilde{a}_j^-, \widetilde{a}_j^-, \widetilde{a}_j^-) \text{ and } \widetilde{a}_j^- = min_j\left\{\widetilde{a}_{ij}\right\} \tag{21}$$

Calculation of I^+ and I^- would help to compute the distance of each alternative from FPIS and FNIS at step 7. The distance (d_i^+ and d_i^-) of each weighted alternative i=1,2,3,…,m from fuzzy PIS and the fuzzy NIS can be computed as follows:

$$d_i^+ = \sum_{i=1}^{n} dv(\widetilde{v}_{ij}, \widetilde{v}_j^+), i = 1, 2, 3, \cdots, m \tag{22}$$

$$d_i^- = \sum_{i=1}^{n} dv(\widetilde{v}_{ij}, \widetilde{v}_j^-), i = 1, 2, 3, \cdots, m \tag{23}$$

In order to identify the ultimate ranking of alternatives, the closeness coefficient (CC_i) of each alternative must be obtained at step 8 using the following equation:

$$CC_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{24}$$

Ultimately, alternatives can be ordered based on CC_i in decreasing order. The optimum alternative is the one closest to fuzzy PIS and farthest from fuzzy NIS.

4. The empirical approach

This study advanced a systematic approach to identify the key enablers of BMD and determine the most significant barriers to it. The decision conferring BMD is a multi-criteria decision-making situation that required the identification and assessment of multiple criteria with various, in some cases conflicting, characteristics. For this purpose, MCDM techniques are plausible remedies to assist the decision-makers within the organization (Jafari-Sadeghi et al., 2022). Fig. 2 depicts the flowchart of the empirical approach adapted for the present study. Initially, the relative literature regarding the enablers and barriers of BMD has been carefully reviewed. As the result, an initial list of all possible criteria was developed (see Table 2 and Table 3).

Since the results of the proposed systematic approach is depended on expert judgments, experts were selected based on their relative expertise in the airline industry with a minimum experience of 10 years in relative fields such as strategic managerial role, marketing managers and representatives, and sales and finance. After a careful screening of potential

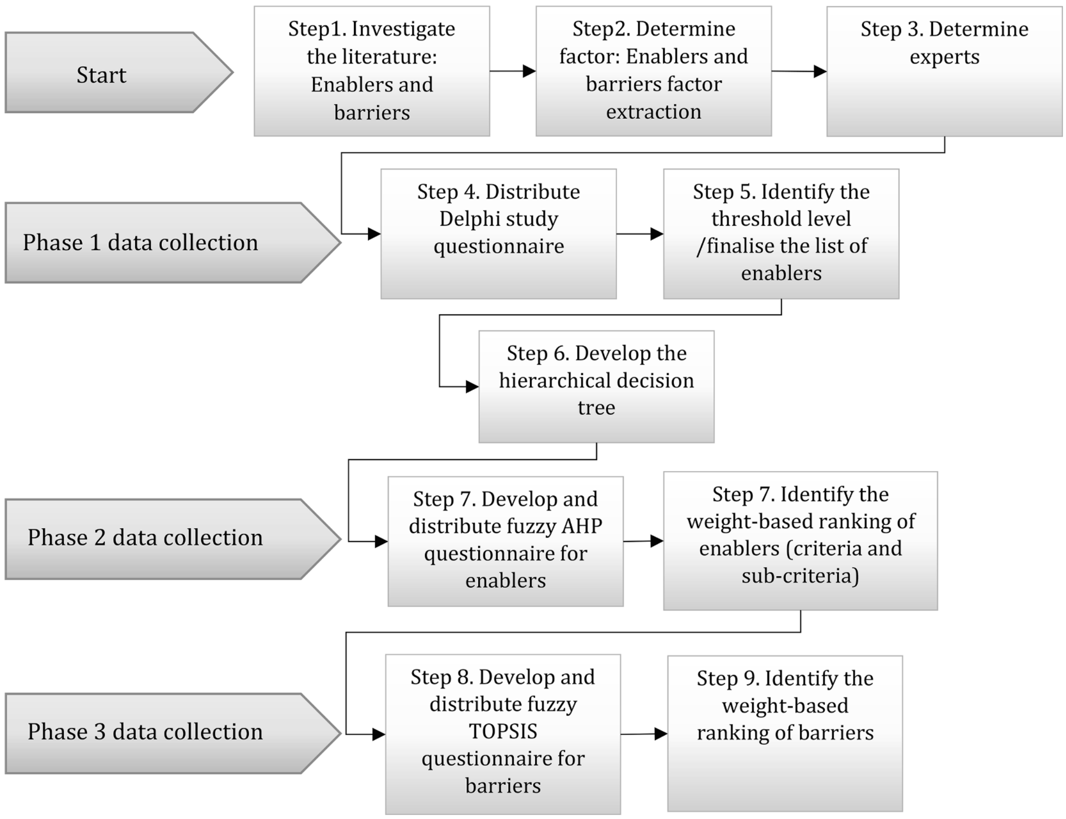

Fig. 2. Proposed empirical approach flowchart.

experts against the selection criteria, a judgmental sample of 36 airline experts were initially identified via LinkedIn. The corresponding author contacted experts via LinkedIn to describe the research aims and objectives and to ensure the confidentiality of responses. The data was collected in February and March 2022 by distributing the survey link among the experts using their email addresses. The experts' profile is provided in Table 7. Fuzzy Delphi study was performed to validate the list during the first phase of data collection. Specifically, the experts were asked to use the linguistic terms shown in Table 4 to express their judgment regarding the importance of identified enablers to be included in the study.

Table 7
Experts' profile.

Expertise	Years of experience	Gender	Age
Marketing manager	11	Male	45-55
Marketing manager	12	Male	45-55
Marketing officer	10	Male	35-45
Marketing specialist	10	Male	35-45
Head of strategy	11	Male	45-55
Strategic manager	13	Male	45-55
International relations	10	Female	35-45
Sales officer	10	Female	35-45
Accounting and finance	10	Male	45-55
Accounting and finance	11	Male	35-45
Head of cabin services	14	Male	45-55
Flight services manager	16	Male	55 and more
Assistant general manager	11	Male	45-55
General manager	18	Male	55 and more
Head of resource allocation and strategic orientation	18	Male	45-55
Flight operations manager	14	Male	55 and more
Flight services manager	12	Female	45-55

The validated list informed the questionnaire preparation for fuzzy AHP and fuzzy TOPSIS. That is, two sets of questionnaires (i.e., fuzzy AHP questionnaire and fuzzy TOPSIS questionnaire) were prepared and distributed among experts, during the second and third phase of data collection, respectively. In total, 17 useable responses were returned. The sample size meets the sampling criteria for MCDM studies (Jafari-Sadeghi et al., 2022). Before data collection, a pilot study with five experts was conducted. Experts did not have difficulties understanding the questionnaire items. Therefore, no changes were applied to the original questionnaires. Sample questionnaires are provided in Appendix A.

The fuzzy AHP questionnaire included pairwise comparisons among key enablers of BMD as manifested by organizational form, organizational dynamism, and organizational capabilities and competencies, as well as their corresponding sub-criteria depicted in Fig. 3. Experts were asked to determine the relative importance of each criterion over the others, using the linguistic variables shown in Table 5. On the other hand, the fuzzy TOPSIS questionnaire included a matrix to evaluate the relative significance of each barrier type including type I, type II, and external barriers with regard to the main enablers of BMD.

Experts were asked to rate the performance of each barrier type to act as a significant obstacle to BMD using the linguistic terms provided in Table 6. Despite the importance of BMD in organizational literature (Breier et al., 2021; Schneider et al., 2013) and entrepreneurship research (Osiyevskyy & Dewald, 2015), enablers of and barriers to BMD have not been previously assessed by organizational scholars. This study is the first of its kind that treats BMD as a multi-criteria decision-making problem and advanced the knowledge in the BM literature by identifying the key enablers of and determining the barriers to BMD using fuzzy MCDM techniques. The results of the current study are substantially precise due to their consistency with the requirements of triangulation in terms of multi-methods and multi-source data throughout the data collection and analysis (Denzin, 1978; Jick, 1979).

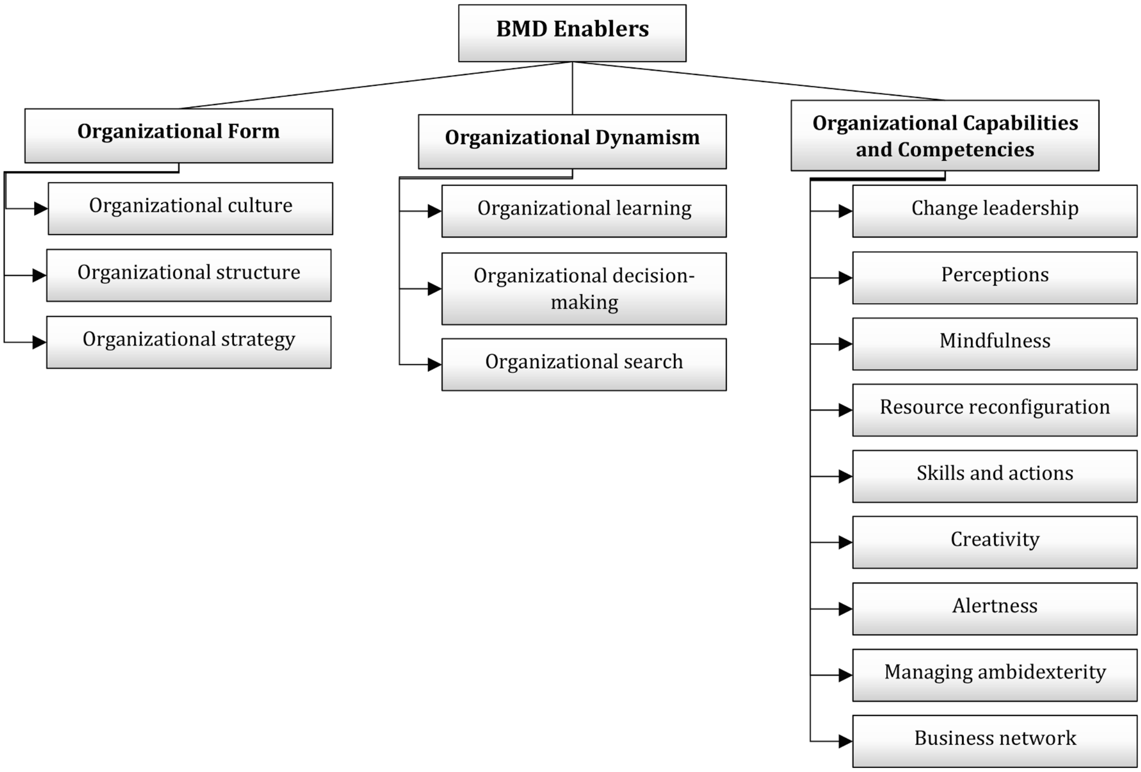

Fig. 3. Graphical representation of BMD enablers.

5. Results

5.1. Fuzzy Delphi study

In line with the tenets of the fuzzy Delphi study, equation (6) was used to compute the threshold level as $\tilde{z}$=0.678 for the identified enablers of BMD. It means that, the criteria with the weight below the threshold level were considered as inappropriate by the experts and should be eliminated from further assessment. According to the results, except for paradox heuristics ($\tilde{z}$=0.577) and system perspectives ($\tilde{z}$=0.584), the rest of the study criteria met the inclusion criteria (i.e., $\tilde{z}$>= 0.678) and have been used to develop the fuzzy AHP decision tree. The hierarchical structure of key elements of fuzzy decision-making systems enables the decision-maker to develop a better understanding of key configurational components of the decision-making problem, hence, should be established as the principal practice for such systems (Kahraman et al., 2003). Fig. 3 represents the hierarchical structure of key enablers of BMD in the airline industry.

5.2. Fuzzy AHP

In line with the requirements of Chang's extent analysis, a number of pair-wise comparisons were made by the experts using linguistic terms provided in Table 5. The pairwise comparison matrix for the main enablers of BMD is provided in Table 8. Using equation (10), the degree of possibility of each enabler being greater than the other, has been computed. Fuzzy and non-fuzzy weight vectors have been consequently calculated using equations (11) and (12), respectively. Sample calculations are provided in Appendix B. As shown in Table 8, organizational form is the most significant enabler of BMD in the airline industry (0.485). This is followed by organizational dynamism (0.319) and organizational capabilities (0.196), respectively. The results suggest that organizational form including organizational structure, culture and strategy is the most significant enabler of BMD. However, the other two higher-order sub-systems namely organizational dynamism and organizational capabilities are also contributing to the BMD.

The same procedure has been applied to calculate the relative weights of each sub-criterion in the enablers list. According to the results, mindfulness (0.140) is the most significant sub-criterion under organizational capabilities. The results further revealed that organizational decision-making (0.429) is the most important sub-criterion representing the organizational dynamism and organizational structure (0.585) is the most salient sub-criterion related to organizational form. Similar to the main enablers of the BMD, the sub-criteria under each main criterion is contributing to the development of the BM in the weight-based ranking order where higher weights are representing stronger impact on the overall system. The results are provided in Appendix C.

To enable the decision-maker to decide on the significance of sub-criteria regardless of their corresponding criterion, the global weights of all sub-criteria should be calculated by multiplying the weights of each sub-criterion by the weight of its corresponding criterion. As shown in Table 9, organizational structure (0.284), organizational culture

Table 8
Pairwise comparison matrix among main enablers of BMD.

	Organizational capabilities	Organizational dynamism	Organizational form	Weights
Organizational capabilities	(1.00, 1.00, 1.00)	(0.65, 0.86, 1.19)	(0.43, 0.56, 0.77)	0.196
Organizational dynamism	(0.83, 1.15, 1.53)	(1.00, 1.00, 1.00)	(0.62, 0.82, 1.126)	0.319
Organizational form	(1.28, 1.75, 2.30)	(0.88, 1.20, 1.59)	(1.00, 1.00, 1.00)	**0.485**

*CRm: 0.006; CRg: 0.018

Table 9
Global weights of sub-criteria.

Main enablers	Sub-criteria	Local weights	Global weights
Organizational capabilities (0.196)	Change leadership	0.138	0.027
	Perceptions	0.139	0.027
	Mindfulness	*0.140*	0.027
	Resource reconfiguration	0.119	0.023
	Skills and actions	0.128	0.025
	Creativity	0.094	0.018
	Alertness	0.120	0.024
	Managing ambidexterity	0.049	0.010
	Business network	0.072	0.014
Organizational dynamism (0.319)	Organizational learning	0.317	0.101
	Organizational decision Making	*0.429*	**0.137**
	Organizational search	0.254	0.081
Organizational form (0.485)	Organizational structure	*0.585*	**0.284**
	Organizational culture	0.317	**0.154**
	Organizational strategy	0.098	0.048

(0.154), and organizational decision-making (0.137) are the predominant enablers of BMD in the airline industry. However, the remaining sub-criteria are also weighted in the current list and their impact should be comparably taken into consideration.

5.3. Fuzzy TOPSIS

As shown in Fig. 4, this study attempts to determine the most influential barrier to BMD. Accordingly, experts evaluated the relative performance of each barrier type to act as a significant obstacle to BMD using the linguistic terms shown in Table 6. Consistent with the fuzzy TOPSIS method, Table 10 is a fuzzy decision matrix that demonstrates the aggregated matrix of expert judgments. Once the aggregated decision matrix is established, a normalized decision matrix can be determined. Using equation (19), weighted normalized decision matrices have been obtained. The results are shown in Table 10 and Table 11, respectively (see Table 12).

Chen (2000) argues that the optimum alternative should be the closest to the FPIS and farthest from the FNIS. Hence, FPIS (0.32) and FNIS (0.08) have been identified. Consequently, the distance from the FPIS and FNIS has been captured using equations (22) and (23). The results are provided in Table 13. Ultimately, equation (24) was used to calculate the CC_i for the final ranking of the most significant barrier to BMD. As shown in Table 14, type II barriers such as organizational structure, culture, rigidities, and design are the most significant obstacles to BMD in the airline industry. Type I barriers including organizational inertia, ambidexterity challenges, and managerial cognitions are the second important obstacles to BMD in the airline industry. Ultimately, external barriers counting supplier barriers, demand barriers,

Table 10
Aggregated rating of barriers.

	Organizational capabilities	Organizational dynamism	Organizational form
Type I barriers	(4.17m 6.67, 8.33)	(5.83, 8.33, 10.00)	(3.33, 5.83, 8.33)
Type II barriers	(3.33, 5.83, 8.33)	(5.00, 7.50, 10.00)	(5.83, 8.33, 10.00)
External barriers	(1.67, 4.17, 6.67)	(2.50, 5.00, 6.67)	(4.17, 6.67, 8.33)

Table 11
Normalized decision matrix.

	Organizational capabilities	Organizational dynamism	Organizational form
Type I barriers	(0.50, 0.80, 1.00)	(0.58, 0.83, 1.00)	(0.33, 0.58, 0.83)
Type II barriers	(0.40, 0.70, 1.00)	(0.50, 0.75, 1.00)	(0.58, 0.83, 1.00)
External barriers	(0.20, 0.50, 0.80)	(0.25, 0.50,0.67)	(0.42, 0.67, 0.83)

Table 12
Weighted normalized decision matrix.

	Organizational capabilities	Organizational dynamism	Organizational form
Type I barriers	(0.10, 0.16, 0.20)	(0.19, 0.27, 0.32)	(0.16, 0.28, 0.40)
Type II barriers	(0.08, 0.14, 0.20)	(0.16, 0.24, 0.32)	(0.28, 0.40, 0.49)
External barriers	(0.04, 0.10, 0.16)	(0.08, 0.16, 0.21)	(0.20, 0.32, 0.40)

Table 13
Distances of each barrier from BMD enablers.

	d^+	d^-
Type I barriers	0.37	0.46
Type II barriers	0.30	0.53
External barriers	0.48	0.34

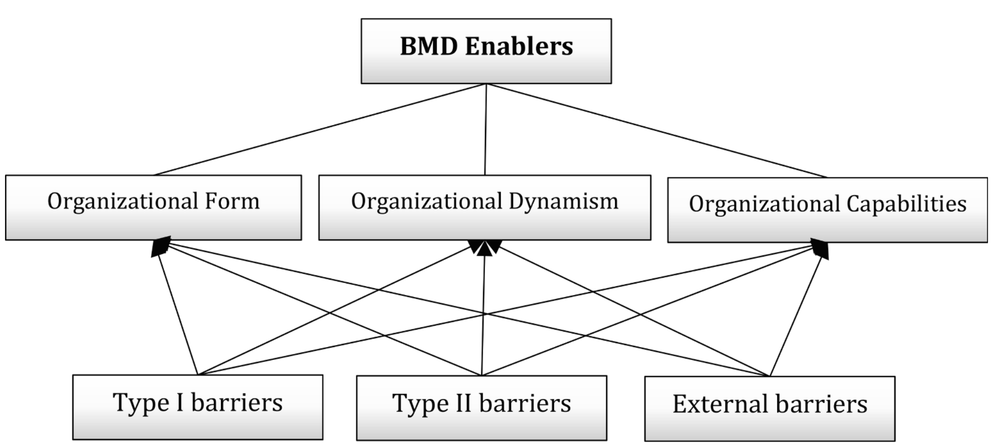

Fig. 4. BMD enablers and corresponding barriers.

Table 14
Final ranking of barriers to BMD.

	CC_i	Normalized CC_i	Rank
Type I barriers	0.56	0.35	2
Type II barriers	0.63	0.40	1
External barriers	0.41	0.26	3

and regulatory barriers are the third significant obstacles to BMD.

These findings are intuitively plausible and detailed understanding of these most and least notable challenges airlines face in transforming their BMs could help them overcome the major difficulties in the implementation of BMD via prioritization.

6. Discussion and Implications

According to Pereira and Caetano (2017), changes in airline BMs might be the source of value creation, competitive advantages, and profitability. However, it is not clear why airlines are still suffering from failure in innovating and developing their BMs. Literature about the enablers and barriers of BMD has been progressed in a general way (Bocken & Geradts, 2020; Rüb et al., 2017; Saebi et al., 2017; Ulvenblad et al., 2018), and researchers have stressed the need to investigate the issues relevant to developing BMs in the context of the airline industry (Reinhold et al., 2017, 2019; Vatankhah et al., 2019). In answering the proverbial 'so what' question, drawing on the notion of hierarchy within complexity theory and adopting fuzzy AHP approach, this study affords us a closer look at enablers of BMD by assessing the relative importance of each criterion over all others.

Moreover, the fuzzy TOPSIS method was applied to highlight the barriers of great concern to developing airline BMs. Based on pertinent literature and with the validation of airline experts, a set of fifteen BMD enablers and twelve BMD barriers were identified. The entire set of enablers is categorized into three main criteria (higher-order subsystems), labelled organizational form, organizational dynamism, and organizational capabilities. Similarly, the entire set of barriers is classified under three main criteria of internal barriers including type I and type II, as well as external barriers. At the cluster level of enablers, the fuzzy AHP analysis reveals that organizational form has the highest level of priority (0.485), followed by organizational dynamism (0.319), and organizational capabilities (0.196), respectively. With respect to the organizational form criterion, organizational structure (0.585) is the most important sub-criterion that can facilitate the development of BMs, followed by organizational culture (0.317) and strategy (0.098).

These findings are important, and align with the notion that organizational structure can significantly enable airlines to effectively develop their BMs via various tools such as exploiting new opportunities (Bashir & Verma, 2018), innovating in operational optimization at airports (Pereira & Caetano, 2017), and implementing of newly complex BMs (Albers et al., 2020). In addition, decision-making (0.429) as one of the main components of organizational dynamics was found to be a second significant airline BMD enabler. Consistent with entrepreneurship literature (Hock et al., 2016; Reymen et al., 2017; Ricciardi et al., 2016), consideration given to the need for generating a viable value proposition can be satisfied through the effectuation logic of decision-making, while the causational approach is applied to the other components of BMs.

Regarding organizational capabilities, the cognitive capability of airline top managers in terms of mindfulness (0.140) also emerges as a critical ingredient for developing BMs within the aviation industry. While these management attributes are not new to the literature on BM change, what is new is the consideration of these individual-level cognitive enablers and mechanisms (i.e., decision-making logic and mindfulness) in the context of the airline industry. Ranking the barriers of BMD, this study found that 'internal barriers' related to the dark side of enablers named "Type II barrier" (0.63), are the most critical barrier to developing new BMs. This finding highlights the role of internal barriers such as complex structures of network carriers (Albers et al., 2020) and organizational culture in adding up some crises to airlines' innovation (Taneja, 2016).

6.1. Implications for theory

This study has several implications for theory in the BM literature. First, the study mitigates challenges to the concept of BM change (Bhatti et al., 2021; Clauss (2017) by providing a new perspective borrowed from the entrepreneurship literature rather than focusing on the typology of change (e.g., radical, imitative, evolutionary, etc.). Going beyond the dynamic approach to BMD introduced by Osiyevskyy & Dewald (2015), this study identified and categorized enablers and barriers to explorative as well as exploitative change in BMs. While there have been a handful of studies that have investigated BMD barriers/enablers (Bocken & Geradts, 2020; Rüb et al., 2017; Saebi et al., 2017; Ulvenblad et al., 2018), none to the authors' knowledge have used the entrepreneurial lens (exploitative vs. explorative lens) for investigating BMD enablers/barriers.

Second, this study contributes to the literature by investigating the elements of successful BMD through the lens of complexity theory and the concept of hierarchy. The underlying logic for employing the concept of hierarchy lies in the fact that, as a complex system with nested higher- and lower-systems, levels of operational responsibility, tasks, actions, and personnel, various factors within an organization can affect BMD in a hierarchical order. That is, various factors might adversely/favourably affect the lower-level subsystems of activities (such as opportunity identification) and, in turn, value-related mechanisms (such as value creation) at a higher order, which can eventually lead to (un)successful BMD.

Third, applying this theoretical lens to the proposed framework, this research illustrates that barriers as a lower subsystem can affect enablers and its related subcategories at a higher-level hierarchy and consequently affect BMD. Indeed, the present study provides a useful tool to answer the question of "why" successful BMD emerges (Budler et al., 2021; Foss & Saebi, 2017; Zhao et al., 2021) and paves the way for a better understanding of "how" BMs function dynamically through the lens of complexity theory and its interdependency concept (Ramdani et al., 2019; Snihur & Zott, 2020). Doubtless, complexity theory is a broad and multifaceted domain, yet the contribution of this study signals that significant insights can be gained from a better understanding of the features of BMs as complex, hierarchic systems, and how such features determine the appropriateness of different levels of theoretical and analytical model building to advance knowledge.

As such, the contribution of the proposed study also offers a preliminary blueprint for complexity theory application for others to take forward in a continuous and hopefully profitable research journey. And finally, this study presents an integrative perspective to airline BM literature consisting of factors leading to/ hampering the development of BMs. Although research has necessitated airlines to change the way of value creation and capture to follow market trends, provide value for all stakeholders, and affect related industries such as tourism (Bieger et al., 2002; Choi et al., 2015; De Almeida et al., 2020; Zoumpoulidis et al., 2021), research on the reasons why airlines still suffer from an inability to develop their BMs is scant (Reinhold et al., 2017, 2019).

In this manner, this research is one of the few studies which explores the related literature and identifies enablers and barriers to BMD in the airline context. Third, the proposed framework which is empirically assessed by experts offers priority to identified enablers and barriers to airline BMD. That is, while researchers have established the facilitating role of organizational form, dynamism, and capabilities (e.g., Booyens & Rogerson, 2017; Castiglioni et al., 2018; Pereira & Caetano, 2017) in developing airline BMs and also the impeding role of internal and external barriers (Albers et al., 2020; Gittell et al., 2004; Joshan & Maertens, 2020; Taneja, 2016), this study adds to the literature by providing a comprehensive list of priorities in terms of barriers and enablers.

6.2. Implications for practice

From the managerial perspective, the context of the current study warrants findings of paramount importance as airlines face the need to rethink and develop BMs in their whole lifecycle. Surrounded by ever-changing environments, airlines might not experience growth or even survive unless they adapt their BMs to dramatic environmental shifts. Accordingly, highlighting the factors empowering airlines to develop their BMs is of great importance. Airline managers must change their organizational form in a way in which they can quickly respond to changes. More specifically, this must be achieved through organizational structures that support opportunity exploitation and operational innovation and facilitate the new BM implementation. Linking organizational advantages to more individual settings, airline managers are encouraged to strengthen their cognitive mechanisms such as entrepreneurial decision-making as well as capabilities such as mindfulness.

In addition, trends in service industries affected by the Covid-19 pandemic, require airlines to transform their organizational culture, structure and strategy to support customer-centric and networked BMs (Cambra-Fierro et al., 2022). Identifying and prioritizing significant barriers, the current study points airline managers' attention to internal issues. This study shows that complex structures, hindering cultures, and a strict atmosphere, that are still pervasive within airline organizations, are among the most negative factors for successful BMD. The core implication is clear, removing bottlenecks within organizational structure and culture should be a high-priority task for airline managers. Encompassing all these factors, airline organizations can effectively tackle rapidly unpredictable changes, proposing and creating value for their stockholders and effectively capturing those values.

6.3. Limitations and future research directions

Despite its contributions, the results of the current study are subject to limitations. First, this study used a sample of international airline experts to gauge their rating of questionnaire items using a self-report data. This might affect experts' responses based on their personal experiences and preferences and might not be applicable to other industries. This would call for future research to use a wider sample from other industries such as manufacturing and fashion industries to attest the validity of the proposed framework. Second, this study advanced a systematic approach to study the enablers of and barriers to BMD using fuzzy MCDM techniques. Particularly, a fuzzy Delphi study was employed to initially validate the identified list of enablers captured from the extant literature.

Fuzzy AHP was further utilized to assess the priorities among key enablers of BMD. Ultimately, fuzzy TOPSIS was used to determine the most significant barriers to BMD enablers. Despite its abilities in identifying the significant enablers of and barriers to BMD, the proposed method did not present the interrelationship among variables. Accordingly, researchers are encouraged to apply fuzzy Decision-making trial and evaluation laboratory (DEMATEL) (Wu et al., 2007) and fuzzy analytical network process (ANP) (Chan et al., 2007) to advance the current knowledge pertaining to the potential interrelations among key enablers of and barriers to BMD. The proposed combination of MCDM techniques would enhance the precision and robustness of the findings (e.g., Büyüközkan & Çifçi, 2012; Mavi & Standing, 2018).

Third, future research including symmetric as well as asymmetric modelling of regression analysis is called for to empirically assess the positive (i.e., enablers) and negative (i.e., barriers) impacts of the proposed frameworks on BMD. Fourth, since this study explores BMD through the lens of complexity theory and its hierarchical attribute in order to answer the core question of why some firms are able to successfully change their BMs while others fail (Zhou et al., 2021), future studies may find it a profitable avenue to focus on the interdependency aspect of complex systems and investigate how interdependencies within and among those hierarchies can affect BMD to untangle the question of how BMs change (Ramdani et al., 2019).

Lastly, the exploration of enablers of and barriers to BMD have been conducted for the airline industry in general. However, the industry-specific configuration of the proposed framework might differ across key BMs and dimensions (value proposition, market segmentation, value chain and profit structure) in the airline industry in terms of legacy carriers, full-service network carriers, low-cost carriers, charter and regional airlines (see, e.g., Çetin et al., 2016). Hence, existing knowledge could be well developed by incorporating such distinctions in future research.

CRediT authorship contribution statement

Sanaz Vatankhah: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Vahideh Bamshad:** Writing – review & editing, Writing – original draft, Conceptualization. **Levent Altinay:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Conceptualization. **Glauco De Vita:** Writing – review & editing, Validation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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