

Entrepreneurial orientation and post entry internationalization speed: the moderating role of big data analytics capability and home country alliance network centrality

1. Research motivation

With the intensified international competition, the accelerating internationalization has been becoming an increasingly important route to competitive advantage for international companies (Hilmersson & Johanson, 2016). Firms eagerly seeking to participate in international business are on the rise (M. Johanson & Kalinic, 2016), with the expectation that a faster internationalization strategy will facilitate them to seize fresh opportunities, enter potentially global niches, and build first-mover advantages (Acedo & Jones, 2007; Vermeulen & Barkema, 2002). The firm's speed of internationalization, a key aspect of international strategic decision-making, has become an important issue for expanding international markets (Chetty et al., 2014; Prashantham & Young, 2011). The conceptualization of internationalization speed has predominantly revolved around the duration between a firm's establishment and its initial international sales (Kiss & Danis, 2008; Li et al., 2015; Musteen et al., 2010). However, this perspective has faced criticism for its failure to capture the multidimensional nature of speed such as the progressive increase in the proportion of foreign sales achieved by a firm (depth of internationalization speed) and the number of foreign markets it has penetrated (breadth of internationalization speed) (Prashantham & Young, 2011). Recognizing this limitation, Chetty et al. (2014) argue that the conceptualization of internationalization speed should be grounded in the internationalization process model, which encourages research to extend beyond the initial speed of internationalization. To address this, researchers have increasingly adopted a multidimensional perspective that considers both the time taken to achieve the first foreign market entries and the time span over which firms achieve their current depth and breadth of internationalization (Casillas & Acedo, 2013; Chetty et al., 2014; Hsieh et al., 2019) to align with the broader context of the internationalization process.

The literature on strategic orientation attempts to explain internationalization as a form of entrepreneurial and strategic behaviors needed to deal with the challenges of the competitive landscape (Liu et al., 2011). Particularly, entrepreneurial orientation (EO) is regarded as one of the most important strategic orientations (Amankwah-Amoah et al., 2019; Semrau et al., 2016; Zhang et al., 2012). Internationalization is considered an entrepreneurial activity (Oviatt & McDougall, 2005a) and international entrepreneurship is defined as "*a combination of innovative, proactive, and risk-seeking behavior that crosses national borders and is intended to create value in organizations*" (McDougall & Oviatt, 2000a). This definition suggests that it is important to focus on the

entrepreneurial qualities of firms and to investigate how firms compete after internationalization, more than understanding whether and how they enter global markets (S. A. Zahra, 2005). Accordingly, there are a significant number of prior studies investigating the relationship between entrepreneurial orientation and speed of internationalization (Dai et al., 2014a; Felzensztein et al., 2015; Hsieh et al., 2019; L. Li et al., 2015; X. Li et al., 2021; Ripollés-Meliá et al., 2007a; Zhou, 2007). However, they have predominantly focused on firms small and medium-sized enterprises (SMEs), which often face more severe resource limitations compared to large multinational enterprises (MNEs) (Lu & Beamish, 2006) and international new ventures or born-global firms which are often characterized as highly entrepreneurial entities and strives to gain substantial competitive advantage through the effective utilization of resources and the expansion of market presence across multiple countries (Hennart et al., 2021; Oviatt & McDougall, 2005b). Given their nature, entrepreneurial orientation serves as a prominent catalyst for acquiring and leveraging information (Keh et al., 2007), and expanding internationally (Dai et al., 2014a; L. Li et al., 2015). While these studies have contributed valuable insights, they have largely neglected the examination of this relationship among established firms, which are often recognized for their strategic prowess rather than their entrepreneurial orientation. The necessity of broadening the scope of investigation to include established companies has been highlighted in extant literature (Dess, 2003; Dimitratos & Jones, 2005; McDougall & Oviatt, 2000b). Moreover, apart from the empirical study by (Bell et al., 2001; Ripollés-Meliá et al., 2007a), a multidimensional perspective of established firms' internationalization speed in relation to entrepreneurial orientation remains relatively underexplored. While this research reveals a positive correlation between the development of entrepreneurial orientation and the extent and scope of internationalization within established companies, the cross-sectional nature of this study limits the ability to control the influence of certain factors associated with the broader environment, calling for subsequent more longitudinal studies to evaluate the interplay between entrepreneurial orientation and the firm's international commitment (Ripollés-Meliá et al., 2007a). This corroborates with the call by Felzensztein et al. (2015) and Hsieh et al. (2019) for investigating the post-entry dynamics of internationalization speed through a longitudinal research design to allow for the documentation of significant events that indicate changes in speed, as well as capturing the highest or lowest points of internationalization speed at specific time intervals. Therefore, there is a pressing need for longitudinal research to determine the causality and temporal dynamics of this relationship in the context of established firms. To achieve this goal, we will use a sample of Fortune 500 US firms. Based on that, we propose the first research question as below:

Research question 1: How does entrepreneurial orientation impact the speed of post-entry internationalization in established firms?

Extant research related to international business has mainly employed the Uppsala ‘stages’ model (Johanson & Vahlne, 1977) which emphasizes that the knowledge required for progressive new market entries can be provided by a firm’s experience with foreign operations and thus internationalisation is an incremental process of experiential knowledge accumulation. However, the Uppsala ‘stages’ model has been severely challenged in today’s information-based competitive environment since the extensive use and dispersion of ICT has accelerated information flowing throughout international markets (Skudiene et al., 2015). As a result, enterprises are required to establish agile, IT-based business systems, such as business intelligence or big data analytics, to effectively support their international business operations in real-time. Big Data Analytics Capability (BDAC) refer to the company’s abilities to leverage on technology and talent to exploit big data towards the generation of the insights that are necessary to overperform rivals (Mikalef et al., 2019). Big Data Analytics Capability is to play a leading role as it represents a powerful approach for capturing, storing, managing, and analyzing huge volumes of data that traditional approaches cannot perform (Mikalef et al., 2019). Besides, analyses of and insights into descriptive, prescriptive, and predictive forms of knowledge are expected to be more robust and convincing with such techniques to support better the management’s decisions within organizations (Wang et al., 2018). Recently, there has been an emerging body of research exploring the influence of business intelligence and big data analytics on a company's international activities (Bertello et al., 2021; Chen et al., 2012; Cheng et al., 2020; Gnizy, 2019). Further, the prevalence of Big Data Analytics has been highlighted in the NewVantage Partners annual survey of senior corporate c-executives on the topics of Big Data and Artificial Intelligence (AI) business adoption which reveals that more than 90% of Fortune 1000 companies are employing Big Data and Artificial Intelligence (Businesswire, 2019). However, it is unclear whether Big Data Analytics Capability may lead firms, especially established one, with entrepreneurial orientation to accelerate their post-entry internationalization, for example, targeting only neighboring countries or whether it supports a global internationalisation strategy. We contribute to the debate by exploring the moderating effect of Big Data Analytics Capability on the link between entrepreneurial orientation and the speed of post-entry internationalization. Thus, our second research question is proposed as follows:

Research question 2: How does big data analytics capability moderate the relationship between entrepreneurial orientation and the speed of post-entry internationalization in established firms?

Within the realm of international business, there is evidence that companies are often unable to translate their entrepreneurial orientation into better performance because of a lack of strategic

resources (e.g., Hitt et al., 2001). A growing body of research indicates that a firm's external collaboration network can serve as a significant strategic resource (Lavie, 2006; Stam & Elfring, 2008). The importance of such networks becomes even more pronounced as multinational enterprises (MNEs) expand their global footprint, necessitating a comprehensive understanding of host-country attributes, new business practices, technological advancements, and market opportunities. Despite establishing operations in a foreign country, MNEs may continue to experience gaps in market knowledge stemming from their outsidership (Estrin et al., 2009; Johanson & Vahlne, 2009). While these knowledge gaps may diminish over time as MNEs integrate into local business networks, they persist to some extent due to variations in MNEs' ability to access knowledge within the network (Chi, 2000). These dynamics, in turn, can have implications for entrepreneurial firms in their pursuit of international expansion. Furthermore, the existing body of literature on strategic orientations suggests that a borderless mindset, such as entrepreneurial orientation and international networks, such as alliance capability form the foundational elements for firms to establish partnerships with foreign markets and achieve favourable international financial and market performance (Karami & Tang, 2019; Solano Acosta et al., 2018). However, previous studies focused on internationalization have often overlooked the complementary nature of these orientations. It has been recognized that adopting a complementary and multi-faceted strategic orientation approach is essential to align the environmental context and organizational characteristics, ultimately maximizing international performance (Boso et al., 2013; İpek & Bıçakcıoğlu-Peynirci, 2020). Against this backdrop, drawing from the network theory, this study aims to investigate the influence of complementarity between EO and AO on speed of post-entry internationalisation, examining the potential ways in which these orientations interact and shape firm outcomes in the international arena.

Therefore, we propose the second research question as follows:

Research question 3: How does home country alliance network position moderate the relationship between entrepreneurial orientation and the speed of post-entry internationalization in established firms?

2. Research contribution

This study makes several notable contributions to theory in the field. Firstly, it represents a pioneering effort to examine the relationship between entrepreneurial orientation and internationalization speed specifically among established firms. While prior research has extensively explored this relationship in the context of SMEs and international new ventures, there has been a relative neglect of studying this dynamic in established firms. By focusing on established

firms, this study sheds light on the unique characteristics and strategic behaviors that influence the speed at which these firms internationalize.

Secondly, this study explores the moderating role of big data analytics capability in the relationship between entrepreneurial orientation and internationalization speed. Previous research has highlighted the significance of big data analytics capability in driving organizational performance and competitive advantage. However, its role as a moderator in the context of entrepreneurial orientation and internationalization speed has received limited attention. This study addresses this gap by investigating how the presence of big data analytics capability within firms may enhance or constrain the impact of entrepreneurial orientation on the speed of internationalization.

Additionally, this study examines the moderating effect of home country alliance network centrality on the relationship between entrepreneurial orientation and internationalization speed. While the influence of networks on internationalization outcomes has been widely acknowledged, the specific role of home country alliance network centrality in this relationship has been less explored. This study offers valuable insights into how the degree of a firm's centrality within its home country alliance network may shape the link between entrepreneurial orientation and the speed of internationalization.

By addressing these research gaps and investigating the interplay of entrepreneurial orientation, big data analytics capability, and home country alliance network centrality, this study contributes to advancing theoretical understanding of the factors and mechanisms that drive the speed of internationalization among established firms.

3. Hypotheses development

3.1. The impact of entrepreneurial orientation on post-entry internationalization speed

Entrepreneurial orientation reflects a strong disposition to aggressively pursue untapped opportunity (Baker & Sinkula, 2009). It manifests itself in proactive, innovative, and risk-taking behaviours in pursuit of such opportunity (Covin & Slevin, 1991). *Proactiveness* refers to addressing opportunity ahead of competitors, even in the face of significant uncertainty; *innovativeness* refers to addressing opportunity through the configuration or reconfiguration of resources and capabilities to enable innovations in processes, products, and practices; *risk-taking* refers to the willingness to address opportunity in bold ways with the potential of high returns, but also the possibility of failure. Entrepreneurial firms are willing to act as first movers to address opportunity and to commit resources and capabilities to situations whose outcomes are unknown.

Expansion into each foreign market can be considered an entrepreneurial act involving risk-taking, innovation and proactive behaviour (Ellis, 2011). With that in mind, we now examine how post-entry internationalization speed reflects the degree to which a firm develops an entrepreneurial

orientation in its international activities. **First**, a high tolerance for risk-taking can foster rapid international expansion (Pérez-Luño et al., 2011). A high level of internationalization speed can help a firm obtain sustained competitive advantages from the decline of production costs due to economies of scale, yet considerable operational risks and uncertainties are inevitable (Chetty et al., 2014). For example, differences in the endowment of resources, in governance quality requirements and in institutional diversity can leave exporters with high operational costs and other barriers to entering foreign markets (Deng et al., 2018). However, a firm with a risk-taking orientation tends to be optimistic and may perceive opportunities as more imperative than threats (Dai et al., 2014; Donbesuur et al., 2020). Consequently, risk-taking firms tend to expend their resources to exploit opportunities in a wide range of foreign markets at a rapid speed (Lumpkin & Dess, 1996). In comparison to their risk-averse counterparts, such firms are more likely to adjust their routines to address different barriers and seek market opportunities both globally and rapidly (Sapienza et al., 2005).

Second, the demand patterns of overseas customers often differ from those in the domestic market, requiring firms to produce innovative products (Zhang et al., 2012). Hence, innovativeness constitutes a key competence internationalisation (Genc et al., 2019). Cassiman and Golovko (2011) outline some innovative approaches taken by exporting firms: producing tailored products and services, improving segmentation of potential clients and introducing innovative adaptations to marketing techniques and promotions to appeal to heterogeneous overseas demand patterns (Hughes et al., 2019). As a result, innovative firms are better equipped to reach a wider range of foreign markets within a relatively short time (Hsieh et al., 2019). Furthermore, the innovativeness required to meet different demands overseas implies many upfront costs, which can be amortized faster by pursuing export opportunities rapidly in a more diverse range of markets (Zahra & Garvis, 2000). Thereby, firms' innovative orientation fosters post-entry internationalisation speed.

Third, the proactiveness dimension of entrepreneurial orientation is related to a firm's intrinsically aggressive nature—pursuing opportunities well ahead of its competitors despite resource limitations (Zahra & Dess, 2001). Proactive firms are sensitive to foreign market needs and identify opportunities faster than their competitors (Zahra & Covin, 1995); they constantly initiate opportunity-seeking and forward-seeking moves to gain a competitive advantage, regardless of the resources they currently control (Ripollés-Meliá et al., 2007). Research shows that firms characterized by a high degree of proactiveness will start internationalization quickly and undertake rapid expansion (Rasmussen et al., 2009). In contrast, firms with low proactiveness are more likely to focus on servicing their existing key customers. They are more reluctant to adopt a proactive stance to develop new opportunities (Rosenbusch et al., 2011). Overall, we argue that firms with a

higher level of entrepreneurial orientation will be able to identify new international business opportunities more quickly and exploit those identified opportunities faster (Ripollés-Meliá et al., 2007). Thus, we propose the following hypothesis:

H1: Entrepreneurial orientation has a positive impact on post-entry internationalization speed

3.2. The moderating role of big data analytics implementation

A strong motivation to investigate the role of this entrepreneurial orientation in data-driven contexts is that entrepreneurial decision-making is characterized by its inherent complexity, which can be effectively managed through appropriate decision-support logics and capabilities (e.g., BDAC), thereby enhancing the firm's inclination to pursue disruptive and risky actions (Ciampi et al., 2021; Pappas & Brown, 2021). Big data (BD) refers to digital data characterized by its "volume, velocity, and variety" (3V), representing the diverse formats, sources, and high volumes of data. While some scholars include additional attributes like veracity and value, the 3V concept is commonly used to define BD. In the literature, BD is recognized as advanced technology encompassing hardware, software/applications, and IT infrastructure, as well as a set of skills and knowledge. Importantly, it is regarded as a business strategy and process that empowers organizations to analyze data and leverage insights to inform their choices and actions (Chen et al., 2012).

Several classifications of big data analytics (BDA) have been suggested in existing research. Rooted in the resource-based view, Gupta & George (2016) and Mikalef et al. (2018) emphasize three categories of BDA resources necessary for achieving BDA success: tangible resources (such as data, technology, investments, and time), human resources (including technical and managerial skills), and intangible resources (i.e., data-driven culture and organizational learning intensity). Building on the big data literature, Akter et al. (2016) and Wamba et al. (2018) identify three groups of BDA capabilities that organizations should develop to generate value from their BDA investments: BDA management capability (covering planning, investment, coordination, and control of BDA), BDA technology capability (encompassing connectivity, compatibility, and modularity of BDA technologies), and BDA talent capability (involving the management of BDA technology and possessing technical, business, and relational knowledge). Although the terminology varies across the literature, these classifications share similar taxonomy schemes as they collectively address BDA technology, human skills, and management-related aspects.

There are a few prior studies regarding data-related capabilities and their effects on international activities (Bertello et al., 2021; Chen et al., 2012; Cheng et al., 2020; Gnizy, 2019). In these studies, several key activities, including data collection, data analysis, and information sharing and dissemination, have been highlighted. Building on this perspective, we propose a conceptualization of BDA capability that asserts the ability of BDA resources, represented by its components of data

aggregation, data analysis, and data interpretation, to generate BDA-specific capabilities. Data aggregation involves the collection and consolidation of observable data from various sources to generate descriptive information, providing insights into the "who, what, when, and how much" aspects of the unified data's impact (Ferraris et al., 2019). Analytical capability, on the other hand, is closely linked to the firm's decision-making process and facilitates the transformation of valuable information into explicit knowledge through employee engagement, thereby enhancing decision-making effectiveness (Chen et al., 2012; Dubey et al., 2020). Data interpretation aims to present reports or summaries in the form of interactive dashboards and charts, empowering managers to make informed decisions and take appropriate actions (Wang et al., 2018).

We presume that data aggregation, analytical capability, and data interpretation represent crucial attributes of BDA that enable firms to gather business data, assimilate valuable information, and generate new knowledge during the internationalization process. Specifically, complementarity between entrepreneurial orientation and knowledge acquisition and insights generation through BDAC affects the post-entry speed of internationalization for the following reasons.

Firstly, the data integration of BDA provides comprehensive information for firms to speed up their internationalization. In the firm's internationalization process, data integration involves filtering, summarizing, and sorting data from various sources, such as host markets, competitors, and local governments, then systematizes a unified information from the gathered data (Popovic et al., 2012). When combined with entrepreneurial orientation, which emphasizes innovation and proactiveness, firms can leverage this information to make more informed and data-driven decisions regarding their internationalization efforts. By leveraging this capability, firms can identify the most promising international markets and allocate their resources strategically, focusing on areas that offer higher growth potential. The systematic information contributes to firms' deep understanding of the turbulent environment and can inform the most appropriate strategy for the firm's international learning and committing activities, which are the two core elements of internationalization speed (Casillas & Acedo, 2013; Chetty et al., 2014).

Secondly, the analytical capability of BDA is likely to assist in optimizing decision-making knowledge on the firm's internationalization speed. Entrepreneurial orientation often involves taking calculated risks and pursuing aggressive growth strategies. Big data analytics capability assists firms in optimizing resource allocation by analyzing data on market potential, customer preferences, and competitive landscapes. The involvement of the analytical capability enables these firms to transform descriptive information into instructive knowledge comprehensively and provides them feasible options for decision-making (Gudfinnsson et al., 2015). Hence, BDA-based analytical capability can build trustful and instant communication to improve decision-making

efficiency via sharing explicit knowledge, promoting the firm's internationalization. In this sense, the utilization of the right BDA tools is expected to reduce incorrect analysis of business opportunities (White, 2012) and to provide a competitive edge in the face of environmental uncertainty from foreign markets by means of real-time, detailed, and multi-source information. By leveraging big data analytics, firms can make more accurate risk assessments, develop risk mitigation strategies, and navigate the internationalization process more efficiently, ultimately leading to a faster speed of internationalization. This alignment of entrepreneurial orientation with data-driven resource optimization enables firms to accelerate the speed of their internationalization efforts.

Thirdly, the BDA-based interpretation capability can aid in representing key information and knowledge effectively by using various visual formats such as a pictorial or graphical layout to deliver meaningful information to parties involved, allowing them to discover business values and insights in a timely fashion. For example, eBay is using "Tableau" - a Big Data visualization tool - for transforming large and complex datasets into clear depictions, facilitating thus the employees and decision makers to grasp complex information and come to fast and accurate conclusions in their international activities (Sivarajah et al., 2017). It can be therefore seen that the implementation of BDA could lead companies to explore and scan foreign markets, assess risks resulting from foreign expansion, and reduce the complexity and uncertainty of the environmental and strategic contexts (Gnizy, 2019; Westhead et al., 2004), thus enhancing the firm's internationalization speed. Accordingly, we propose that:

H2: *Big data analytics capability strengthens the positive relationship between entrepreneurial orientation and post-entry internationalization speed.*

3.3. The moderating role of alliance network position

We focus our attention on centrality – the network position that is core to network theory. Network centrality refers to how well connected an actor is to the parts of the network with the highest connectivity (Bonacich, 1987). Previous research suggests that firms with central network positions enjoy several advantages that contribute to higher performance (Brass et al., 2004), and we argue that network centrality positively moderates the relationship between entrepreneurial orientation and post-entry internationalization speed for three reasons.

Firstly, being positioned at the confluence of information and resource flows, a central firm will be the first to learn about new market conditions, strategies of competitors, and partnership opportunities through distant search via their direct and indirect local network connections (Koka & Prescott, 2008) (Koka & Prescott, 2008; Powell et al., 1996). A centrality position represents a high volume and speed of resource flows as well as network influence as each network tie act as a

channel for assets and information (Yang et al., 2011). Therefore, it can be argued that MNEs that are well connected via alliances can better tap into the resources in the network and stay better informed than peripheral members (Kim & Kim, 2018). High network centrality, then, facilitates an entrepreneurial orientation by increasing an MNE's capacity to quickly identify, access, and mobilize external resource in foreign markets, thereby promoting proactiveness and enabling faster international expansion.

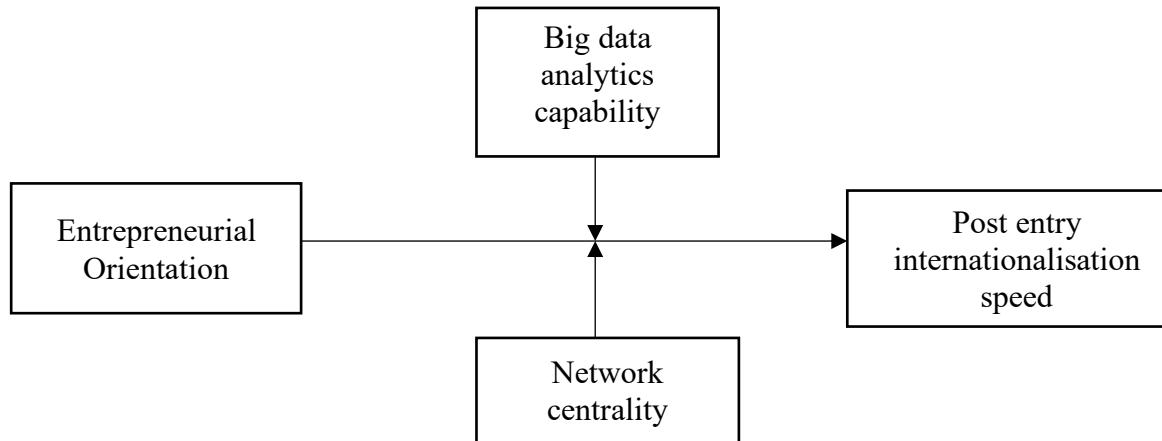
Secondly, high network centrality indicates that entrepreneurs have access to many alternative providers of valuable resources (Tsai, 2001) since being able to access indirect partners via prominent direct partners not only broadens the MNE's knowledge search (Shi et al., 2014; Sorenson & Stuart, 2008) but also accelerates the assimilation of information from the local network (Gilsing et al., 2008). The market knowledge gaps associated with outsidership may persist even after the MNE sets up operations in the host country (Estrin et al., 2009). Although such gaps may diminish over time as MNEs embed themselves in local business networks, they are not fully eliminated due to MNEs' differential ability to source knowledge in a network (Chi, 2000). Such privileged access due to network centrality is particularly beneficial to highly entrepreneurial firms since entrepreneurial orientation constitutes a resource-intensive strategic posture that involves much uncertainty (Wiklund & Shepherd, 2005). Indeed, extant research in new ventures supports this view and shows that ventures with high centrality pursue more innovative strategies and have better odds of acquiring venture capital (Burton et al., 2002). Furthermore, compared to peripheral firms, central firms are in an advantageous position to garner useful information in order to reduce the variability of potential risks, thus lowering the perception of risk in potential entrepreneurial ventures as well as increasing the likelihood that the firm will undertake the risky venture (Yang & Dess, 2007). In this sense, centrality facilitates the risk-taking dimension of entrepreneurial behaviour in driving the speed of internationalisation.

Thirdly, firms that sustain a central network position enjoy higher social status (Podolny, 1993) and are perceived as industry leaders, which makes them more visible and trustworthy to potential resource providers from outside their industry, such as suppliers, customers, and venture capitalists interested in the entrepreneurial activities introduced by the firms. Likewise, a company that is embedded in a region of the network with powerful and prominent international partners is also acknowledged as a reputable firm, which facilitates the willingness of partners to trust, share information, exchange resources, and allocate relational assets all of which facilitate decision-making for further engagement in foreign markets (Johanson, 2003). A central MNE is thus more likely to be granted access to their resources because they perceive it as more trustworthy and of better quality than more peripheral firms. MNEs with strong entrepreneurial orientations benefit

from the industry leadership status associated with high centrality in terms of facilitating internationalisation speed, because penetration into many foreign markets require the acquisition of resources and mobilization of institutional support from a variety of domains to successfully commercialize their innovations. Accordingly, we propose that:

H3: *A centrality position in the host-country alliance network strengthens the positive relationship between entrepreneurial orientation and post-entry internationalization speed.*

Conceptual framework:



4. Data and methods

4.1. Data collection

The data used in this study was obtained from two main sources. Firstly, firm-level announcements regarding the big data analytics capability were collected from various prominent U.S. news outlets, including wire news agencies (Business Wire, PR Newswire, ENP Newswire, GlobeNewswire, and USA Today), leading newspapers (The New York Times and Wall Street Journal), and renowned computer journals (Computerworld, eWeek, Computer Weekly, InformationWeek, Network World, and Infoworld). Secondly, data related to industry characteristics and firm performance was obtained from the COMPUSTAT database and 10K filing. The sample consisted of Fortune 500 firms in 2022, as these firms receive extensive media coverage. The data collection period spanned from 2010 to 31st December 2022. The year 2010 was chosen as the starting point due to the increased media interest in big data during that time. IT firms were excluded from the sample as they heavily rely on IT, which could obscure the influence of BDAC. Additionally, private firms were excluded due to the unavailability of their financial data.

To identify relevant news articles, a search was conducted using the company names within 25 words of a list of auxiliary verbs and within 50 words of BDA-related keywords. The list of BDA-related keywords was derived from previous studies and included an additional keyword, "artificial intelligence" (AI), as AI is considered an overlapping component of BDA. Each target firm's search

resulted in multiple articles related to big data. The titles and sections mentioning the search words were manually examined to identify articles specifically pertaining to the focal firm's BDA implementation, focusing on new or improved software and hardware related to big data. For each qualified news article, the starting year of the BDA implementation was recorded. In cases where the starting year was missing, additional informative keywords within the article were searched for to retrieve the starting year. Articles that could not provide the starting year were excluded from the analysis to ensure performance effects could be measured over the years. News articles discussing BDA implementation across multiple firms were counted as multiple BDA implementations, each attributed to one of the involved firms. Duplicate articles that were republished in multiple outlets were only counted once.

4.2. Measurement of variables

4.2.1. Entrepreneurial orientation

In line with previous research on entrepreneurial orientation (EO) using computer-aided text analysis (CATA) (e.g., Hunt, 2021; McKenny et al., 2018; Short et al., 2010), we employed a reflective measure of EO based on its three dimensions: Innovativeness, Proactiveness, and Risk Taking, adopting the approach used by Hunt (2021). Thus, we calculated EO as the multiplication of counts for Innovativeness, Proactiveness, and Risk Taking. To obtain the EO counts, we utilized the dictionaries from McKenny et al. (2018) while making improvements by incorporating additional terms using a Python scanner. The EO measure was then divided by the total number of words in each firm-year annual report to control for the influence of report length.

4.2.2. Big data analytics capability

We counted the cumulative number of BDA announcement in each year for each firm to measure this variable (Chi et al., 2010; Joshi et al., 2010). Organizations' adoption of technologies related to big data analytics encompasses two types of projects: (1) those that introduce new BDA-related technologies, and (2) those that apply existing BDA-related technologies in novel ways or domains (Seddon et al., 2017). BDA-related technologies can be broadly categorized into three groups: (1) fundamental database technologies that facilitate the collection, integration, processing, storage, and management of big data; (2) advanced data analytics solutions that enable the analysis of big data to derive valuable insights; and (3) tools for data visualization and interpretation (Abbasi et al., 2016; Grover et al., 2018). The first category includes technologies such as NoSQL databases, open-source frameworks like Hadoop and Spark, in-memory databases, and data lakes, which can be deployed either on-premises or in the cloud. These technologies are specifically designed to handle large volumes of structured and unstructured data from diverse sources, characterized by high

velocity and varying degrees of reliability. The second category encompasses advanced analytics applications for tasks like predictive analytics, social media analytics, and stream analytics, which can also be implemented on-premises or in the cloud. The third category involves visualization applications that allow users to perform basic analytical queries, access key performance indicators, and generate custom reports through self-service or mobile interfaces.

4.2.3. Speed of post-entry internationalisation

Internationalization speed encompasses two primary dimensions: initial entry speed and post-entry internationalization speed, each characterized by distinct aspects. Initial speed (earliness of internationalization) focuses on the time elapsed between a firm's establishment and its first international sales. It measures the speed at which a company initiates its international expansion (Kiss & Danis, 2008; Musteen et al., 2010). Post-entry internationalization speed comprises two components: international commitment speed which reflects the rate at which the percentage of foreign revenue increases over time (Kiss et al., 2013; Prashantham & Young, 2011) and international scope speed which evaluates the pace at which a company expands into foreign markets and how rapidly it enters countries that are physically distant from its home country (Kiss et al., 2013; Prashantham & Young, 2011). This study focuses on post-entry speed of internationalization; therefore, international commitment speed and international scope speed will be used to proxy speed in the context of the study. Data for these two variables are obtained from Compustat database and firms' annual reports (10-K) filed with the U.S. Securities and Exchange Commission (SEC).

(1) international commitment speed: percentage of international to total sales/ the number of years operating

(2) international scope speed: The measurement of the speed of geographic diversification involved the division of geographic diversity by time. Geographic diversity was determined by calculating the total number of geographic regions in which firms operated outside their home region. Each region was assigned a score of 1 if mentioned, and 0 if not mentioned. The regions considered included Europe, North America, South & Central America, MENA (Middle East & North Africa), Oceania, East & Southeast Asia, South Asia (India, Pakistan, Bangladesh), and Sub-Saharan Africa.

4.2.2. Network centrality

The data for alliance network centrality was obtained from SDC Platinum alliance data for alliances spanning the years 2010-2022. Consistent with previous studies (Lavie & Rosenkopf, 2006; Yang et al., 2011) we utilize a 5-year timeframe to analyze the alliance network. For each year within our dataset, we calculate a 5-year window that ended on that specific year. UCINET's eigenvector centrality measure, a widely used approach in alliance network research (Gulati, 1999) will be

employed to determine the centrality. Eigenvector centrality evaluates the influence of a node within a network, giving more weight to the overall impact of the node on the network rather than local idiosyncrasies.

4.2.2. Control variables

Financial leverage of firms is measured by calculating their liquidity ratio, which is obtained by dividing the sum of cash equivalents, marketable securities, and accounts receivables by the current liabilities of the firm. *Firm age* is determined by subtracting the year of inception from the year of observation (Chang et al., 2013). *Firm size* is assessed using the natural logarithm of total sales, consistent with previous research (Carpenter et al., 2004). *Firm international experience* is measured as the cumulative number of years the firm has operated in different foreign countries, capturing both the depth and breadth of its international experience (Casillas & Moreno-Menéndez, 2014). *Firms' intangible assets* of firms are measured by computing the ratio of intangible assets to total assets, following prior studies (Chang et al., 2013).

At the country-level, we incorporate controls for cultural distance. To calculate this variable, we utilize the formula developed by (Kogut & Singh, 1988) and cultural values reported by (Hofstede, 2001). Finally, we introduce a dummy variable to account for the impact of the post-Covid 10 pandemic, which has adversely affected global trade flows overall. This dummy variable takes a value of 1 if the respective year is after 2020 and 0 otherwise.

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