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A Literature-Derived Entrepreneurial Framework for Organizational Development towards Ambidexterity

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Affidavit

I, **DR. RER. NAT. MARC JOCHEN BREHME, M.SC.**, hereby declare

1. that I am the sole author of the present Master's Thesis, "A LITERATURE-DERIVED ENTREPRENEURIAL FRAMEWORK FOR ORGANIZATIONAL DEVELOPMENT TOWARDS AMBIDEXTERITY", 115 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 09.08.2023

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Signature

This thesis is dedicated to my wife Michaela, the love of my life.

Abstract

Entrepreneurship is a challenging undertaking where uncertainty and fast evolving dynamics are complexifying the process of taking a company from its seed stage to market entry, growth and commercialization with competitive advantage and commercial success through market leadership, sustainable performance, or exit through acquisition or initial public offering (IPO). A broad literature base addresses entrepreneurship, startup business, venture capital, including in the biotech sector. Innovative approaches to entrepreneurship are centered around a "lean startup" approach based on build-test-learn cycles via minimum viable products (MVPs). When it comes to the complexity associated with bringing a tech startup from its foundation through growth investments to market and commercialization, entrepreneurs are challenged. While success is based on the fit between organizational competencies, technology, product, and market need, environmental dynamics render competitive advantage temporary, and call for adaptive dynamic capabilities, especially regarding the competence base. Strategy is defined as "how firms create, capture and sustain economic value", for which a competence base is essential. Successful revenue generation and capture are essential for sustainable commercial success. A "tension field" exists between efficient use of existing versus establishing new competencies. Towards "ambidexterity", exploitation of existing capabilities for revenue generation must be managed in synergy with the exploration of new technology and product. The quest towards effective ambidexterity should be a core focus of entrepreneurs' managerial strategy, requiring experience, skill and capability. A critical priority for tech startup companies lies in translation of R&D into innovations through transformation of inventions into products with market value. Combining exploration with commercial capability and exploitation of know-how and product sets the basis of organizational ambidexterity. Similar approaches are driving later phases of commercialization, where ambidexterity becomes crucial during continued business in face of competition. Frequently, advisory boards, business angels and network-proximal mentors are consulted on strategic business decisions. Suitable guidelines and actionable frameworks towards achieving organizational ambidexterity, value generation, innovation, and sustainable competitive advantage, however, are scarce. This thesis presents results from a systematic and broad review of the scientific and business literature on ambidexterity, and the extraction, clustering and prioritization of core concepts and key success factors into a contextual "Entrepreneurial Framework for Organizational Development towards Ambidexterity". This framework is discussed as a supporting practical guide for entrepreneurs and managers in strategic decision-making when it comes to managing dynamic capabilities and competence development towards achieving ambidexterity and sustainable business success.

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Chapter 1: Introduction

1.1 Motivation

Generally, about nine out of ten startup companies can be expected to fail; a fraction that has been underlined for instance by Neil Patel in his 2015 blog article in Forbes (N. Patel, 2015). Importantly, this high failure rate of 90% must be approached from the angle of the characteristics of successful startup companies, of which entrepreneurial skill and a working technology and successful product with strong, pervasive market fit are a vital aspect. Here, hands-on personal experience as C-level manager in quality of Chief Technology Officer and as Co-Managing Director in a venture capital funded platform biotechnology company active in the synthetic biology market at the brink of market entry, transitioning during Series A financing stage from a strong R&D base into commercial operations, was considered in association with the need of establishing operational structures enabling commercial exploitation through introduction of product capabilities into the markets, while simultaneously continuing innovative research and tech development to advance, de-risk and mature the early platform technology and the associated products towards a "release-for-sale" (RFS) stage with suitable and powerful "target product profiles" (TPPs).

1.2 Definition of the Research Problem

A major hurdle is represented by the so-called "Valley of Death" from a company's start and seed stage investment to value generation (Ta et al., 2020, pp.1-3). Besides founder's talent, ingenuity, or even prior relevant entrepreneurial education or experience, factors such as ecosystem positioning and availability of external support through mentors, investors, business angels, board members and advisors, the relevant ingredients for entrepreneurial success in driving their ventures towards commercial success are overall still ill-defined and ultimately frequently remain attributed to the business idea and product - market fit.

In many cases, especially in the (bio)tech sector, Research and Development (R&D), technology, and innovation through patenting and early development to proof of principle and proof of concept prototype stages are the founders' real strength, as innovation in the tech sectors often stems from ideas developed out of academic research projects. A challenging path towards further development of proof of principle or proof of concept developments towards translation to the market is the foundation of a start-up business. Here, employees either stem from the proximal network of the founders and new affordable expertise that can be recruited at the young companies' stage frequently transitions from academia. The consequence being

that an imbalance exists, where strong scientific and technological expertise with a high potential and drive for exploration contrasts with the lack of expertise in management and finance as well the ability and skill of successfully translating innovative technology and product offering to the market for successful and sustainable commercial success.

Repeatedly, the startup venture process is an adventure subject to failure or success depending on the strength of the invention, timing, entrepreneurial skill, an ecosystem, and network of support. Proven frameworks of success in the decisive stages of startups however are lacking. Recently, a set of ten simple rules has been proposed to guide successful establishment of science start-ups, with a focus on the founding stage and process, mainly aimed at early academic entrepreneurs (Reichmuth & Ewald, 2022). The valuation of seed- or early-stage ventures furthermore is frequently determined largely by factors such as the appeal of the industry, the founder's or founders' profile(s), as well as the quality and qualifications of the top management team (TMT) (Miloud et al., 2012, pp. 155–157). However, the later phases following the first years of the startup, where success is about the transition of the startup from initial explorative startup activities through commercialization all the way to market stage, revenue generation and subsequent commercial scaling is a crucial phase determining long-term success of the venture. Especially the case for venture capital (VC) backed tech startup companies, early market traction and early product validation in a market relevant setting, frequently referred to as "Minimum Viable Products" (MVPs) (Ries, 2011, pp. 76–78) and their iterative improvement and perfection are important to validate and increase the valuation of the company in preparation of further VC financing rounds towards a desirable exit scenario (Montanaro et al., 2021). Here, simple rules do not exist, and business frameworks are as diverse as complex. While Sull and Stanford studied simple rules in a complex environment and their relevance and applicability for tech companies as opposed to complex frameworks (Sull & Eisenhardt, 2012, p. 3), to the knowledge of the author no set of simple rules exists nor has been shown to guarantee successful introduction of ambidexterity. Regardless, considering the state of the art, the topic is still rooted largely in academic theory and practitioners' observations and of an extent of complexity that simply rules are on the one hand elusive, while on the other hand of attractive appeal.

Meanwhile, this thesis is focused on the elucidation and characterization of a compendium of relevant core concepts and key success factors that can be used by managers and entrepreneurs during the pursuit of achieving ambidexterity in support of commercial performance.

1.3 Achieving Organizational Ambidexterity – A Proposed Solution Focus for Start-up Entrepreneurs

Therefore, industry know-how and commercial expertise are frequently critically missing or scarce, especially in biotech, biopharmaceutical, and deep-tech startup companies' leadership and teams. These shortcomings jeopardize the crucial generation of MVPs or service offering and their continuous refinement according to technical requirements and market user's feedback according to the "lean startup principle" (Ries, 2011, pp. 8–9). The need to aim for exploitation, which stems from the need for a validation of company valuation and early market access with viable products to ensure market success ahead of potential competitors' entry, spurs the need to set the organizational competencies towards ambidexterity (W. Güttel, 2019, pp. 242–268). To reduce the risk of failure as well as to effectively guide successful strategy through concepts and insights gained previously by other businesses and the scientific community, this thesis seeks to derive an entrepreneurs' guiding support framework for the development of ambidexterity as a driving force of commercial success and profitability.

1.4 Outline of the Main Research Question

This thesis addresses the question whether existing literature concepts and research insights on organizational ambidexterity can be transformed into a generic business guiding "*framework for organizational development towards ambidexterity"* that is suitable to serve as a guiding reference for entrepreneurs' strategic activities towards steering their startup businesses to sustainable profitability, competitiveness, and commercial success.

1.5 Hypothesis

The author hypothesizes that a systematic literature review, combining manual review and extraction with machine-learning-supported topic modeling on a comprehensive body of highly cited literature covering a vast and representative time-span of 50 years can derive an extracted set of core concepts that lend themselves for integration into a "business framework for organizational development towards ambidexterity", which can be applied as strategy-guiding management tool in tackling the complexity of translating early exploration and business strategy into the establishment of organizational ambidexterity, such as in the case of platform biotech companies during early commercialization, and scaling.

1.6 Aims and Structure of the Thesis

Here, a broad and systematically tackled literature analysis, combining manual literature review analysis with LDA machine-learning topic modelling technology and contextual clustering is used to derive an integrated guiding framework of mutually supportive determinants and key success factors (KSFs) that hold scholarly literature and leading management journal - backed insight to support and guide start-up and small and medium enterprise (SME) entrepreneurs in their business strategy and managerial heuristics towards establishing a competent and successful ambidextrous organization towards sustainable profitability, competitiveness and commercial success.

Chapter 2: State of the Art

Early in the 20th century, economists have described and studied organizational structures and strategies and their influence on innovation as well as their interplay and co-existence with value-generating activities through exploiting innovative offerings on the global markets. Around the middle of the 20th century, the term "ambidexterity" arose to describe the co-existence and simultaneous management of explorative with exploiting business activities. The following sections will provide an overview on the state of the art of the research and associated main concepts of organizational ambidexterity with association to the ensuing systematic literature extraction of core concepts and key success factors of ambidexterity as a founding rationale of an entrepreneurs' and managers' guiding framework for the implementation of successful ambidexterity in start-up companies.

2.1 Exploration

Research and innovation stand at the start of the entrepreneurial process within start-up companies where ideas, research concepts or early prototypes are taken to proof-of-concept, which in turn frequently drive the acquisition of third-party funding or seed-investment from VC funds. Especially in technology-based, innovation-driven start-up companies, the challenge lies in the innovation process, which is about advancing an invention from the idea through the R&D laboratories or development platforms on to the market. Continuous Innovation is fundamental and vital to startup success, by bringing a prototype to market stage and in order to staying ahead of potential competitors' or imitators' activities to ensure sustained success of the business (Ries, 2011, pp. 110–112). In interplay with continuous, or incremental innovation, disruptive innovation is essential to trigger shifts and pivots into new directions, to fuel significant technological advance and overcoming of important barriers and hurdles, as well as to allow diversification. Starting off any of the avenues entered through disruptive innovation, incremental innovation is adding in a complementary manner to further advance associated early prototypes or stages to maturity and robustness. A detailed overview and analysis of the theories and practical implications of exploration, however, is beyond the scope of this thesis. Here, exploration as a term is mentioned in order to set the stage for the explanation, definition, and subsequent detailed literature-based analysis of the term and literature concepts on "ambidexterity". Therein, important research started around the late 1970s and early 1980s, contextualizing exploration with organizational structures and resources towards firm performance. Early and seminal work on exploration and organizational adaptive search for new technologies in relation to behavioral models, competencies, and organizational learning can

be found in the early works of James G. March (Levinthal & March, 1981). In his seminal work published in 1991, March elaborates on the relation between relation of exploration of novelties and the exploitation of existing certainties, as will be further discussed below (March, 1991, p. 71).

2.2 Exploitation

Exploitation describes the process of generating and capturing value from existing know-how, services, and product and per this definition is the essence of commercial business success of each firm. This art, by definition, is at the center of attention of the wider literature on business economics. It is, however, just as the focus mention on exploration above, of particular importance and relevance not only to the "ambidexterity" term and associated theories mentioned below, but also of fundamental essentiality to entrepreneurs. Part of the reason for the majority fraction of startups to fail lies in the failure in translation inventions and innovations to market, customers and patients before company funding drains, before existing investors lose interest, or until new investors can be found to further sustain the idea and vision until successful commercial readiness is established. Developed, defined, and protected as a company's intellectual property and assets they critically contribute to the company unique selling proposition (USP) and commercialization strategy in execution of the business plan. As stated above, it is not within the scope of this thesis to provide a comprehensive overview on theories and mechanisms of exploitation. Rather, the term is being introduced in the context of the term "ambidexterity", which describes the action of exploitation in ambidextrous balance with exploration activities during. This is crucial, as both activities, exploration and exploitation, are frequently and historically considered and seen as contradictory activities, fighting for competing talent and resources. Here, the theories and concepts of ambidexterity start, presenting concepts and strategies for the balancing and resolution of conflicts and tensions between the two fields (March, 1991, p. 72).

2.3 Ambidexterity

During the early developmental stages of a startup, such as during the seed stage years upon founding, usually activities and expertise are strongly driven and determined by the founders' and the founding team's expertise, primarily as regards a particular technology or scientific subject matter. At this point, specialization is usually low and interdisciplinary activities converge to applying early prototypic technology or a minimum viable product (MVP) to test client use cases. Ideally, such "lean startup" modalities, referred to as such as they start early, with little resources, in a lean manner, with the tangible testing in customer's hands and

on the market, of early iterations of the company's product towards substantiating its unique selling proposition (USP) and market strategy, include "build-test-learn" cycles of tech development in combination with customer and market validation with translation of the learnings back into the tech development and innovation cycle (Ries, 2011, pp. 75–78).

Here, we encounter "ambidexterity". First introduced as a term by Duncan in 1976 (Duncan, 1976), and followed by March's work involving ambidexterity in organizational learning (March, 1991), organizational ambidexterity describes the existence of dual structures in support of both exploratory and exploitative activities in driving innovation and commercial success in a sustainable manner in support of firm survival. It is within the above-mentioned "lean concept" put forward by Eric Ries that ambidexterity has relevance to young, starting companies and novel innovation ventures and ultimately bears fruits. Exactly as a startup following a lean concept takes an early start towards exploitation of existing know-how, product or technology offering with customers and on the market, while exploration or incremental innovation and improvements of said product and technology offering are still progressing and under way. As regards this "ambidexterity", importantly, O'Reilly and Tushman found that ambidextrous organizations, organizations that manage to simultaneously pursue exploration and exploitation, were significantly more successful when it came to product or service innovations than organizations with other structures, such as unsupported teams, functional, or even cross-functional teams, with over 90% of ambidextrous organizations achieving their goals, compared to a second best of only 25% of functional designs producing real innovations (O'Reilly & Tushman, 2004, pp. 4–5). O'Reilly and Tushman even observed the superiority of ambidextrous designs in a test pool of cases that transitioned from functional designs, cross-functional teams, or unsupported teams and which consequently switched to ambidextrous design, with about 87,5% (seven out of eight) achieving performance increases (O'Reilly & Tushman, 2004, p. 4). This research serves as evidence that the introduction of ambidexterity into the organizational design can serve as and should help reaching and surpassing the "tipping point" towards successful organizational performance towards goals in exploitation and innovation. Especially as regards the case of biotech startup companies, particularly those employing platform technology approaches, R&D usually happens and exists first, followed by proof-of-principle stages and translation into prototypic implementations of the platform technology. Since R&D alone, however, cannot be infinitely or sustainably sustained without value generation and value capture, ambidexterity can help to wards implementation of value capture throughout exploitative activities with competitive performance.

2.4 Organizational Vacillation Theory versus Ambidexterity

The systematic literature analysis also unveiled the juxtaposition of the theories of Organizational Vacillation versus Organizational Ambidexterity, as alternative ways towards reaching sustainable high performance through simultaneously high levels of exploration and exploitation. Nickerson and Zenger originally proposed and modeled in their "Dynamic Theory of Organizational Choice", how vacillation, a dynamic switch between organizational modes, may lead to organizational ambidexterity (Nickerson & Zenger, 2002). Establishing a position that is opposed to the "central proposition of organization theory that discrete organizational forms are matched to environmental conditions, market strategies, or exchange conditions" (Nickerson & Zenger, 2002, p. 1), Nickerson and Zenger argue that optimal efficiency may require and impose a flexible change between discrete governance modes through structural modulation (Nickerson & Zenger, 2002, pp. 547–548). Boumgarden et al compared both approaches by mapping them onto a common performance landscape. They conclude their literature-based case analysis with the finding that vacillation may lead to higher long-term performance as compared to ambidexterity (Boumgarden et al., 2012, pp. 591–592), while ambidexterity in turn can enhance performance on the margin when utilized within larger vacillation epochs (Boumgarden et al., 2012, p. 605). Notably, the study concludes that ambidexterity and vacillation are complementary with respect to performance, each through their respective mechanism (Boumgarden et al., 2012, pp. 604–607). Kang et al added to the missing large-scale empirical study of this concept through an empirical examination of the implications of vacillation on performance. The authors hypothesize that frequency and scale of vacillation will have inverted U-shaped relationships with organizational business performance and test their hypothesis using patent-based measures of exploration and exploitation within the context of technological innovation and knowledge search. Interestingly, acknowledging that organizations frequently shift their focus between exploration and exploitation, which may even be caused merely by the change of CEO or leadership, Kang et al "find that both too infrequent or too frequent changes and a too small or too large scale of changes are not desirable" (Kang et al., 2017, p. 1356).

2.5 Organizational Ambidexterity – Synergizing Exploration with Exploitation

Organizational ambidexterity refers to the co-existence of value-focused commercial exploitation of existing know-how, services and products in relevant accessible markets, with, on the other hand, exploration of novel market trends, know-how, services and innovative

products through research and development (Birkinshaw & Gibson, 2004; March, 1991). Fundamental to each business, a working business model, product or service and a fit with corresponding markets ought to lead to value generation and in consequence, efficient value capture in order to ensure sustainable commercial success. Therefore, it is paramount for the company management to establish successful management strategy to enable said value capture and its utilization for business operations. Simultaneously, however, or in most cases even a priori, innovation is at the root of new technologies, products, or services. Research and development (R&D) activities, such as in a university setting, give rise to validated hypotheses, and when a translational path to a market application is being pursued, an innovation process kicks in. Starting with the formulation of a proof-of-principle, associated experiments and tests can lead further to a proof-of-concept stage, which frequently coincides with the foundation and incorporation of a university spin-off or startup company. Here, initial seed-funding is invested with the intent to develop the proof-of-concept further into a market-ready prototype or "minimum viable product" (MVP). Crucially, at this point, companies must devise, besides a business plan, a feasible financing strategy that will allow for a successful path forward in the market introduction of the innovation. Two fundamental alternatives exist: Firstly, initial seed funding can lead to a level of maturity and performance of a product or service, including platform technology, that key partnerships with selected customers can be developed through a prudent business development tactic to lead to a cash-cow, self-financing model, where revenues obtained with the product or platform technology service are used to cover cost and to drive further improvements and developments. Here, frequently, public grants and non-dilutive funds serve as additional catalyzers and enablers of further, incremental innovation. Continued incremental innovation, leading to further improvements and competitiveness of the technology, accompanied by required intellectual property protection activities are essential. Secondly, when the platform technology requires significant investments to advance from an MVP stage to a market-ready commercially capable state, such as in the case of deep-tech, nanotech or other resource-intense complex engineering-based innovations, venture capital (VC) investors are usually partnered to enable the further maturation and market translation of the technology and product. While both strategies aim at translating the innovation to market, two aspects remain crucial in both cases: continued explorative activities need to further improve and advance the innovation, while early exploitative activities are crucial in validating the technology and product with the clients and markets, while simultaneously raising valuation, generating traction, and initiating market entry. Upon early market entry, two different types of innovation should be given ground to co-exist; continued incremental innovation of the (platform) technology and product as the innovation is being exploited on the markets, with second

order, more disruptive innovation out of R&D activities to enable continued market leadership vis-à-vis the competition. The importance of disruptive innovation and its essential contribution to sustained commercial success of business enterprises was described early by Schumpeter (Schumpeter, 1934). As regards the product and market-related dimensions of ambidexterity, Voss & Voss developed theoretical arguments linking revenue, i.e. organizational performance, to strategic combinations of exploration and exploitation across product- and market-domains followed by a longitudinal study to test the effect on respective combinations of strategic emphasis on control variable readouts such as revenue and competition (Voss & Voss, 2013, p. 1460). The study underlines paradoxes of ambidexterity, related to tensions between required resources and capabilities for exploitation and exploration, being that established and larger firms possess the required resources, capabilities and experience necessary for successful benefit from product ambidexterity despite their lower likelihood for implementation of product ambidexterity, just like only larger forms seem to have both resources and capabilities required to harness market ambidexterity benefits, while the latter is absolutely required for driving long-term growth. These explicit tensions between the required resources and difficulties in reconciliation of exploitation and exploration strategic focus within and between product and market domains as well as the missing measurable benefit to small and medium enterprises (SMEs) further highlights the need for strategic methodology towards successful seeding of ambidexterity in startups and SMEs (**Figure 1**).

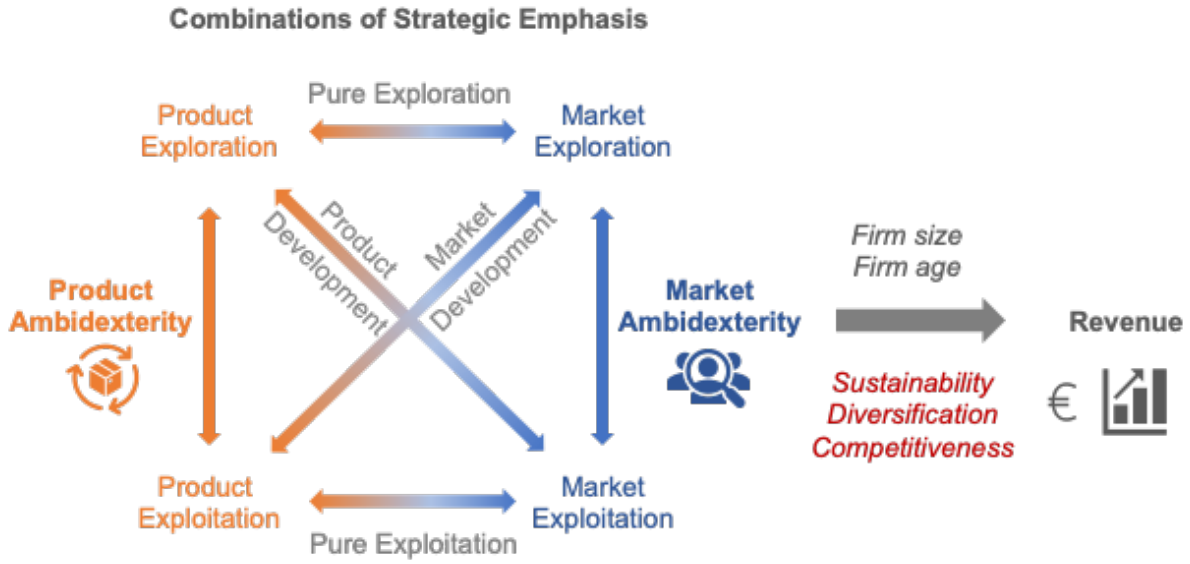

Figure 1. Impact of Product and Market Exploration and Exploitation on Revenue. Combination of Strategic Emphasis and conceptualization of their impact on revenue as economic indicator of commercial performance. Figure adapted based on Voss and Voss, Organization Science 2013 (Voss & Voss, 2013, p. 1460).

Later in the second half of the 20th century, March's work on exploration and exploitation in organizational learning provided an important theoretical basis to the research field of ambidexterity. According to March, successful implementation, the right timing, and especially the appropriate balance between exploration and exploitation are crucial in organizational learning and operation for the survival and prosperity of the organization as a system (March, 1991, p. 72). Notable March highlights that both activities are competing for scarce resources within the organization, which is particularly relevant in the context of strategic R&D spending, where exploitability is to some degree uncertain *ab initio* and only associated to a "probability distribution over returns", which depend on choices made, including choices made by others in the past. Importantly, organizational capacity and capability for either of the two streams, exploration as well as exploitation, is facilitated by and dependent on its human capital. A fundamental concept to ambidexterity upon which this thesis rationalizes its research hypothesis, methodological approach and perspective on contextual clustering of literature and research insights on ambidexterity is in the recognition of the dependency of an organization on its "performance core" when it comes to the establishment of "ambidexterity". According to work by Güttel and wo-coworkers, exploitation exploration, and their combined execution in an ambidextrous organization represent major organizational forces of development (see Güttel, 2019, Chapter 4.1). Herein, exploitation and exploration are recognized as driving forces of incremental development and radical innovation, wherein, according to work by J. G. March, organizational leadership invests valuable organizational resources into different modes of learning, namely either into exploration or into exploitation, wherein resources include besides monetary resources, especially also labor force and their association in time and space, with resulting effects of their ecological interaction (March, 1991, p. 85).

Güttel and co-workers further explain the possibilities for continuous changes driven through ambidexterity and in which types and use-cases this can be achieved (see Güttel, 2019, Chapter 4.2). In strategic development, stability, change and ambidexterity deserve particular attention (see Güttel, 2019, Chapter 4.3). For instance in digitalization businesses, as is relevant for highly digitalized deep tech ventures such as in data-driven or robotics-based biotech companies, strategies, organizational structures and leadership concepts are of importance (see Güttel, 2019, Chapter 4.4). Güttel and co-workers also elaborate on the paradox of change (see Güttel, 2019, Chapter 4.4).

2.6 Structural and Contextual Approaches to Ambidexterity

According to Birkinshaw and Gibson, two major types of ambidexterity predominate, structural ambidexterity, and contextual ambidexterity (Birkinshaw & Gibson, 2004, pp. 49–51). According to Birkinshaw and Gibson, organizations frequently struggle with the implementation of ambidexterity. They state the standard approach to be "to create structural ambidexterity, that is, to create separate structures for different types of activities" (Birkinshaw & Gibson, 2004, p. 49). Here, existing core business units for instance are charged with the creation of alignment of existing products with their markets to drive value generation and capture. On the other hand, R&D and Business Development departments are tasked with the development of new technologies, products and the exploration of novel market access opportunities and trends. The argument for the structural separation being that effective co-existence would not be possible given the fundamental difference in the activities. Obviously, this structural separation can suggest shortcomings in the communication, interaction, exchange and transfer of knowledge and know-how between new developments and core business units. Cross-functional teams, frequently used in larger matrix organizations, represent a variation on the structural ambidexterity concept, where individual employees or smaller business development teams participate to core business units for a certain amount of time in order to pursue a certain purpose. Referring to "contextual ambidexterity", Birkinshaw and Gibson describe more flexible systems structures of ambidexterity, where employees can flexibly allocate their time to either alignment-, value-generation focused or adaptation-focused activities, exploring new avenues (Birkinshaw & Gibson, 2004, p. 49). While highlighting that various, important differences exists between the two types of ambidexterity, Birkinshaw and Gibson emphasize their complementarity and that prestigious companies such as Intel or Hewlett-Packard were using them in combination. In their 2004 research paper "The Antecedents, Consequences and Mediating Role of Organizational Ambidexterity" Gibson and Birkinshaw present a conclusive set of regression analyses that correlate organizational context and ambidexterity with business performance (C. B. Gibson & Birkinshaw, 2004, p. 210). Analyzing comprehensive interview data, they find that a) ambidexterity is correlated with performance, b) organizational context, comprising performance management and social support, to be correlated with ambidexterity, and c) organizational context was correlated with performance. Importantly and crucially, they find and highlight, that when ambidexterity and organizational context are jointly analyzed as predictors of performance, only ambidexterity turns out with a significant influence. Gibson and Birkinshaw term this correlate as "full mediation", as the influence of organizational context on performance to only occur through the creation of ambidexterity (C. B. Gibson & Birkinshaw, 2004, p. 2019). Here, importantly, ambidextrous employees are being recognized as more

proactive, cooperative networkers, and opportunity-seeking multitaskers. Uniting these attributes, ambidextrous employees, being more motivated, represent assets for success, within the facilitating or restricting boundaries of the organizational context and structure (**Figure 2**).

In the implementation of organizational ambidexterity, two mutually supportive strategic actions are highlighted: performance management, as stimulator towards high-quality results and associated accountability for everyone's actions, and social support, providing employees with security and support, jointly creating a high-performance organizational context, as a nourishing ground of ambidexterity, bottom up, which in turn serves as a warrant and driver of performance (Birkinshaw & Gibson, 2004, p. 51).

Implementing Ambidexterity	Structural Ambidexterity	Contextual Ambidexterity
How?	Separate Units or Teams	Employee Flexibility
Who decides?	Top Management	Frontline (e.g. sales person)
Role of Top Management	Define Structure	Develop Organizational Context
Nature of roles	Defined	Flexible
Employee Skills	Specialists	Generalists

Adapted from Birkinshaw & Gibson, MIT Sloan Management Review 2004.

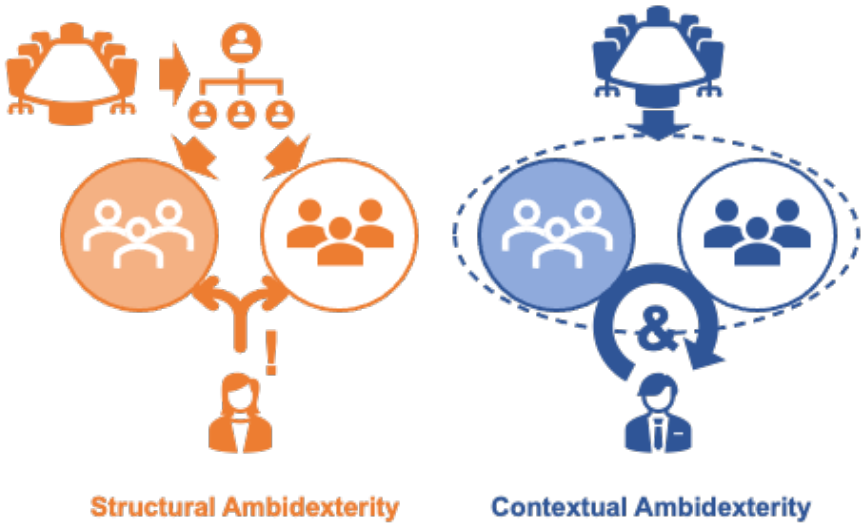

Figure 2. Types of Ambidexterity.
Two Types of Ambidexterity, Structural Ambidexterity vs. Contextual Ambidexterity and their respective key characteristics. Figure adapted based on Birkinshaw & Gibson, MIT Sloan Management Review 2004 (Birkinshaw & Gibson, 2004, p. 50).

Concerning guidelines for the path to establishing ambidexterity, Gibson and Birkinshaw outline five key concepts, 1. the diagnosis of the organizational context, by systematically assessing the degree of performance management and social support, 2. To focus on a few

levers and to consistently employ them, 3. To build an understanding for ambidexterity throughout all levels of the company, to ensure full understanding and employees buy-in to management initiatives, 4. To view contextual and structural ambidexterity as complements, and 5. To view contextual ambidexterity initiatives as "driving leadership" from ground up, not as being "leadership-driven".

2.7 Dynamic Capabilities, Organizational Learning and Modulation of the Competence Base

In the context of organizational learning, March, Levinthal, and others have previously modeled and defined the problem of balancing exploration and exploitation in the differentiation between refinement of existing technologies and invention of a new ones, where levels of intensity of focus and dedication on either draw resources from the respective other and where organizational change results from adaptive search for new technologies and competencies "under conditions of environmental instability and ambiguity" (Levinthal & March, 1981, p. 307). James March focused on the consideration of the relation between exploration and exploitation in organizational learning from a point of view of the conflict of resources that need to be allocated between the two focus areas, such as cost and benefits as well as effects of their ecological integration, wherein March models the effects of mutual learning between members of the organization as well as the relation between learning and resulting "competitive advantage in competition for primacy" (March, 1991, p. 71). According to Hannan and Freeman's theory of organizational ecology, or "The Population Ecology of Organizations" (Hannan & Freeman, 1977, p. 929), changes in the diversity of organizational forms occurring over long periods of time follow the biological concept of evolution, and therefore the principles of selection, such that evolutionary models and concepts of organizational theory emphasize the importance of the generation of new inventions, or features in dynamically changing environments, as well as the importance of their selection from a diverse pool of features and the preservation of the selected features to support survival of the organizational in the economy, in analogy to the organism in nature (Hannan & Freeman, 1977). They advocate however "the application of population ecology theories", "instead of applying biological laws to human social organization" (Hannan & Freeman, 1977, p. 962). In their work entitled "Dynamic Capabilities What are they?" Eisenhardt and Martin defined dynamic capabilities in the context of a resource-based view of the firm (RBVF) (Eisenhardt & Martin, 2000). Their key conclusions were that dynamic capabilities can be seen as „a set of specific and identifiable processes, such as product

development, strategic decision making, and alliancing ", and that they „are idiosyncratic in their details and path dependent in their emergence" (Eisenhardt & Martin, 2000, p. 1105). However, Eisenhardt and Martin underline that dynamic capabilities have „significant commonalities across firms (popularly termed „best practice") (Eisenhardt & Martin, 2000, p. 1105). The authors explain that in dynamic markets, dynamic capabilities could be compared to the "traditional conception of routines", being "detailed, analytic, stable processes with predictable outcomes", whereas on the contrasting example of "heigh-velocity markets, they are simple, highly experiential and fragile processes with unpredictable outcomes" (Eisenhardt & Martin, 2000, p. 1105). Importantly, Eisenhardt and Martin clarify that "well-known learning mechanisms guide the evolution of dynamic capabilities" (Eisenhardt & Martin, 2000, p. 1105). They conclude that in moderately and high-velocity dynamics markets, "the evolutionary emphasis is on variation" versus "selection", respectively (Eisenhardt & Martin, 2000, p. 1105).

2.8 Role of the Competence Base in Start-up Companies

Organizational performance and success build based on its core competencies. Especially in start-up companies, and therein predominantly in those that are built on technology inventions out of a research setting, the founders'' competencies are vital for the success and value of the company. This is rooted in the knowledge of the technology, the details of the innovation as well as the ability to protect and grow the intellectual property portfolio towards commercial competitiveness and success. Especially venture capital investors are aware of this value of founders' competencies and therefore attribute significant weight to the valuation during due diligence in an investment process in association with the founders' profiles. This strong value and capability dependency on the founders' competencies can frequently lead to path dependencies. Strengths, weaknesses, chances and risks are almost equally associated with the founders. When it comes to environmental dynamics analysis, a broader assessment is required. For instance, environmental dynamics include the existence or emergence of competitors in the product space and markets. Also, organizational culture is an important indicator and component of the company's competence base and capability. Jointly, the competence base results from an interplay between founders' capabilities, team members' combined capabilities and the resulting organizational culture. Referred to as "performance core", the competence base provides the basis for organizational structures and modes in both directions, exploration as well as exploitation and therefore defines the organization's potential towards a development of successful ambidexterity and successful future development.

2.9 Importance of Ambidexterity for Sustained Competitive Success

In their seminal 2004 article "The Ambidextrous Organization" O'Reilly III and Tushman presented their results on a systematic real-world assessment of companies' strategic efforts to solving the "conundrum" between exploration and exploitation (O'Reilly III & Tushman, 2004). In their analysis, they extract companies that were seemingly successful in "both exploiting the present and exploring the future" (O'Reilly & Tushman, 2004, p. 3) and expose their shared characteristics. This 2004 article by O'Reilly and Tushman therefore was not only included as a key research article in the literature body underlying this thesis' systematic literature research, but also served as input for the set of key literature core concepts that went into the literature review and extraction of core concept clusters, as described in the Methods and Results sections below.

2.10 Ambidexterity in start-ups vs. established companies

Fundamental differences exist between small startup ventures vs. established companies when organizational ambidexterity is concerned.

For instance, as mentioned above in the context of reference to the research by Voss & Voss (Voss & Voss, 2013), a key challenge for the pursuit towards ambidexterity lies in the required conflicting resources on the one hand, while in a dynamic industry setting apparently only larger companies seem to visibly profit from both product ambidexterity as well as market ambidexterity, which the authors largely attribute to the resources, capabilities, and experience required to benefit from product- and market ambidexterity. Voss & Voss concluded that SMEs, or also nascent organizations, or seed-stage companies were lacking resources, capabilities, and know-how needed in order to cope with the tensions and trade-offs found critical when exploration and exploitation come to manifest within a domain, product and/or market.

Principles of relevance to startup success can be of similar relevance to intrapreneurial activities within larger, established companies. Therefore, the organizational path to successful ambidexterity can take various differing routes especially in established companies, where ambidexterity is missing, incomplete or where it needs to be fostered in order to reactivate innovation and economic competitiveness through new products.

2.11 Derived need and justification for this Thesis

Literature and systematic, proven guidance on the establishment of ambidexterity in startups, especially in the platform technology sector as frequently encountered in the biotech industry, which is frequently characterized by tremendous capital investments on CAPEX

(capital expenditures) through venture capital investment rounds and subsequent pressure to valorize on these investments, is scarce. This scarcity, however, is in paradoxical contrast with the absolute dependency on commercialization, translation to market, value generation and value capture through exploitation of available know-how, technology and product. Hence, this thesis addresses the needed challenge to extract and condense the knowledge hidden in the past decades' scholarly and management practitioners'' literature on ambidexterity into a guiding framework of core concepts of ambidexterity for application in practice by managers and entrepreneurs during the development of their organizations towards sustainable market success.

Chapter 3: The Problem & Research Hypothesis

This thesis addresses the importance of successful organizational ambidexterity for organizational performance in the special case of innovating tech start-up companies, such as in the biotech sector, with a focused emphasis on core concepts and strategic guidelines for implementation towards ensuring commercial success from early foundational research activities through market entry and organizational growth.

3.1 Hypothesis

Herein, the hypothesizes is put forward that a systematic review of the literature on ambidexterity can derive a focused set of key topics that lend themselves for integration into a compact "strategic business framework for organizational development towards ambidexterity", which can be applied as a strategy-guiding management framework during the process of tackling the complexity of translating early and advanced explorative activity and commercial business strategy into the establishment of organizational ambidexterity, and that it finds validation by supporting effective commercial capability building and resulting positive performance impacts over time, such as in the case of platform (bio)tech start-up companies and small and medium enterprises (SMEs), and in supporting further commercial scaling and internationalization activities thereafter.

3.2 Aims and Structure of the Thesis

The hypothesis is addressed through a broad and systematic, citation-impact focused literature analysis, expert review and machine-learning supported topic modelling applying unsupervised Latent Dirichlet Association (LDA) methodology, core concept extraction and contextual clustering methodology in order to derive an integrated framework of mutually supportive core concept clusters (LCCCs) and key success factors (KSFs) that hold scholarly literature and leading management journal-backed insight to support and guide start-up and SME entrepreneurs in their business strategy and managerial heuristics towards establishing a competent and successful ambidextrous organization.

Chapter 4: The Methodical Research Approach

This thesis employs a systematic analysis of the most highly cited literature covering the past 50 years and attempts a deep and systematic extraction focus on key insights, concepts and critical success factors in organizational ambidexterity followed by their contextual clustering, association, and modelling into a generic framework of mutually supportive key success factors that support and guide entrepreneurs in their managerial strategy and heuristics towards establishing a competent and successful ambidextrous organization with sustainable.

The methodological research approach employs a systematic analysis of the research covered in the Scopus database body, and follows a two-pronged approach, initially employing on the one hand manual extraction of core concepts, their clustering into core concept clusters (LCCCs) and extraction and listing of key success factors (KSFs) from the most highly cited publications, and on the other hand subsequent unsupervised validation through a machine-learning based topic modelling approach, Latent Dirichlet Allocation (LDA). The approach comprises the following seven key steps, in summary:

This thesis takes a novel approach towards identification of key concepts of successful ambidexterity through the challenging tasks of systematic literature review across a multi-decade time period, by combining expert review of high-impact, frequently cited publications extracted from the Scopus literature database, their expansion through network similarity modelling in order to include additional relevant publications otherwise missed based on citation-centred Scopus DB extraction, as well as additional and subsequent unbiased validation through unsupervised machine-learning based topic modelling of the scientific research and management journal articles. The approach follows the following seven key steps:

Step (1) Scopus Database Literature search

Step (2) Prioritisation Ranking by Citation Count

Step (3) Similarity Network Expansion

Step (4) Literature Review & Core Concept Cluster Analysis

Step (5) Machine Learning Topic Modelling

Step (6) Convergence and Validation of Key Concepts

Step (7) Conceptual Modelling of a Framework Towards Organizational Ambidexterity

The methodological research approach is outlined in **Figure 3** and further described in the Methods Sections 4.1 to 4.4 following below.

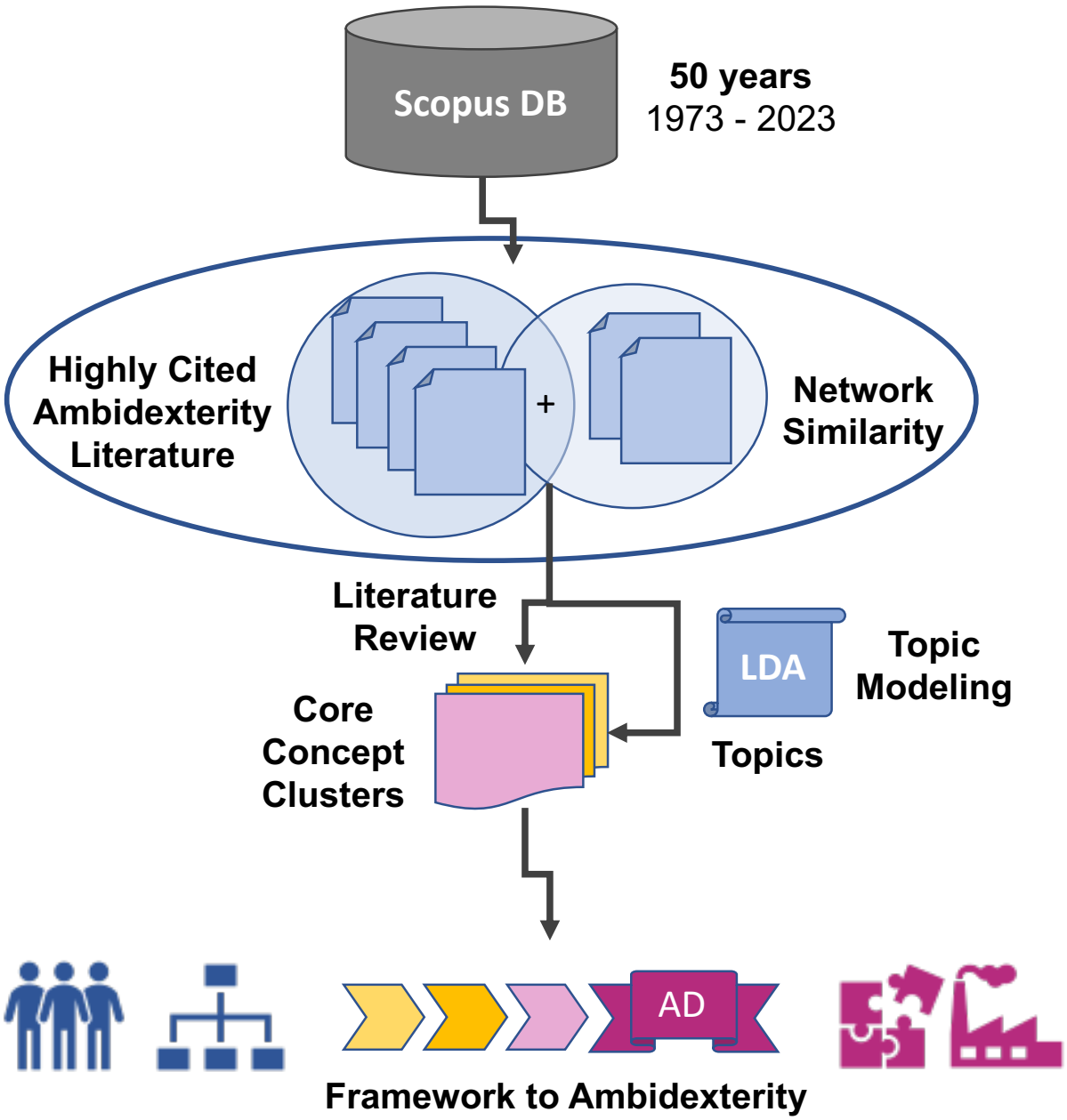

Figure 3. Conceptual outline of the Methodological Research Approach.
Querying the Scopus literature database over a 50-year period, the most highly cited research articles and reviews were rank-extracted and expanded using network similarity search. All papers were used to extract core concept clusters (LCCCs). Consequently, an unsupervised machine learning topic modeling approach was used to survey the most highly cited literature body via LDA topic modeling, obtaining a list of most relevant concepts (LDACs) serving for LCCC validation through linkage analysis, Validated LCCCs were modeled into an entrepreneurial framework for organizational development towards ambidexterity.

4.1 Systematic Literature Review and Retrieval of Core Concepts on Organizational Ambidexterity

Towards a literature-derived framework for the development of organizational ambidexterity based on literature-proven concepts, a systematic review of the scientific and managerial literature was conducted, looking to extract the key determinants and success factors of organizational ambidexterity. While the scientific literature is rich in theories and concepts, management literature provides crucial information from business use cases and managerial practice. By systematically extracting insights, concepts and key success factors from both literature sources spanning the past 50 years and focussing on the most highly cited publications to select for validated relevance, strong connections are established between business theoretical concepts and their manifestation in business cases and managerial practice. In order to allow for a systematic search and ranking by citations both research articles as well as reviews, the Scopus database was used, covering more than 82 Mio records across more than 36,000 titles from over 11,000 publishers (Elsevier, 2022).

The systematic literature review analysis aimed at retrieval of key concepts from the most impactful, highly cited research published throughout the past 50 years follows these four initial steps (see also **Figure 3**):

Step (1) Scopus Database Literature search

Step (2) Prioritisation Ranking by Citation Count

Step (3) Similarity Network Expansion

Step (4) Literature Review & Core Concept Cluster Analysis

4.2 Topic Modelling Algorithm Approach to Concept Extraction

The goal of this analysis is the discovery of key topics of relevance to organizational ambidexterity from a long-term timespan of fifty years of scientific and high-level management literature of universal applicability and relevance in driving organizational development. In order to avoid overweight of potential literature selection based on the number of citations or author-attention biases within the highly cited literature, an un-supervised machine learning approach is utilized on the vast number of research article and review PDF files in order to obtain an automated output of key topics on ambidexterity. The approach employed therefore utilizes Latent Dirichlet Allocation (LDA), as a machine learning approach to natural language

processing (NLP) using Bayesian network statistical modelling to discovery significant topics from a large number of PDFs in the extracted highly cited corpus of literature on ambidexterity. Frankly, while each document consists of numerous words, each extracted topic (on ambidexterity), will have various words attributed to it. The goal of the LDA method herein is to identify the topics each particular document belongs to, based on its constituent words. Therefore, the method provides a statistically optimized output, comprising cross-validated topics, topic-associated key words, and a tabular attribution of articles with the respective key topics.

Therefore, an important additional, unsupervised literature analysis added to the Methodological Approach is focused on:

Step (5) Machine-Learning Topic Modelling

To this end, a published framework for the application of Latent Dirichlet Association (LDA), using an implementation of the machine learning method in the statistical programming language R (Asmussen & Møller, 2019) was adopted, customized and optimized to the parameters required for this study and applied to the literature corpus of the most highly cited literature on ambidexterity published throughout the past 50 years. **Figure 4**, adapted based on a schematic presented by Buenaño-Fernández et al. outlines the process and methodology of the LDA algorithm (Buenaño-Fernández et al., 2020, p. 35322).

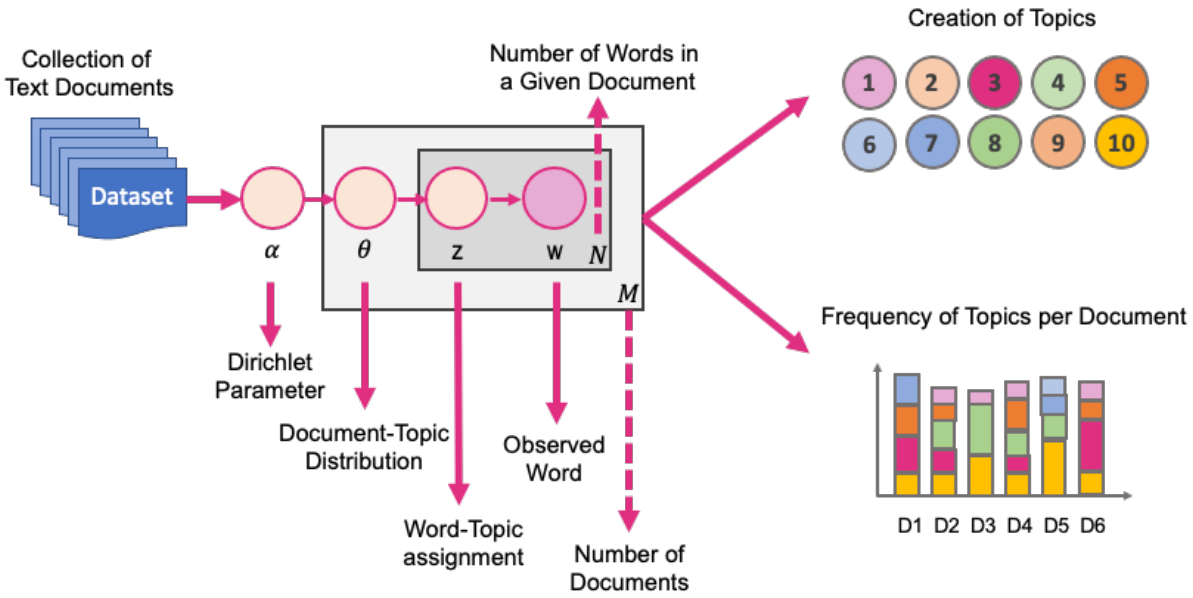

Figure 4. Outline of the LDA approach.
Outline of the LDA methodology. Figure adapted from (Buenaño-Fernández et al., 2020, p. 35322).

Relevant to the methodological application in this thesis, **Figure 5** outlines the procedure of the applied LDA machine learning topic modeling framework according to Asmussen and Møller, 2019 (Asmussen & Møller, 2019, p. 6).

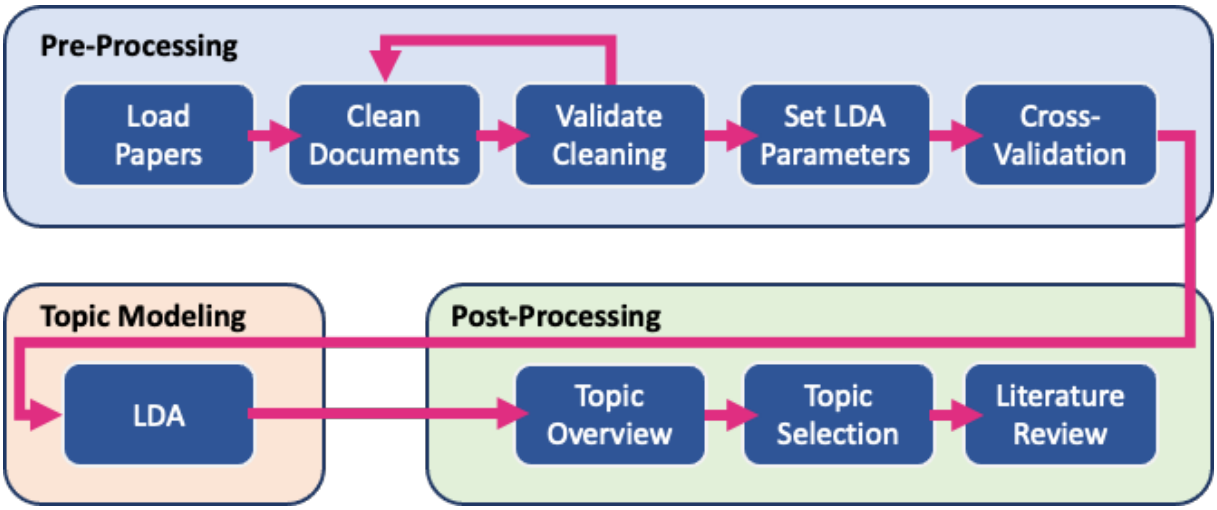

Figure 5. Outline of the LDA framework.
The LDA framework followed in this study is outlined according to Asmussen and Møller 2019. Figure adapted from Fig. 1 by Asmussen and Møller, 2019 (Asmussen & Møller, 2019, p. 6).

4.3 Convergence and Validation of Key Concepts in Ambidexterity

Next, convergence and clustering of these key topics by managerial and business strategic context serves as a reduction mechanism towards modelling the key concepts that recur most significantly in the most pervasive and highly cited academic and management literature. Thereby, we obtain the most prominent determinants and key factors of successful ambidexterity as literature-proven management theoretical concepts on the one hand, as well as, on the other hand, guideposts for decision-making and strategic agenda points towards organizational ambidexterity development during managerial practice.

Step (6) Convergence and Validation of Key Concepts

While manual literature review is tedious and subject to time-constraints with an associated limit to the number of research articles and reviews that can be assessed in sufficient quality, subject matter expertise and rationalized assessments of the research in the context of the target subject and associated prior or subsequent research works in context allow for high-confidence conclusions and sufficient relevance of the extracted information. Biases, however, may influence results, when areas of interest combined with subjective assessment filters lead

to accordingly confounded outcome or results. Therefore, this study employed a two-pronged approach, through the parallel processing of the same literature body through an unsupervised semantic evaluation at hands of the machine learning algorithm referred to as LDA. Here, text underlying the research article and review PDF files is extracted, cleaned, and cross-validated to enter LDA processing for topic modeling, as described in Section 4.2.
The resulting lists of

i) Manually derived literature concepts of ambidexterity, and
ii) LDA topic modeling – derived concepts of ambidexterity,

now serve a two-fold purpose:

1. We use a bi-partite graph to identify overlaps & similarities between each concept group
2. We use said graph for additional validation of core concepts of the derived framework.

4.4 A Systematically Derived Conceptual Model and Framework towards Organizational Ambidexterity

Based on the integrated, two-pronged approach described above, combining systematic literature review and core concept extraction from the scholarly published literature spanning the past 50 years, enriched through similarity network literature search, and alongside concept extraction through algorithmic topic modeling, the next step was to derive a generic framework, applicable to serve as strategic guide and to consult entrepreneurs and managers at young organizations, start-ups and SMEs with the organizational development towards successful ambidexterity.

Step (7) Conceptual Modelling of a Framework Towards Organizational Ambidexterity

The resulting concepts and topics were taken as input to a bipartite network model for the identification and clustering of a high-confidence core of key concepts to derive a generic, applicable guiding framework for managerial competence development towards ambidexterity in innovating startup companies, such as in the biotech sector.

Chapter 5: Results

Herein the results of a systematic review of the key concepts as determinants of success of organizational strategic actions in the implementation of ambidexterity as well as their consequences are presented.

Using Elsevier's Scopus, the largest abstract and citation database of peer-reviewed literature as a comprehensive, accessible database with functionality for export and analysis of citation-related parameters such as publication type and citation status, the database was queried for the keyword "ambidexterity" through the past 50 years between 1973 and 2023. In this analysis the focus is on the leading research published during these past 5 decades, extraction of overall statistics, as well as the focused analysis of the most highly cited scientific research articles as well as reviews on ambidexterity. The focus on the most highly cited publications enables a feasible focus on the extraction of key concepts and success factors from these highly validated publications.

5.1 Literature-derived Determinants and Key Factors of Successful Organizational Ambidexterity

We start with an extraction and systematic assessment of the scientific literature on ambidexterity, as selected by key word filtering, over a defined time window of 50 years, and by using Scopus DB citation count information for rank-filtering of the most highly cited literature.

Step (1) Scopus Database Literature search

Querying the Scopus database for the keyword "ambidexterity" yielded 2,468 publications in total, with a majority of 2,436 covered within the past 50 years between 1973 and 2023, using the Scopus search string "TITLE-ABS-KEY ("ambidexterity") AND PUBYEAR > 1972 AND PUBYEAR < 2024". The field has seen a remarkable and recognizably steep increase in publications in the past decades, with 83,0% (2,022 publications) of the publications released within the past 10 years since 2013 alone, and almost the entirety of 94% within the past 20 years, since 2003 (2,283 publications) (**Figure 6** A). Given that Scopus has seen an exponential growth of journal articles not only recently, but since 1900 through until 2020 according to a recent API-based analysis of the Scopus database (Thelwall & Sud, 2022, p. 37), this increase stands out as a significant acceleration in the publication rate on Ambidexterity. Comparing the count of publications on "Ambidexterity" with the count increase of Scopus articles on another, more general search term "Management" during the same period of 50 years

between 1973 and 2023 shows a different pattern with a more linear slope increase in publication count. Searching the Scopus database for "TITLE-ABS-KEY (management) AND PUBYEAR > 1972 AND PUBYEAR < 2024", resulted in about 5 million (4.974.944,00) publications over the past 5 decades, 77% of which during the past 20 years and almost half (49%) of which during the past 10 years, also indicating an increase in management literature in the past decades, albeit less dramatic as compared to literature on "Ambidexterity" (**Figure 6** B). Querying the Scopus database on the distribution and increase of all literature, without the constraint of a specific search term resulted in 83.309.048,00 publications between 1973 – 2023 (**Figure 6** C). Determining correlation (r values) and coefficients of determination (r^2 values) and their associated t statistics and p values in comparison, highlights the overall correlation of literature on "Management" (r^2 = 0,8789) as well as literature in general (r^2 = 0,8998) with time, while time explained only about 50% of the distribution of literature on "Ambidexterity", which increases over 50 years with a stark increase in slope from about 2007-2008 onwards (r^2 = 0,5107). Interestingly, the noticeable marked increase in publication count on "Ambidexterity" can be observed in the transition from the year 2007 to 2008, which coincides precisely with the onset and peak of the worldwide financial crisis, whereas this trend increase is not seen for management literature or literature in general during that time (**Figure 6**).

It is hypothesized that this trend might have been prompted by economic hardship or changing top management and leadership mindset in entrepreneurial and intrapreneurial practice during the financial crisis. Also likely, however, it likely was triggered in consequence of key literature, research findings and concepts published during that time, or a couple of years prior in the mid- to late-90s, which in turn might have triggered the field to gain popularity and momentum. As also highlighted by Snehvrat et al. in the context of their meta-analysis on ambidexterity in 2018 (Snehvrat et al., 2018) this observation is in line with the "three discernible phases in the growth of ambidexterity as an academic discipline" as suggested by Birkinshaw and Gupta in 2013, whereas the period between 1995 to 2005, starting with the seed and core literature included in this study (**Table 3**), set the starting stage period by providing the theoretical foundations for the field of ambidexterity, while the following years between 2005 to 2009 transitioned into a growth phase with a broad proliferation of studies on the topic, followed by further consolidation within the field between 2009 to 2013 (Birkinshaw & Gupta, 2013). Based on the results of the systematic literature extract and review presented in this thesis, it is evident that the proliferation phase lasted long beyond the year 2009 with a continued steep increase in studies on ambidexterity to the present day (**Figure 6**).

Figure 6. Ambidexterity Literature Corpus Growth over Past 50-Year Period
Publication Count Increase on **A.** „Ambidexterity" during the past 50 years as compared to **B.** literature on "Management" in general and **C.** overall database growth (source: Scopus).

As will be addressed in the following sections, key publications and review articles in the popular management literature have been published between the mid-90s and early 2000s that may be identified as responsible triggers of the management discipline of ambidexterity, the penetration of the term "ambidexterity" throughout the management literature and its steep increase in publication count. These seminal works, all included in this systematic analysis of key concepts of ambidexterity include the research article by March et al. published in Organization Science in 1991 on "Exploration and Exploitation in Organizational Learning" (March, 1991), and the Review articles published by Tushman and O'Reilly in 1996 and 1997 in the California Management Review and the Journal of Business Strategy about "The Ambidextrous Organization" (Tushman, 1997; Tushman & O'Reilly, 1996). Further key papers were included in this analysis when not ranked amongst the priority focus sets ranked by citation count, such as the systematic abstract-based text mining analysis of ambidexterity literature covering a 20-year period between 1996 – 2016 published by Snehvrat et. al in 2018 (Snehvrat et al., 2018), or the seminal review about the "Ambidextrous CEO" by Tushman, Smith and Binns, published in Harvard Business Review in 2011 (Tushman et al., 2011) (**Supplemental Table S 4**).

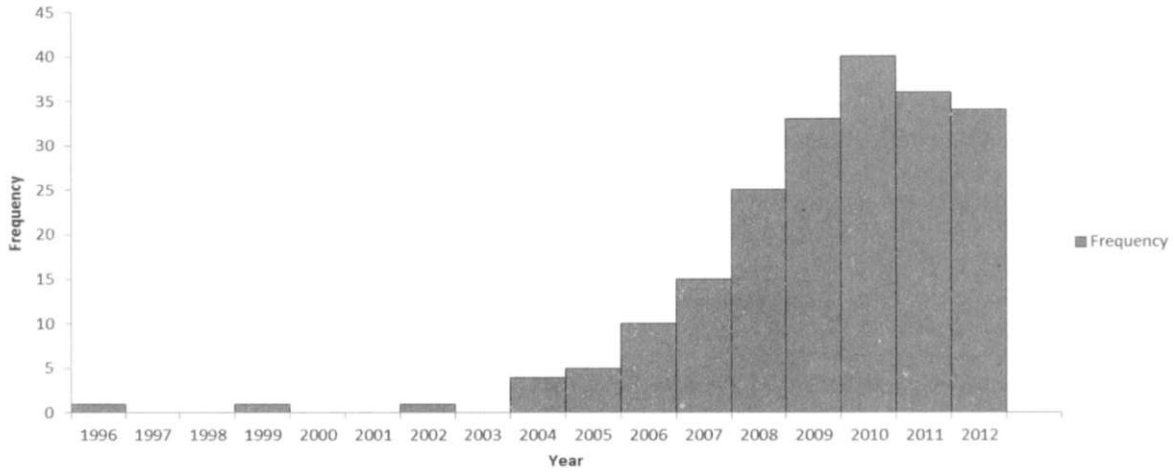

Figure 7. Histogram of Ambidexterity Papers 1996-2012 by Birkinshaw & Gupta 2013
Figure 1a from (Birkinshaw & Gupta, 2013) searching "ambidexterity" and "ambidextrous" in title or abstract from search engines EBSCOHost, JSTOR and Mendeley, captured the early rise of literature between 2004 – 2012, which was observed and monitored to continue at much steeper and continued increase up until today by this study (see for comparison slope increase in **Figure 6** A. above).

Assessing the published ambidexterity literature by subject area clearly identifies 26 subject areas covered, with a strong predominance of the subject area "Business, Management and Accounting", representing 1735 or 74% of the total literature, followed by Social Sciences,

Computer Sciences, and Decision Sciences. Of interest to this study about key concepts of ambidexterity in the biotech or tech sector at large, where exploration towards successful establishment of platform technologies is crucially involved also in their exploitation towards revenue generation and commercial profitability, two main groups of subject area are showing a paradox. On the one hand, a small fraction of 294 (12,5%) publications falls into the domain of "Engineering", suggesting that the management discipline of ambidexterity has not yet reached broad awareness in the management and capacity building towards organizational ambidexterity. Secondly, a group of subject areas of relevance to biotech, comprising "Agricultural and Biological Sciences" (14), "Biochemistry, Genetics and Molecular Biology" (7), "Chemical Engineering" (4), "Physics and Astronomy" (4), "Chemistry" (2), "Immunology and Microbiology" (2), and "Pharmacology, Toxicology and Pharmaceutical" (1), jointly represent no more than 1,4% (34 publications combined) of the literature corpus on ambidexterity. This stark underrepresentation indicates the potential and need for the dissemination, coaching, and consulting in the biotech, tech and biomedical sector of entrepreneurs, startups, and SMEs about the management theory and key concepts of ambidexterity in organizational capacitation towards successful balances between exploration and exploitation.

Scopus DB query : (TITLE-ABS-KEY(ambidexterity))
Number of results : 2349

SUBJECT AREA	COUNT
Business, Management and Accounting	1735
Social Sciences	466
Computer Science	387
Decision Sciences	332
Economics, Econometrics and Finance	326
Engineering	294
Psychology	138
Medicine	104
Environmental Science	97
Energy	73
Mathematics	64
Arts and Humanities	43
Neuroscience	19
Agricultural and Biological Sciences	14
Health Professions	13
Multidisciplinary	12
Earth and Planetary Sciences	8
Biochemistry, Genetics and Molecular Biology	7
Materials Science	5
Chemical Engineering	4
Physics and Astronomy	4
Nursing	3
Chemistry	2
Dentistry	2
Immunology and Microbiology	2
Pharmacology, Toxicology and Pharmaceutics	1

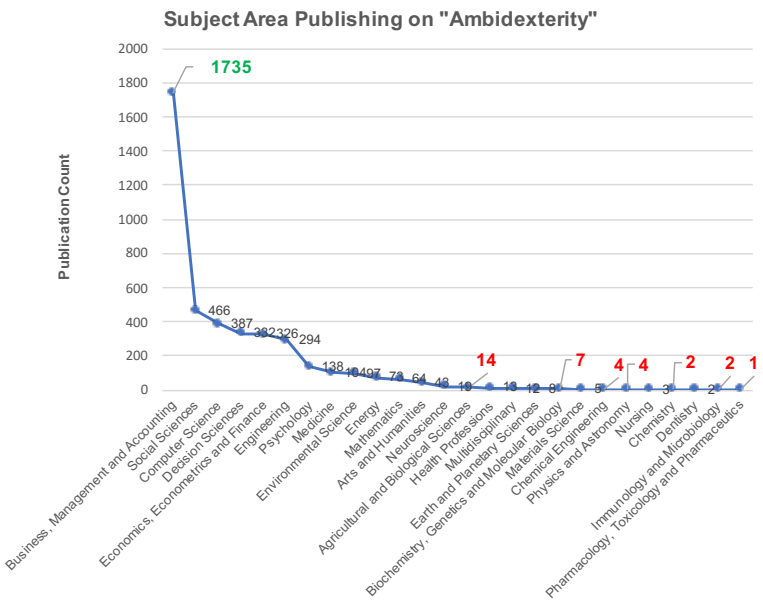

Figure 8. Subject Areas Covering Literature on Ambidexterity
Subject Area Attribution of 2,349 publications on "Ambidexterity" covering a 5-decade timespan between 1973 and 2023.

Step (2) Prioritisation Ranking by Citation Count

The comprehensive Scopus database - extracted literature body was chosen for its inclusion of systematic citation count annotation, enabling citation-based rank-sorting of the publications as an indicator of quality, relevance, and general adoption by the scientific and management practice communities worldwide. Categorizing this 50-year literature body on ambidexterity between the years 1973 – 2023 by a) Articles and b) Reviews followed by rank-sorting according to the number of citations as annotated in the Scopus database allowed the rank-based prioritization of research works according to overall relevance. Consequently, regarding a), here the focus is on the manual review of a prioritized set of the most frequently cited 50 research articles, representing a collective total of > 25,000 citations, highlighting a broad coverage and penetration across the scientific and management practice communities of the selected literature (**Table 1**; **Supplemental Table S 1**).

Table 1. Leading Literature on Ambidexterity – Top 50 Research Articles
Table displays list of 50 most highly cited research articles as per Scopus database extracted citation counts, rank-sorted by number of citations. Journal titles are abbreviated as per Web of Science convention for journal names.

Rank	Article Citation	Journal	Citations
1	(C. B. Gibson & Birkinshaw, 2004)	Acad Manage J	2542
2	(Gupta et al., 2006)	Acad Manage J	2011
3	(Raisch et al., 2009)	Organ Sci	1328
4	(Lubatkin et al., 2006)	J Manage	1324
5	(Andriopoulos & Lewis, 2009)	Organ Sci	1244
6	(O'Reilly Iii & Tushman, 2013)	Acad Manage Perspect	1159
7	(Adler et al., 1999)	Organ Sci	978
8	(Cao et al., 2009)	Organ Sci	860
9	(Helfat & Winter, 2011)	Strategic Manage J	711
10	(Jansen et al., 2009)	Organ Sci	648
11	(Rothaermel & Alexandre, 2009)	Organ Sci	593
12	(Rosing et al., 2011)	Leadership Quart	578
13	(Junni et al., 2013)	Academy of Manage Perspect	526
14	(Simsek, 2009)	Journal Manage Stud	497
15	(Eisenhardt et al., 2010)	Organ Sci	473
16	(Tiwana, 2008)	Strategic Manage J	442
17	(Mom et al., 2009)	Organ Sci	440
18	(Beckman, 2006)	Acad Manage J	424
19	(Simsek et al., 2009)	Journal Manage Stud	411
20	(Pavlou & Sawy, 2010)	Inform Syst Res	404
21	(Birkinshaw & Gupta, 2013)	Academy of Manage Perspect	395
22	(Rapp et al., 2013)	J Acad Market Sci	372
23	(Jansen et al., 2008)	Journal Manage Stud	370
24	(O'Reilly III & Tushman, 2011)	Calif Manage Rev	352
25	(Im & Rai, 2008)	Manage Science	339
26	(Kristal et al., 2010)	J Oper Manag	322
27	(Turner et al., 2013)	Int J Manag Rev	315
28	(Z. Lin et al., 2007)	Manage Science	312

Rank	Article Citation	Journal	Citations
29	(P. C. Patel et al., 2013)	Acad of Manage J	310
30	(Hoang & Rothaermel, 2010)	Strategic Manage J	307
31	(Sidhu et al., 2007)	Organ Sci	288
32	(Stettner & Lavie, 2014)	Strategic Manage J	285
33	(Schreyögg & Sydow, 2010)	Organ Sci	282
34	(Luo & Rui, 2009)	Academy of Manage Perspect	282
35	(Gulati & Puranam, 2009)	Organ Sci	278
36	(Webb et al., 2010)	Entrepren Theory & Practice	276
37	(Ambos et al., 2008)	J Manage Stud	274
38	(Taylor & Helfat, 2009)	Organ Sci	271
39	(Voss & Voss, 2013)	Organ Sci	251
40	(O'Connor & DeMartino, 2006)	J Prod Innovat Manag	250
41	(Tarafdar & Gordon, 2007)	J Strategic Inf Syst	232
42	(Lee et al., 2015)	Inform Syst Res	229
43	(Bresciani et al., 2018)	Technol Forecast Soc	228
44	(Vorhies et al., 2011)	J Acad Market Sci	225
45	(Markides, 2013)	Academy of Manage Perspect	223
46	(Jansen et al., 2012)	Strategic Manage J	222
47	(Vrontis et al., 2017)	J Technol Transfer	217
48	(Andriopoulos & Lewis, 2010)	Long Range Plann	216
49	(Nemanich & Vera, 2009)	Leadership Quart	211
50	(H.-E. Lin et al., 2013)	J Prod Innovat Manag	208

These 50 articles are represented in 22 different journals of which Organization Science represents by far the most relevant and frequently represented journal, with a quarter, or 26%, and precisely 13 of the top 50 most cited publications on Ambidexterity being published in this bi-monthly, peer-reviewed journal (**Figure 9**).

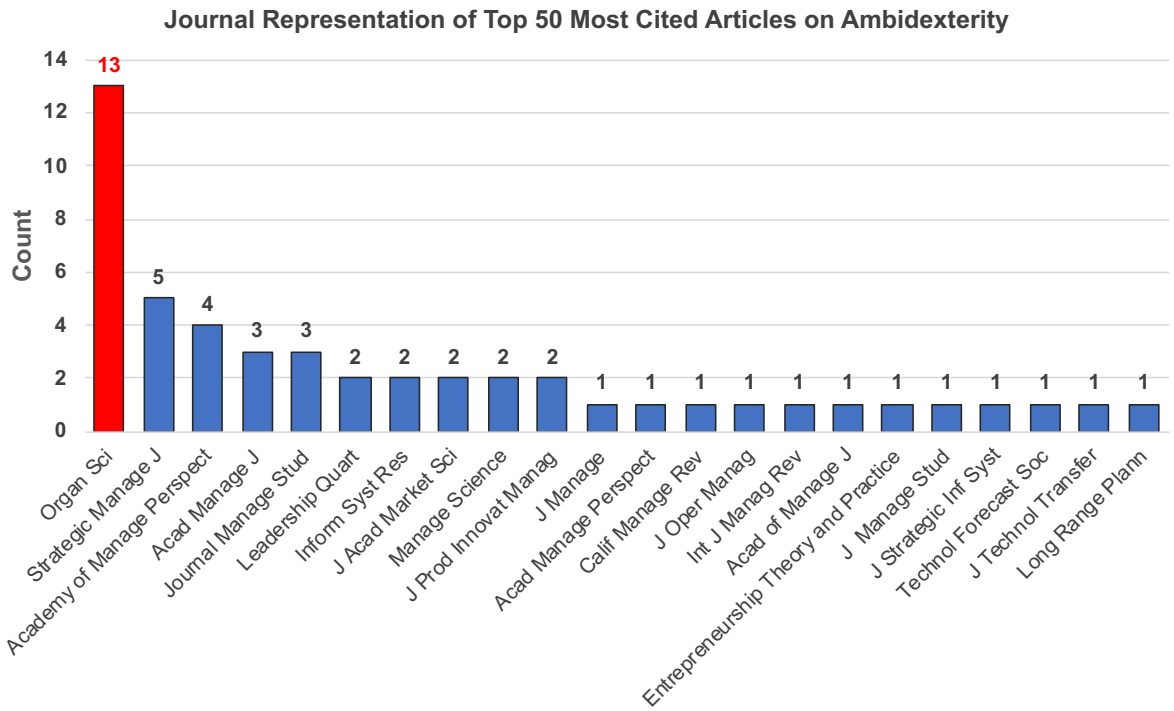

Figure 9. Journal Representation Amongst 50 Most Highly Cited Articles
Graph displays 13 unique journals publishing the 50 most highly cited articles as identified upon Scopus citation count rank sorting, ordered by frequency of occurrence.

Furthermore, regarding b), the focus is, additionally, on the manual review of a prioritized set of the most frequently cited 25 literature reviews as obtained from the Scopus literature corpus, representing an additional total of > 7,000 citations (**Table 2**; **Supplemental Table S 2**). These review articles represent and cover the leading edge of opinion and state-of-the-art research on ambidexterity, themselves, given their nature as review articles, referencing a very comprehensive multitude of relevant and important research articles.

Table 2. Leading Literature on Ambidexterity – Top 25 Reviews
Table displays list of 25 most highly cited review articles as per Scopus database extracted citation counts, rank-sorted by number of citations. Journal titles are abbreviated as per Web of Science convention for journal names.

Rank	Review Citation	Journal	Citations
1	(He & Wong, 2004)	Organ Sci	2324
2	(Raisch & Birkinshaw, 2008)	J Manag	1527
3	(O'Reilly III & Tushman, 2008)	Res Organ Behav	1263
4	(Birkinshaw & Gibson, 2004)	MIT Sloan Manag Review	518
5	(Parker, 2014)	Annu Rev Psychol	328
6	(Luo & Tung, 2018)	J Int Bus Stud	274
7	(Parmigiani & Howard-Grenville, 2011)	Acad Manag Ann	257
8	(Boumgarden et al., 2012)	Strat Manag J	224
9	(Yu et al., 2013)	J Serv Res	86
10	(Bui et al., 2021)	Sust Prod and Consumpt	71
11	(Wan et al., 2017)	Sustainability	52
12	(H.-E. Lin & McDonough, 2014)	J Prod Innovat Manag	49
13	(Melewar & Nguyen, 2015)	J Brand Manag	36
14	(Poutanen et al., 2016)	Eur J Innovat Manag	32
15	(Steiber & Alänge, 2013)	Total Qual Manag Bus Excel	32
16	(Mueller et al., 2020)	Rev Manag Science	22
17	(Konlechner et al., 2018)	Int J Tech Manag	22
18	(Pertusa-Ortega et al., 2020)	BRQ Bus Res Quarterly	21
19	(Chen et al., 2018)	Knowl Manag Res Pract	21
20	(Petro et al., 2019)	J Manag Eng	16
21	(Parikh, 2016)	Manag Decis	16
22	(Mishra & Pani, 2020)	VINE J Inform Knowl Manag Sys	13
23	(Lièvre, 2016)	Rev Francaise de Gestion	13
24	(Liu et al., 2011)	Asian J Bus Manag	12
25	(Eriksson & Fundin, 2018)	J Organ Change Manag	11

As regards representation of journal representation amongst the most highly cited reviews, strikingly the most 25 highly cited reviews are published in 25 uniquely different journals, with

no single journal occurring twice. This indicates a broad representation covered by this literature body extract across the available literature.

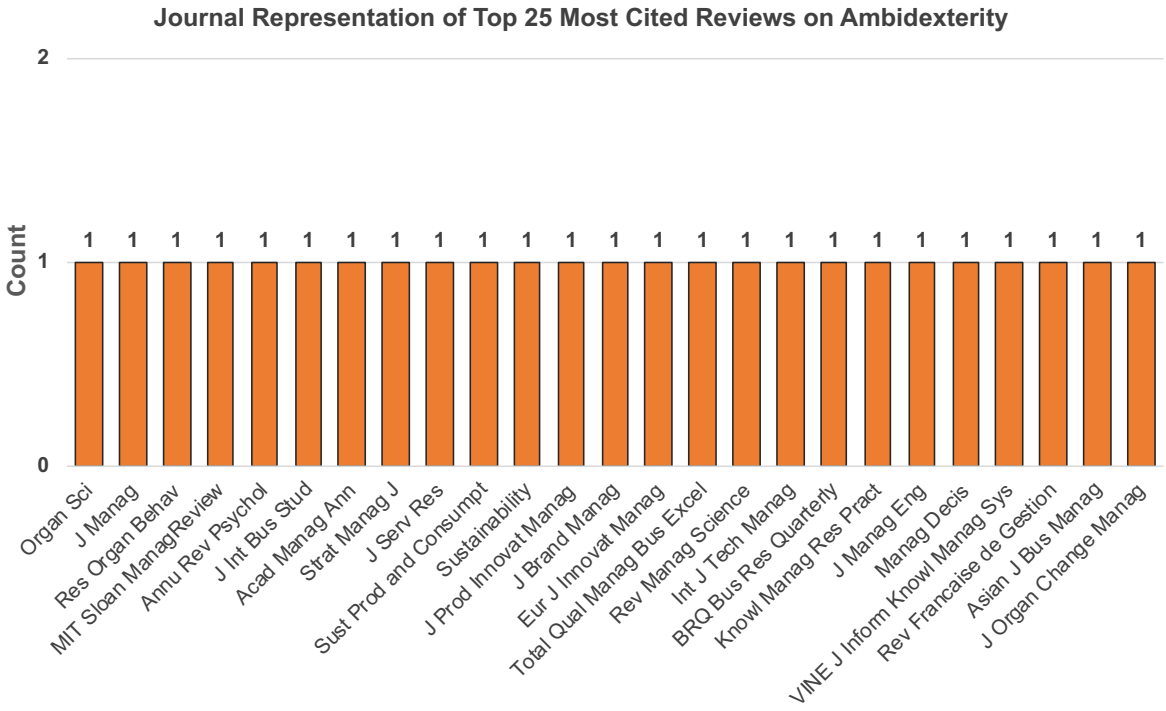

Figure 10. Journal Representation Amongst 25 Most Highly Cited Reviews
Graph displays 25 unique journals publishing the 25 most highly cited articles as identified upon Scopus citation count rank sorting.

Step (3) Similarity Network Expansion

Using the seminal work published by Tushman and O'Reillly in California Management Review in 1996 (Tushman & O'Reilly, 1996) as input seed in the "Connected Papers" similarity graph search algorithm (Eitan et al., 2023), which is itself connected to the Semantic Scholar Paper Corpus (Ammar et al., 2018), comprising 100s of millions of publications across scientific disciplines, a graph is obtained where publications are connected to the starting seed based on their similarity, where mutual citation is not a determinant. Similarity-based edges (connections) of two nodes (publications) in the graph is determined by a similarity metric based on co-citation and bibliographic coupling, where two nodes (publications) that have strongly overlapping citations are scored as having a high likelihood of treating a related topic. The Connected Papers algorithm thereby compiles a force-directed graph, distributing the nodes such that similar publications are co-clustered proximally, whereas less similar publications are more peripheral in the network graph (**Figure 11**).

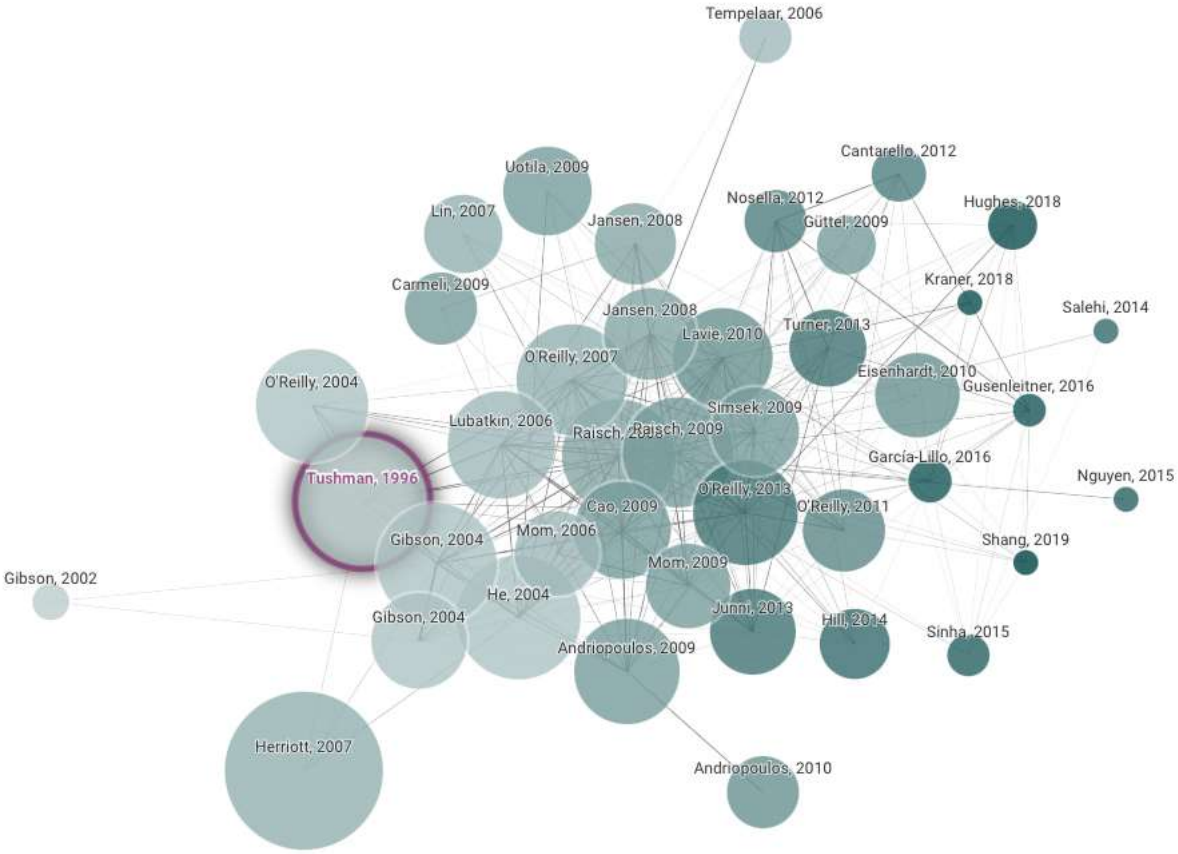

Figure 11. Network-expanded Model of Key Literature on Ambidexterity
Using Tushman & O'Reilly's seminal 1996 publication in California Management review (Tushman & O'Reilly, 1996) as input seed, the 35 most significantly associated publications according to Connected Papers' graph modeling algorithm where extracted. The network recovers numerous articles and reviews shortlisted amongst the most highly cited articles and reviews in this study, and further enriching the literature corpus with highly associated and frequently cited publications not represented in the initial Scopus extract.

Accordingly, the 35 most significantly associated publications according to Connected Papers' graph modeling algorithm where extracted. **Table 3** summarizes the retrieved literature, ranked according to similarity to the seed paper by Tushman an O'Reilly (Tushman & O'Reilly, 1996), including indication of the citation count as retrieved by Connected Papers, which is based on the Semantic Scholar Paper Corpus (**Supplemental Table S 3**).

Table 3. Similarity Network Expansion
Table displays list of 35 publications identified through similarity network association. Using the seminal publication by M. Tushman and C. O'Reilly published in California Management Review in 1996 as a seed (highlighted in red), the most similar publications, ranked here by Similarity Score, were included in the literature review and topic modeling approach. Journal titles are abbreviated as per Web of Science convention for journal names. Overlaps with the Top 50 Articles and Top 25 Reviews sets are indicated in column "Set Overlap". * Connected Papers citation counts derived from Semantic Scholar Paper Corpus.

Rank	Network-Expanded Citation	Journal	Citations*	Similarity Score	Set Overlap
1	(Tushman & O'Reilly, 1996)	Calif Manage Rev	4242	100,0	SEED
2	Gibson & Birkinshaw, 2004)	Acad Manage J	2860	43,8	Articles
3	(He & Wong, 2004)	Organ Sci	3309	41,6	Reviews
4	(Raisch & Birkinshaw, 2008)	J Manage	2271	40,0	Reviews
5	(Raisch et al., 2009)	Organ Sci	2008	34,6	Articles
6	(Lubatkin et al., 2006)	J Manage	1812	34,2	Articles
7	(O'Reilly III & Tushman, 2008)		2061	31,7	Articles
8	(O'Reilly III & Tushman, 2004)	Harvard Bus Rev	2200	31,5	New
9	(O'Reilly Iii & Tushman, 2013)	Acad Manage Perspect	1607	28,4	Articles
10	(Cao et al., 2009)	Organ Sci	1158	26,6	Articles
11	(Andriopoulos & Lewis, 2009)	Organ Sci	1668	26,2	Articles
12	(Lavie et al., 2010)	Acad Manag Ann	1304	25,6	New
13	(Simsek, 2009)	J Manage Stud	740	25,4	Articles
14	(Jansen et al., 2009)	Organ Sci	903	25,0	Articles
15	(March, 1991)	Organ Sci	8703	24,0	New
16	(Mom et al., 2009)	Organ Sci	630	22,4	Articles
17	(Uotila et al., 2009)	South Med J	779	21,4	New
18	(Mom et al., 2006)	J Manage Stud	618	21,2	New
19	(Jansen et al., 2008)	J Manage Stud	530	20,5	Articles
20	(Junni et al., 2013)	Acad Manage Perspect	674	19,7	Articles
21	(O'Reilly III & Tushman, 2011)	Calif Manage Rev	559	19,5	Articles
22	(García-Lillo et al., 2016)	Scientometrics	24	19,1	New
23	(Turner et al., 2013)	Int J Manag Rev	417	18,8	Articles
24	(Hill & Birkinshaw, 2014)	J Manage	272	18,6	New
25	(Gusenleitner, 2016)	Junior Manage Science	3	18,3	New
26	(W. H. Güttel & Konlechner, 2009)	Schmalenbach Bus Rev	122	18,2	New
27	(C. Gibson et al., 2002)	USC Marshall CEO	8	17,7	New
28	(Andriopoulos & Lewis, 2010)	Long Range Plann	308	17,7	Articles
29	(Nosella et al., 2012)	Strateg Organ	158	17,7	New
30	(Sinha, 2015)	Vikalpa: J Decision Make	21	17,7	New
31	(Cantarello et al., 2012)	Entrepreneurship	84	17,6	New
32	(Hughes, 2018)	J Marketing Manage	49	17,4	New
33	(Carmeli & Halevi, 2009)	Leadership Quart	311	17,2	New
34	(Eisenhardt et al., 2010)	Organ Sci	630	17,2	Articles
35	(Z. Lin et al., 2007)	Manage Sci	451	16,9	Articles

This similarity network association-based set of 35 publications recovers several of the articles and reviews shortlisted amongst the most highly cited articles (**Table 1**) and reviews (**Table 2**) in this study, and further enriching the literature corpus with highly associated and frequently cited publications not represented in the initial Scopus extract. Precisely, the similarity network expansion recovers 34% (17) of the 50 most highly cited articles, and 8% (2) of the 25 most highly cited reviews. This finding suggests that the Connected Papers algorithm may be biased towards research articles. Importantly, however, 16 new research articles, including the seed, are added that are highly associated with the seed by similarity, while they had not been included in the citation rank-based shortlists of articles and reviews. Thereby, a high-confidence

literature corpus of about 100 research papers has been generated and considered for literature review and core concept extraction.

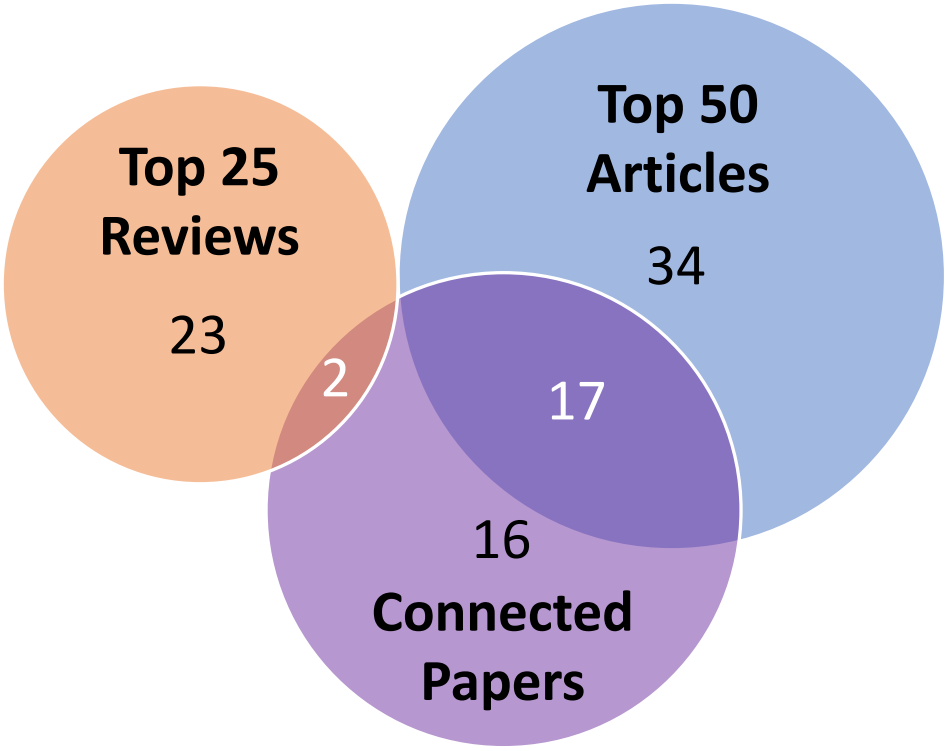

Figure 12. Similarity Network Graph Recovery and Addition of Key Literature
Venn Diagram displaying overlaps and uniqueness of Connected Papers based retrieval of similarity graph association-based literature. The 35 most significantly associated publications share 2 of the 25 most highly cited reviews and 16 of the 50 most highly cited articles, while 17 unique publications were added.

Step (4) Literature Review & Core Concept Cluster Analysis

The literature-based concept extraction is based on the 50-year period between 1973 – 2023, considering the 50 most highly cited original research articles as extracted from the Scopus DB literature corpus, of which each was counting with more than 200 citations at the time of database download (**Table 1**). In terms of review articles, the focus was on the Top 25 most cited items, each being cited more than ten times (**Table 2**). Furthermore, similarity network-based expansion contributed an additional set of 35 publications (**Table 3**), as described above (**Supplemental Table S 1**, **Supplemental Table S 2**, **Supplemental Table S 3**).

Table 4. Literature-Derived Core Concepts of Ambidexterity and Their Prevalence
Core concepts extracted from about 100 most relevant papers on ambidexterity, rank-sorted by their prevalence. Prevalence shown in total counts and % across the full literature body.

Rank	Literature Core Concept Cluster (LCCC)	Prevalence	Prevalence %
1	**Organizational Ambidexterity Strategy**	63	67%
2	**Ambidexterity Management & Leadership**	48	51%
3	**Manage & Balance Internal Competition & Resources**	27	29%
4	**R&D, Innovation, Product & Technology Development Cycle**	26	28%
5	**Foster & Harness Dynamic Capabilities**	24	26%
6	**Team, Network & Organizational Integration Mechanisms**	23	24%
7	**Business Model, Commercial Operations & Performance**	19	20%
8	**Cognitive Frames, Organizational Learning & Knowledge Sharing**	15	16%
9	**Diversification, Cross-Boundary, Alliances, M&A**	15	16%
10	**Environmental Risk & Change Management**	12	13%
11	**Product, Supply Chain, Marketing & Sales**	11	12%
12	**HR, Team Management, Diversity & Culture**	10	11%
13	**Lead by Mission, Vision & Core Values**	9	10%
14	**Uncertainty, External Competition & Vulnerability**	8	9%
15	**Information Systems & Information Technology**	6	6%

The literature-derived key determinants of successful organizational ambidexterity were extracted as 15 literature core concept clusters (LCCC) (**Table 4**). LCCCs were grouped by their prevalence within the literature body analyzed. The five most frequently occurring are 1.) Organizational Ambidexterity Strategy as extracted from 67% of the analyzed publications, 2.) Ambidexterity Management & Leadership with 51%, 3.) Manage & Balance Internal Competition & Resources with 29%, 4.) R&D, Innovation, Product & Technology Development Cycle with 28%, 5.) Foster & Harness Dynamic Capabilities with 26%. A clustering analysis of the co-occurrence of these core concepts within research studies highlights a dense co-occurrence of the 7 to 8 most frequently occurring core concepts, with decreased co-clustering and co-occurrence of the less frequent core concepts (**Figure 13**). For each core area, key determinants of success are collected and grouped into contextual clusters. This visual heat map of co-occurrence exposes content-based logical associations that are reproducible from a subject expert's point of view but that would not be recognizable from a prevalence-based ranking alone.

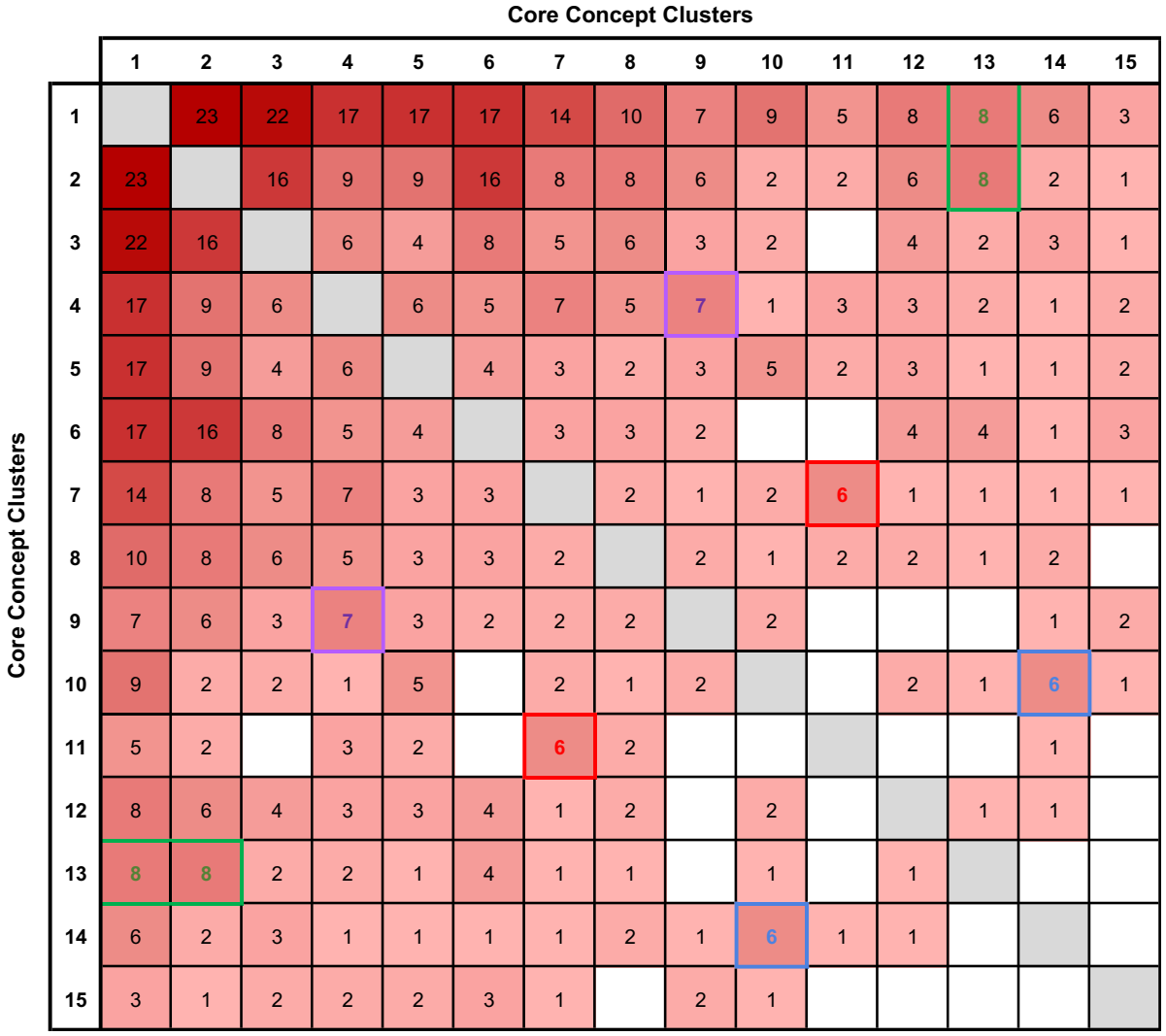

Figure 13. Co-Occurrence Cluster Analysis Map of Literature-Derived Core Concepts
Heat map indicating co-occurrence, clustered by frequency of the 15 literature-derived core concepts with each other. Heat map annotation is with increasing color intensity by increasing mutual co-occurrence.

The cluster marked in red, for instance, reveals increased co-occurrence between core concepts 7 and 11, namely "7. Business Model, Commercial Operations & Performance" and "11. Product, Supply Chain, Marketing & Sales", which match in terms of their logical connection and co-dependence given that product, marketing, and sales are required for business model execution and representing the core of commercial operations and firm performance. Next, the cluster highlighted in blue, exposes elevated co-occurrence as compared to the map vicinity, between core concepts "10. Environmental Risk & Change Management"" and "14. Uncertainty, External Competition & Vulnerability", both of which link logically given that environmental risks trigger uncertainty, just like external competition and vulnerability require change management. The purple cluster shows a slightly elevated co-occurrence between "4. R&D,

Innovation, Product & Technology Development Cycle" and "9. Diversification, Cross-Boundary, Alliances, M&A", the latter being dependent on product development, or a consequence of product and technology development and sourcing initiatives. Finally, the cluster highlighted in green reveals an increase in co-occurrence between "1. Organizational Ambidexterity Strategy", "2. Ambidexterity Management & Leadership", and "13. Lead by Mission, Vision & Core Values". Core Concept 13, while being significantly less prevalently annotated across the literature studies, logically is a core element of strategy, management and leadership and hence its increased co-occurrence is reproducible (**Figure 13**).

5.2 Unsupervised Machine Learning - Based Topic Modelling via Latent Dirichlet Allocation (LDA)

Next, adding an additional input layer to the manual literature concept extraction, the corpus of prioritized literature was subjected to a performant natural language processing Machine Learning algorithm referred to as LDA, or Latent Dirichlet Allocation.

Step (5) Machine Learning Topic Modelling

In Machine Learning, topic discovery as a subproblem in natural language processing (NLP) aims at discovering topics in a corpus of data, e.g., a collection of PDF documents, to consequently automatically classify each individual document within the corpus in terms of how "relevant" the document, or paper, is with respect to each of the identified topics, wherein a topic is considered as a set of terms such as individual words or phrases, which jointly suggest a common theme, or "key concept". The LDA algorithm as implemented by Asmussen and Møller in 2019 (Asmussen & Møller, 2019) was therefore applied onto the systematically Scopus-derived, citation-ranked and network proximity-expanded literature body described above comprising about 100 PDF documents, the "50-Year Highly Cited Ambidexterity Corpus (**50Y-HCAC**)" in order to assess the outcome of unsupervised, LDA machine learning – assisted topic extraction and to compare for the degree of similarity and shared topics associated with organizational ambidexterity.

As part of the pre-processing of the topic modelling, first, the optimal number of topics had to be determined. To this end, the perplexity was calculated for different amounts of topics, and second, the specificity was considered. Thereby, while in the most extreme case, each paper would be associated with its specific topic, or one topic would be chosen to describe all of the papers. Therefore, rather, preference is to be given to a low, manageable number of topics. To this end, as recommended by Asmussen and Møller, the perplexity was visualized to support the choice of the number of topics. Therefore, perplexity was calculated over 5 folds to

reduce variability and to ensure higher reliability and reduced risk for overfitting, while using 75% of the papers as training set and 25% of the papers as test set for the model (Asmussen & Møller, 2019, p. 10). To ensure ability to replicate results, seed values were set. As regards the number of topics, 2, 3, 4, 5, 10, 20, 30, 40, 50 topics were selected for the calculations. The calculations were performed on an Apple M1 Pro 10-core CPU and 16-core GPU laptop architecture and concluded in < 5 hours total runtime, including pre-processing, cross-validation, LTA modeling, and post-processing. The results are represented in **Figure 14.**

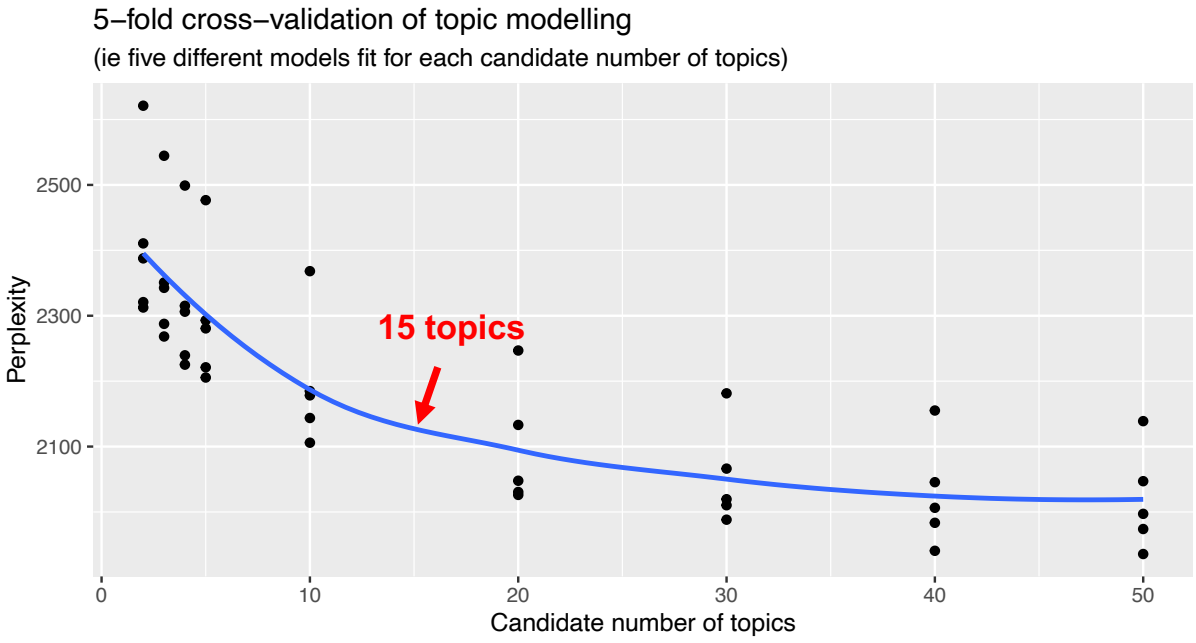

Figure 14. Results of 5-Fold cross-validation of LDA topic modelling.
Cross-validation is applied to find the lowest number of topics that simultaneously have a low perplexity. Here, the fitted line's slope starts to decline at 15 topics, which is why the selected number of topics is 15.

Aiming at a low, manageable number of topics that simultaneously has low perplexity, focus on topic number selection should be on the area of the slope of the fitted lined that starts to decline more gradually, which in this case holds for the range between 10 to 20 topics. In order to match and provide a comparable set to the manually expert-extracted set of topics from the literature review, 15 topics are set for LDA modeling.

With the number of topics set to 15, the LDA model is run on the full "50-Year Highly Cited Ambidexterity Corpus (50Y-HCAC)". The model resulted in a 101 by 15 matrix of topic probabilities (**Supplemental Figure S 2**). Next, for each paper, the topic with the highest probability is identified and chosen to allocate the papers to the topic groups, using Microsoft Excel tables, as described by Asmussen and Møller, As can be seen, most papers have a clearly pre-

dominant likelihood association with a particular topic, while of course, various topics can be associated with a particular paper. It stands out, that papers by the same authors, who tend to write about their same topics, are associated with the same topics (**Supplemental Figure S 2**), such as, for instance, Andriopoulos 2009 and 2010 are associated with Topic 12 (Andriopoulos & Lewis, 2009, 2010), Gibson 2002 and 2004 are associated with Topic 9, or the papers by Luo et al. published in 2007, 2009, and 2018 on MNE and springboard theory associated with Topic 11 (Luo & Rui, 2009; Luo & Tung, 2007, 2018) (**Supplemental Figure S 2**).

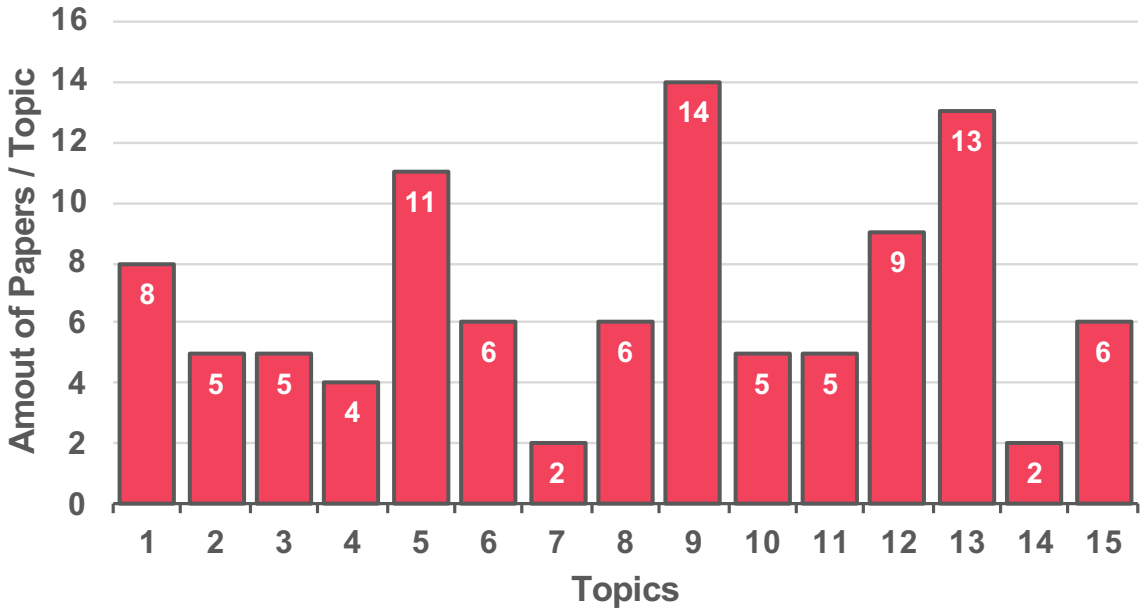

Figure 15. Distribution of Papers on Ambidexterity across Topics

Overall, the allocation between papers and the 15 LDA-derived topics (LDATs) resulted in a distribution as shown in **Figure 15**. While some topics have been allocated with more papers, indicating more research attributed to those, others have been associated with less papers, hinting at less research papers being represented for that topic.

Advancing with the LDA framework's workflow into the post-processing step (**Figure 5**), the findings are translated into topic descriptions. This is achieved through a combined review of the most frequent words as obtained as output from the model (**Table 5**), with the respective topic-associated publications' titles. **Table 5** shows an overview of the five most frequent words associated with each of the 15 LDA-derived topics.

Table 5. Five Most Frequent Words per LDA derived Top 15 topics on Ambidexterity

Top 5 Words	1	2	3	4	5
Topic 1	knowledg	firm	allianc	technolog	innov
Topic 2	market	social	custom	brand	media
Topic 3	chang	manag	organ	visual	formal
Topic 4	work	design	job	product	employe
Topic 5	explor	exploit	ambidexter	organiz	manag
Topic 6	firm	ambidexter	content	subject	fromn
Topic 7	chain	suppli	manag	oper	-
Topic 8	organ	organiz	learn	chang	theori
Topic 9	manag	perform	unit	measur	knowledg
Topic 10	team	leadership	behavior	innov	integr
Topic 11	market	intern	global	institut	busi
Topic 12	busi	manag	innov	compani	technolog
Topic 13	manag	ambidexter	innov	research	journal
Topic 14	firm	manag	learn	heurist	-
Topic 15	capabl	dynam	routin	process	manag

Based on the 5 most frequent words associated with each of the 15 LDATs, and systematically considering each topic group's highest likelihood associated papers' titles, topic titles were named. The full overview on these data is included in **Supplemental Table S 5**. Logical associations based on topic names and topic literature content with the LCCCs (core concept clusters), as manually derived from literature review, are indicated in **Table 6**.

5.3 Convergence and Validation of Core Concepts in Ambidexterity

Expert-driven literature review and information extraction, such as in this case the extraction of core concept clusters on organizational ambidexterity might be biased or influenced by investigator's prior knowledge or preferences. Therefore, the results from the LDA model described above, as an unsupervised machine-learning methodology for concept (or topic) identification and extraction executed over the identical, full literature body, the "50-Year Highly Cited Ambidexterity Corpus (50Y-HCAC)", were used to mutually associate a) literature-

derived core concepts with b) LDA-derived topics. As shown above in **Table 6**, a full coverage exists in content linkage between LDA-derived topics (LDAT) and literature core concept clusters (LCCC).

Table 6. LDA topic modeling Algorithm Derived Top 15 topics on Ambidexterity (LDAT)

	Machine-Learning (LDA) Derived Topics (LDATs)	Papers	Core Concept Link
1	Innovation and Knowledge Alliances in Technology Firms	8	4; 8; 9
2	Customer Focused Social Media Marketing & Branding	5	11
3	Organizational Change Management	5	10
4	Job & Work Design for Production Employee Development, Motivation & Efficiency	4	7; 8; 13
5	Managing Exploration and Exploitation for Organizational Ambidexterity	11	1; 2; 3
6	Subject and Content Influences on the Ambidexterity of the Firm	6	1; 2
7	Supply Chain Management and Operations	2	7; 11
8	Organizational Learning Theory and Change	6	5; 8
9	Knowledge Management and Business Unit Performance Measurement	14	2; 3; 7; 14
10	Innovation Leadership through Team Behavioral Integration	5	2; 4; 6; 12
11	Business & Institutional Internationalization to Global Markets	5	1; 9
12	Technology Company Business Model Innovation	9	1; 2; 7; 13
13	Ambidexterity Management in Research and Innovation	13	1; 2; 4; 15
14	Managing Organizational Learning, Capabilities and Heuristics in the Firm	2	2; 8
15	Managing Dynamic Capabilities in Process Routines	6	2; 5; 15

Step (6) Convergence and Validation of Key Concepts

As stands out from **Table 6**, noticeably, a high degree of linkage is observed between the LDA model – derived topics (LDATs) and the literature – extracted core concept clusters (LCCCs) of ambidexterity. All 15 topics have a contextual link with at least one literature core concept, confirming overall coverage of relevant topics in both sets. Also, 13 LDATs are linked with two or more LCCCs, representing a fraction of 87% of LDATs that are linked with literature core concepts. Furthermore, more than half of the LDATs, precisely 53%, are linked with three or more LCCCs, and 20% are linked with 4 literature core concepts, including and confirming literature core concepts 1 through 4, which ranked highest in terms of prevalence in the 50Y-HCAC literature corpus (**Supplemental Table S 5**). LDATs 9, "Knowledge Management and Business Unit Performance Measurement", 10, "Innovation Leadership through Team

Behavioral Integration", 12, "Technology Company Business Model Innovation", and 13, "Ambidexterity Management in Research and Innovation" are link back with four links each to LCCCs, covering LCCC 1, 2, 3, and 4, the first most prevalent LCCCs extract manually from the literature, as well as various following other LCCCs, thereby confirming through an unsupervised, machine-learning driven topic modeling approach, the relevance of the manually extracted literature core clusters (LCCCs).

Table 7. Literature Core Concept Cluster (LCCC) Association with LDA-Topics (LDAT)
Table lists LCCCs, including their prevalence count in the 50Y-HCAC literature body, and linked LDATs. Heat map coloring of LCCCs highlights degree of linkage with LDATs. LCCCs are color-coded according to the legend used in the framework, as shown in **Figure 18**.

Legend	Core Concept Cluster (Literature)	Prevalence	LDA-Topic Link
1	Organizational Ambidexterity Strategy	63	5; 6; 11; 12; 13
2	Ambidexterity Management & Leadership	48	5; 6; 9; 10; 12; 13; 14; 15
3	Manage & Balance Internal Competition & Resources	27	5; 9
4	R&D, Innovation, Product & Technology Development Cycle	26	1; 10
5	Foster & Harness Dynamic Capabilities	24	8; 15
6	Team, Network & Organizational Integration Mechanisms	23	10
7	Business Model, Commercial Operations & Performance	19	4; 7; 9; 12
8	Cognitive Frames, Organizational Learning & Knowledge Sharing	15	1; 4; 8; 14
9	Diversification, Cross-Boundary, Alliances, M&A	15	1; 11
10	Environmental Risk & Change Management	12	3
11	Product, Supply Chain, Marketing & Sales	11	2; 7; 10
12	HR, Team Management, Diversity & Culture	10	10
13	Lead by Mission, Vision & Core Values	9	4; 12
14	Uncertainty, External Competition & Vulnerability	8	9
15	Information Systems & Information Technology	6	13; 15

Reversely, all LCCCs are linked with at least one LDAT. **Table 7** shows the overview of links and the heat map highlights the predominance of LDAT links validating and further supporting the LDATs throughout. The highest level of validation in terms of number of linked LDATs being for LCCCs "1. Organizational Ambidexterity Strategy", "2. Ambidexterity Management & Leadership". Both LCCCs with high literature prevalence as well as LCCCs with low prevalence sometimes have a seemingly lower LDAT validation by being linked with only one or two LDATs.

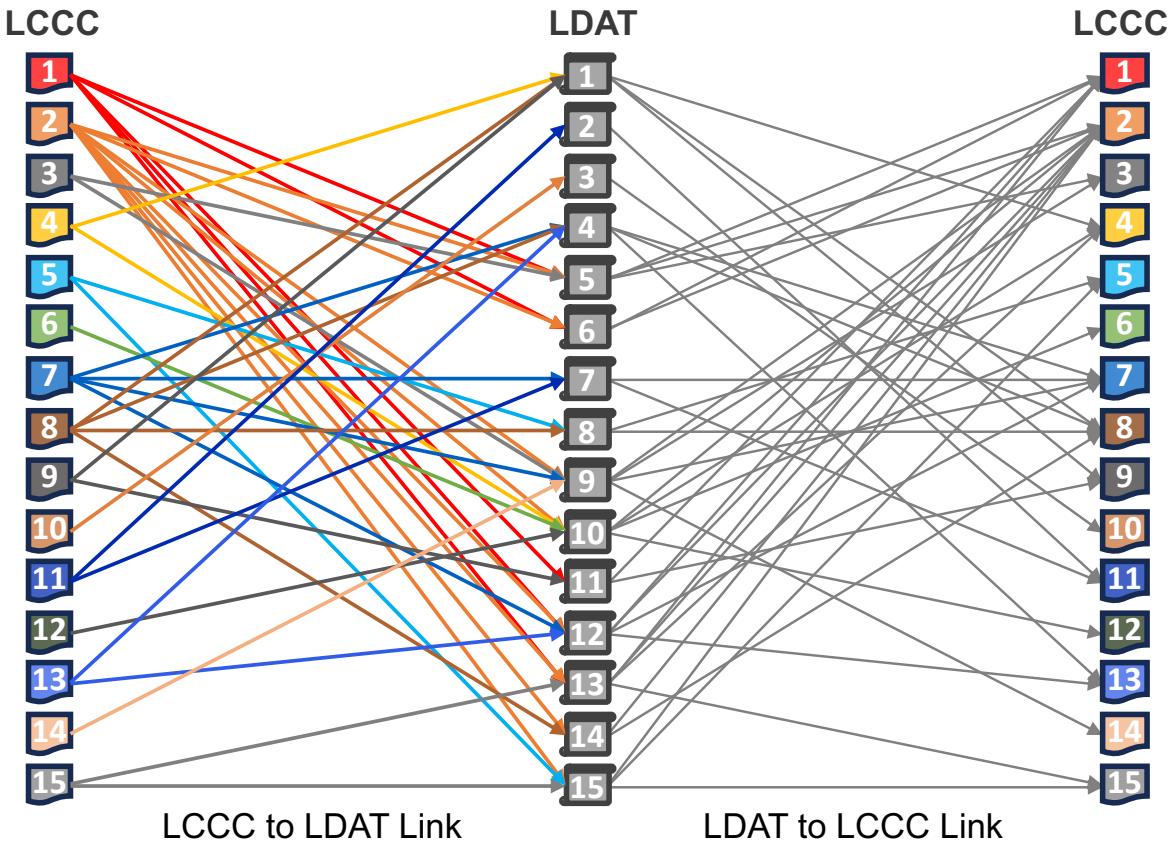

Figure 16. Bipartite Graph Association between Literature-Curated Core Clusters (LCCCs) with Machine-Learning Derived LDA Topics (LDATs) on Ambidexterity

Bi-partite network graph indicating bidirectional linkage between LCCCs and LDATs. Left side of the graph indicates primary linkage between literature-review derived LCCCs with LDATs, serving as confirmation between core concept clusters and topics. Edges (directional arrows) between network nodes (LCCCs and LDATs) are color-coded as per node origin, indicating LCCCs and their respective matching LDATs, as indicated in **Table 7**. Right half of the graph indicates reciprocal linkage back from LDATs to LCCCs as indicated also in **Table 6**, for easier graphical overview. LCCCs and originating edges in the graph are color-coded according to **Table 7** as well as according to the legend used in the framework, as shown in **Figure 18**. Edges originating from LDATs are shown in grey.

In order to highlight the complexity in the interrelations between LCCCs and contextually matching LDATs as well as the validating reverse linkage between LDATs and LCCCs, a bi-partite network graph display was chosen to display an overview of the interaction (**Figure 16**). The graph indicates bidirectional linkage between LCCCs and LDATs, with LDATs positioned in the center. The left half of the graph indicates primary linkage between literature-review derived LCCCs with LDATs that match the originating LCCC as per the content and constituting papers, serving as confirmation between core concept clusters and topics. Edges (directional arrows) between network nodes (LCCCs and LDATs) are color-coded as per node origin,

indicating LCCCs and their respective matching LDATs, as indicated also in **Table 7**. The right half of the graph indicates the reciprocal linkage relationships back from LDATs to LCCCs as listed also in **Table 6**, for easier graphical overview. LCCCs and originating edges in the graph are color-coded according to **Table 7** as well as according to the legend used in the framework, as shown in **Figure 18**. Edges originating from LDATs are shown in grey.

This graph display exposes high density of interactions between LCCCs 1 "Organizational Ambidexterity Strategy", and 2 "Ambidexterity Management & Leadership", being the broadest, most fundamental and essential, and most literature-prevalent core concepts. The apparent scattering of network edges off these two predominant LCCCs to various LDATs suggests that the LDA methodology provided more granular or slightly differing topic names, all of which however represent contextual similarity and equal relevance. At this point it is emphasized, that the LDA numbering, and order was kept as generated by the LDA script's output, without influence by the author. A re-ordering of the LDAT topic numbering as per the degree connectivity with LCCCs would generate a list of LDATs with inverted numbering, between 1 – 5, rather than currently between 9 – 13 that would highly align in interconnectivity with the respective first 1 – 5 LCCCs. Despite the density originating from LCCCs 1 and 2, noticeably, more sparsity is observed in the network around the higher LCCC numbers, where less links seems to exist. With this being also the less prevalent LCCCs, with overall less occurrence of concepts in the literature, correspondingly also less links exists between LDATs paper groups and the respective LCCCs, as apparent from the bi-directional bi-partite graph.

These results highlight core clusters and topics on organizational ambidexterity that are found in the in-depth literature review and independently validated through unsupervised topic modeling, such as, for instance, LCCC 15 "Information Systems & Information Technology", for which limited literature exists and where ambidexterity research and theory should receive additional attention. To mention another example, both LCCCs and LDATs exposed the topic "supply chain" through mutual linkage, while only a low number of papers touches on these topics. Being fundamental to exploitation activities, ambidexterity-related research and management focus is consequently recommended as regards the topic supply chain management (**Table 6**, **Table 7**, **Figure 16**).

5.4 Conceptual Model of a Systematically Derived Framework for Organizational Development towards Ambidexterity

Next, the literature review resulting concepts (LCCCs) are being modelled into a contextual business framework to serve as literature-based reference, guidance and support to entrepreneurs and managers in charge of strategic management initiatives during organizational development towards ambidexterity.

Step (7) Conceptual Modelling of a Framework Towards Organizational Ambidexterity

Numerous theories, concepts, methodologies, and principles exist on organizational development, including especially as regards company foundation and the development of start-up companies based on novel ideas that lead to new business foundation, or during an intrapreneurial process, when novel ideas or product development programs are structured and organized in analogy to the startup development process.

Core Concept Clusters	Company Stage: Early Seed	Mid Series A	Late Series B+
1	8	12	19
2	8	9	14
3	5	5	8
4	4	5	7
5	3	5	7
6	2	5	8
7	1	3	5
8	1	3	5
9	2	3	5
10	1	2	4
11	0	1	3
12	3	3	3
13	1	2	3
14	1	2	2
15	1	2	2

Figure 17. Ambidexterity Core Concept Literature Prevalence by Company Maturity Stage
Ambidexterity Core Concept prevalence in this study's literature body associated with relevance by company stage. Prevalence is averaged over annotated sub-stages to match the proposed framework by three key stages in "Early" (Pre-Seed/Seed), "Mid" (Series A), and "Late" (Series B and later). For detailed stage core concept prevalence quantification see (**Supplemental Figure S 1**).

The proposed framework has been reduced to three essential stages, Seed, first investment towards market during pre-market stage (Series A), and subsequent stages for growth and scaling (Series B+) with further annotation of critical sub-stages in accordance with own experience during tech startup building and management, and in line with leading literature that supports also these critical stages not only during startup company development, but also when it comes to radical innovation and intrapreneurial processes in existing established yet innovating companies, as described recently by O'Reilly and Binns in California Management Review (O'Reilly & Binns, 2019). In order to reconcile the observed prevalence of LCCCs with these main stages of company maturity and development, LCCCs were grouped according to their relevance annotated to these stages (**Figure 17**). Frequently spanning across stages, such as "Early (Seed) to Late (Series B+)", for instance, the average was taken for all LCCC counts across their annotation and presented in the average count-based weighting in **Figure 17**. The detailed underlying data is included within the annotations to the full literature review in **Supplemental Table S 4**, as well as in **Supplemental Figure S 1**.

Figure 18 summarizes this model framework, where key concepts of ambidexterity are associated with strategic company stages during the development cycle. Equally, numerous concepts and strategies have been described as regards the development and establishment of organizational ambidexterity, as summarized above. It is becoming apparent that the translation and application of these theories and concepts with the intent to develop towards and to establish ambidexterity is a complex challenge, once due to the diversity of company ecosystems, including workforce, company culture and structure, technology, products, and markets in consideration, and on the other hand due to the multitude of aspects to be considered when it comes to ambidexterity.

This thesis has focused on the systematic literature review and prioritized extraction of core concepts from the most relevant literature in order to cast the core concepts of essential relevance to successful organizational ambidexterity into an entrepreneurial framework of managerial strategy in support of capability development and successful establishment of ambidexterity. In order to reconcile the two large and complex bodies of literature and theories on organizational company development on the one hand, with the development of organizational ambidexterity on the other, the literature-derived key concepts of ambidexterity have been associated to company development and maturity stages, and positioned for application to ensure drive towards organizational capability and ultimately successful application and translation of ambidexterity such that commercial success results.

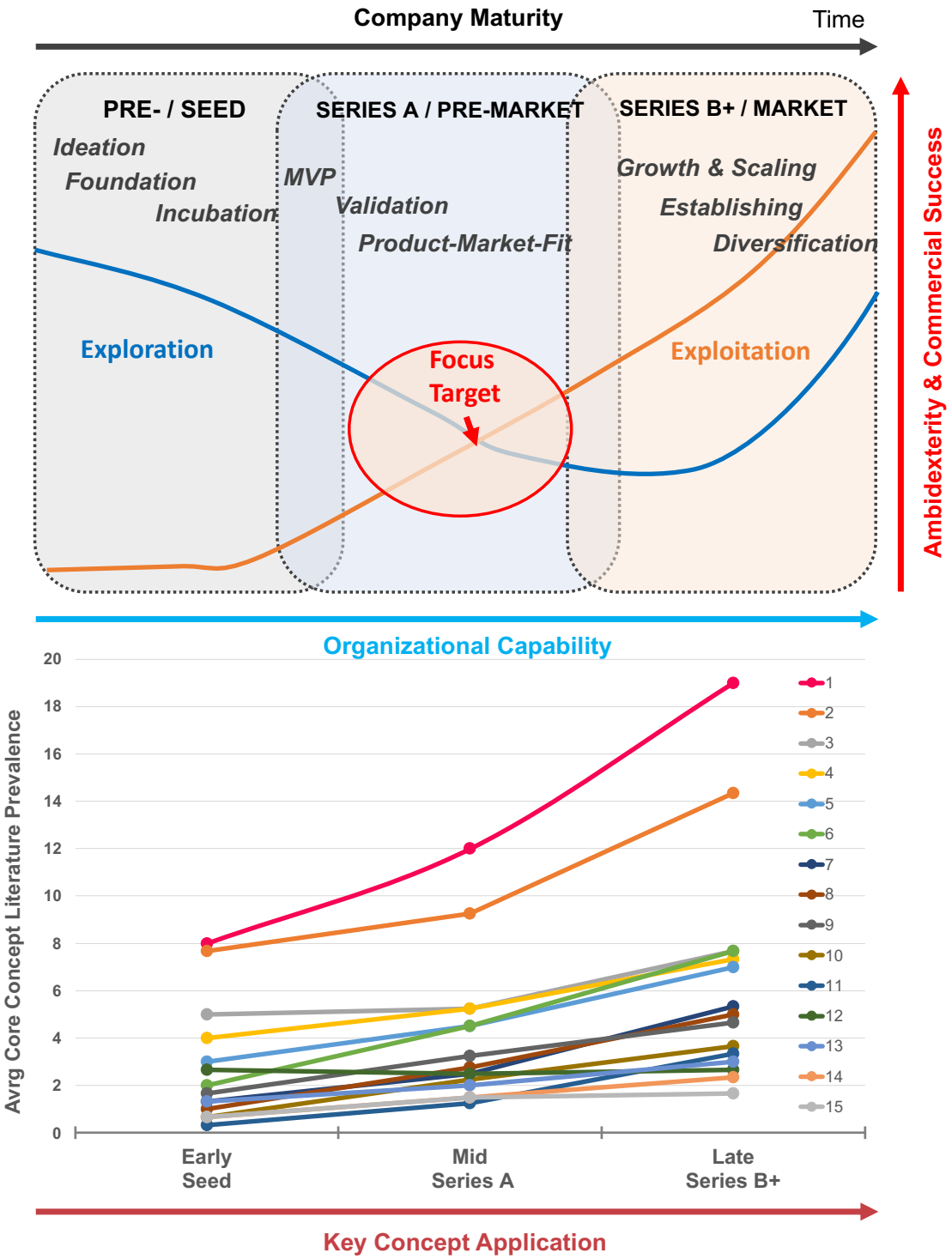

Figure 18. Conceptual Framework for Organizational Development to Ambidexterity. Top panel indicates company development throughout three phases, foundation & seed funding, transition to market and early market through Series A for commercialization, and Series B and later. The framework model assumes increasing maturity over time with increasing organizational resources & capability for strategic actions towards ambidexterity. Bottom panel shows literature-derived core concept clusters, ambidexterity and quantified relevance in comparison to each other and in association to stage based on systematic literature evaluation.

Chapter 6: Conclusion

6.1 Conclusion on the Framework & Strategic Actions

Core concepts, their clusters (LCCCs) and associated Key Success Factors of Ambidexterity (**Supplemental Table S 4**), with associated LDA-derived topics (LDATs) establish the key pillars of the entrepreneurial framework towards organizational ambidexterity presented in this thesis (**Figure 18**). The framework is built on a contextual combination of core concepts of importance for the implementation and execution of ambidexterity, weighted by prevalence and importance, in association with company maturity and stage, given that with increasing maturity also organizational capability is expected to increase and further support and enable ambidexterity. Implementation, execution and optimization of organizational ambidexterity should then lead to sustainable commercial success.

As stated by March, "exploration of new alternatives reduces the speed with which skills at existing ones are improved" (March, 1991, p. 72). This means that considering limited, competing resources, dedication of time and skills resources into R&D comes at the cost of resource availability for the execution of existing synthesis workflow routines, including their incremental optimization to maximum efficiency. Consequently, parallel, ambidextrous organization of such exploration and exploitation through separate teams and technical instrument resources that can be independently accessed for R&D while production routines are in progress, is an important area of investment to support ambidexterity. In relation, Levitt and March state that improvements in competence at existing procedures make experimentation with others less attractive, leading to a "Competency Trap" (Levitt & March, 1988, pp. 322–323). Importantly, strategic emphasis needs to ensure that such paths of least resistance (competency traps) does not halt or slow down innovation and long-term competitive development at the toll of short-term economic benefit. Therefore, and given the complexity of the challenge and associated theoretic literature, the conceptual framework presented in this thesis shall provide a usefully tangible and business applicable guide at a level of abstraction for entrepreneurs and startup managers under the consideration, choice and application of management principles in ambidexterity during the pursuit to their strategic goals and vision.

To this end, concluding strategic actions resulting from this thesis' outcome are, for entrepreneurs and managers, the decision and selection of suitable core concepts and their associated key success factors, combined with their translation into practice, in order to establish successful ambidexterity in the organization.

6.2 Strategic Considerations on Framework Translation to Practice

The conceptual framework of literature-derived core concept clusters (LCCC) and their associated key success factors towards successful organizational ambidexterity derived out of this systematic literature review and analysis provides the vast literature body on ambidexterity with a novel framework and guiding overview on a contextualized and quantified extract summary to navigate a set of important core concepts on ambidexterity. This framework therefore lends itself for application and translation to practice in a real-world setting. Frequently, entrepreneurs, start-up founders, and managers are challenged with the advancement of new ventures to maturity, to the market, and to commercial success. The power of ambidexterity is in the recognition of the obvious need on exploitation for value generation and capture as guiding strategy for each firm, as well as for exploration, either at the venture's start, during its pursuit of tech- and product development, or during more mature company stages, when it is about diversification, and the need for addition of new product to the portfolio or penetration into further promising markets.

A direct validation for economic performance of the framework presented herein would require a planned, long-term assessment of business performance in consequence of strategic actions and behavior, implemented and followed out of guidance by this framework followed by associated outcome quantification. An analysis of fit of the core concept clusters, topics, and key success factors with each respective economic stage and situation of the target company under consideration in perspective of preconditions, or antecedents, prior developments, anticipated challenges and upcoming milestones and goals, as well as expected or desired consequences, can serve as a contextual validation of applicability of the framework to the entrepreneurial community.

A transition in company maturity from early foundational seed stage to commercialisation, driven through a Series A investment for commercialisation and subsequent investment rounds for scaling and growth via Series B and beyond requires a fundamental investment into organizational capability development and the establishment of a performance core that allows successful implementation and execution of ambidexterity (**Figure 18**, **Figure 19**). Transitioning from an early, exploratory phase upon foundation of the venture in early seed stage of the company, where responsibilities and specialization of team members are very and frequently predominantly focused on R&D activities, and in promising cases repurposed for early adopters' or test client activities with MVP production and testing with those clients, commercialization, scaling and growth require the establishment of specialized, dedicated teams beyond R&D, importantly commercial. These specialized commercial teams, including business development, product development and management, marketing, and sales, require their own

organizational resources, processes and systems, and integration within the company strategy and organigram. The top management team needs to provide budget and a hiring plan in order to drive the implementation of these structures and teams, including platform operations and production, associated tech development and quality control and validation, as well as commercial business operations including business development, marketing and sales along the value chain towards commercial success (**Figure 19**).

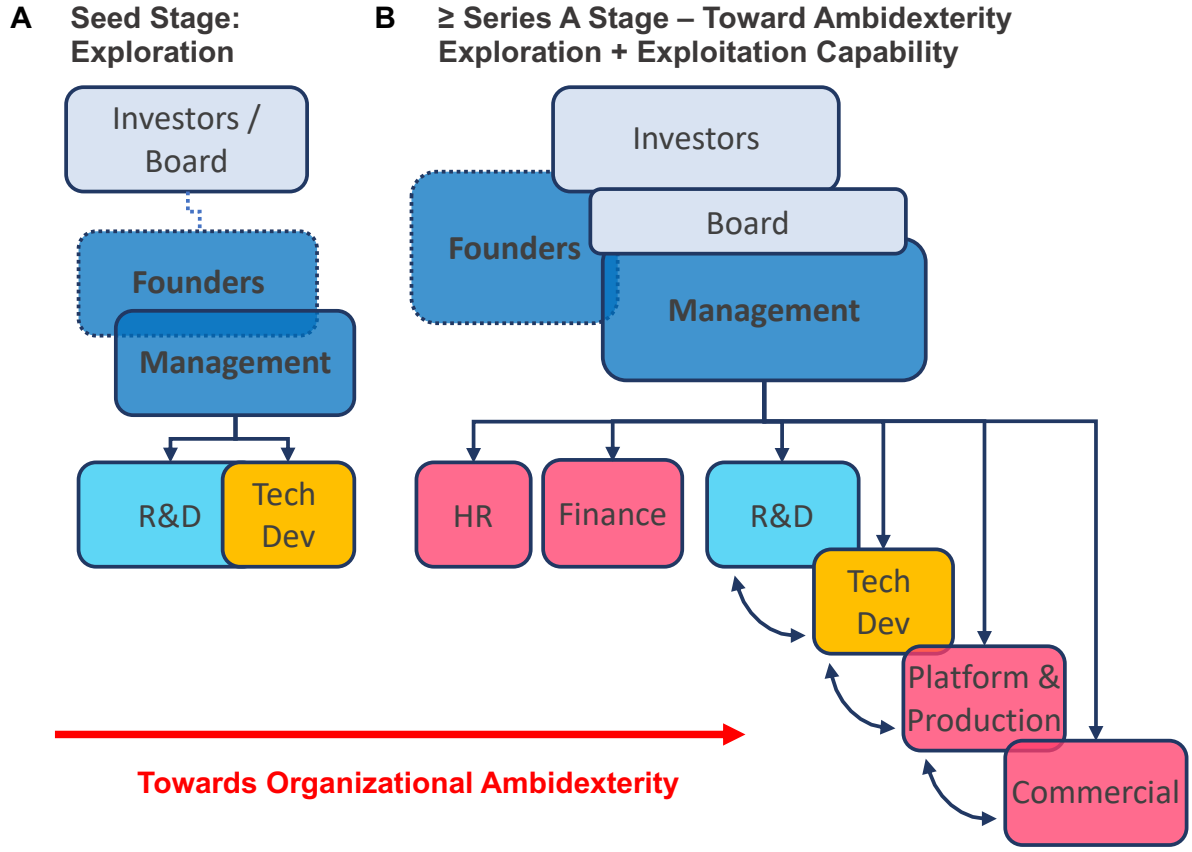

Figure 19. Organigram Evolution towards Ambidexterity
Organigrams in early, seed-stage tech startups frequently lack functional areas of crucial importance for exploitation in ambidexterity (**A**). Panel **B** indicates a conceptualized evolution of the organization to include functional areas to drive exploitation, allowing both structural as well as contextual and more hybrid forms of ambidexterity.

Further, from a process-oriented point-of-view, an early mode of "contextual ambidexterity", achievable at smaller team and operational company size and maturity, needs to transition to a more hybrid form of ambidexterity, where aspects of "structural ambidexterity" emerge and connect with the "contextual ambidexterity" in a tailored "hybrid ambidexterity", suitable to a start-up company's stage of operations. Concordant with the emerging transition of the organization into a commercially active organization, key changes are being implemented in the

organigram of the organization, an example being shown in **Figure 19**. Besides functional areas, focusing on leadership and efficiency in execution on the firm's strategy, the introduction of a middle-management layer across the value chain services to provide head roles within key areas or departments in the company, such as in R&D, HR, or Finance, which will importantly serve as connection and execution control points to ensure efficient communication and management of the respective area through the executives and the TMT. While implementing organizational structures towards ambidexterity, such as through separating exploratory units from exploitative ones, O'Reilly and Tushman highlighted the importance of a tight coordination at the managerial level, as indicated in this model through the interplay arrows between R&D, Tech Development, Platform & Production (value generation), and Commercial areas (value capture) (**Figure 19**).

6.3 Framework Core Concepts & Associated Key Success Factors

Considering the complexity and wealth of information available in the literature, expert-guided prioritization and systematic processing of such information should serve to foster not only practical adoption by management practice, but also their downstream evaluation and assessment in studies on strategy effectiveness and firm performance. The "contextual framework for organizational development towards ambidexterity" as presented in this study (**Figure 18**) aligns organizational capability increase with increasing maturity over time. Simultaneously, in an orthogonal dimension, increasing ambidexterity and associated, resulting commercial success is modeled to increase with increasing degree of ambidexterity (**Figure 18**). While startups frequently start with exploration, such as when a startup is founded out of a university research incubator, the first and foremost key effort according to this model lies in the implementation and increase of exploitation capability (orange line in the framework model). Considering scarcity and to some degree competing nature of resources during early ambidexterity efforts, but also considering successful de-risking and achieved robustness of first technology prototypes, exploration activity and degree may decrease concurrently (blue line in the framework model). According to the framework model, transition from MVP stage through validation and pre-market stage towards market entry requires significant investment into ambidexterity for organizational capability for efficient, sustainable growth and scaling, while sustaining diversification and competitiveness on the market. Therein, the degree of exploitation will break even with the degree of exploration, marking a "focus target" during the young venture's efforts towards becoming an ambidextrous organization (red highlight, **Figure 18**). With advanced market phase and continued exploitation and commercial success, significant resources enable new exploration efforts with resulting increase in exploration in order to enable

diversification through novel product developments or refinements as well as the entry into new markets through disruptive innovation and novel products and offerings. This "focus target" point can also be regarded as a so-called critical "tipping point", as referred to in complex systems theory. As highlighted by Scheffer et al, such tipping points in complex systems as described in this framework of organizational development towards ambidexterity might imply unwanted risks on the one hand, but on the other hand might hold opportunities for positive change towards success of the firm (Scheffer et al., 2012, p. 344). Core concepts and literature theories aside, business decisions lead to consequences tied to management responsibilities down to the core of company survival. Therefore, besides clustering and recommending relevant core concepts, this study focused on annotating respective studies "key success factors" (KSFs) to each publication analyzed within the literature analysis (**Supplemental Table S 4**). Fundamental and prominent examples of such "key success factors" include, according to He and Wong the management's and organization's leadership's capability to "balance" between exploratory and exploitative modes, including by facilitating interaction between both as well as by solving irritations and conflicts out of their overlaps successfully (He & Wong, 2004, pp. 482–483). Also, Raisch and Birkinshaw (Raisch & Birkinshaw, 2008, pp. 389–393), prominently citing the 2004 work by Gibson and Birkinshaw (C. B. Gibson & Birkinshaw, 2004, pp. 209–211) as well as O'Reilly and Tushman strongly emphasize the importance of "adaptability", including from an evolutionary point-of-view of the markets and business protagonists seen as in a competing battle for survival and, to this end, the need for pragmatic and superior "dynamic capabilities" (Konlechner et al., 2018, pp. 190–203; O'Reilly III & Tushman, 2008, p. 189). Company culture, incentive as well as employee health, motivation and psychological safety are emphasized (Nemanich & Vera, 2009, pp. 21–24; O'Reilly & Tushman, 2004, pp. 2–10; Parker, 2014, pp. 663–670), just like "empowerment" and "transformational leadership" positively associate with successful ambidexterity (Yu et al., 2013, pp. 2–3). Clearly, management capability and leadership are central, not only within the most prevalent LDCCs, but also as regards associated key success factors. These include, ambidextrous cognitive frames and the ability to manage tensions between exploitative and explorative teams and activities (H.-E. Lin & McDonough, 2014, p. 175), foresight and inclusiveness in "embracing complexity, embracing ambidexterity, and embracing failure" in innovation (Poutanen et al., 2016, p. 189). Gibson and Birkinshaw emphasize that leadership to ensure simultaneous combination of "stretch, discipline, support, and trust" between business units is crucial to ensure ambidextrous business unit performance (C. B. Gibson & Birkinshaw, 2004, p. 209), just like Gupta et al underline the importance to balance allocation of attention and resources to ensure long-run performance(Gupta et al., 2006, pp. 696–698). Team and employee management as a key

management task and responsibility are highlighted throughout, by Raisch et al as regards the "active management of tensions between differentiation and integration", "at individual and organizational level" (Raisch et al., 2009, p. 693), by Lubatkin and co-workers as regards support towards achieving "TMT behavioral integration" as core driver of firm ambidextrous orientation and performance (Lubatkin et al., 2006, p. 664). Importantly, "ambidextrous leadership" is recognized as a KSF of organizational ambidexterity (O'Reilly & Tushman, 2004, p. 8; Rosing et al., 2011, pp. 966–969; Tushman et al., 2011) (**Supplemental Table S 4**). Therein lies the link and validation as regards KSFs of ambidexterity extracted from this systematic literature review and the *ab initio* motivation behind this thesis, building on the emphasis and importance of providing founders, leaders, and managers with the knowledge and suitable toolkit for successful introduction and implementation of ambidexterity into the organization, for teams and successors to propagate and continue towards long-term company success.

6.4 Critical Discussion

Here, a systematic literature review on a comprehensive literature body covering 50 years based on the comprehensive Scopus literature database is presented. The comprehensive literature review is focused on the most highly cited literature, starting from a citation-based ranking of the Scopus – extracted literature retrieved through the search term "ambidexterity". The Scopus database was chosen for its comprehensiveness and wide adoption within the scientific communities, given that the goal of the review was to also cover research items across domains, beyond pure management literature, and including papers published in journals closer to technical or other scientific disciplines. Of course, medical papers addressing the physician's or psychologist's views and assessments of the anatomical and behavioral phenomenon of ambidexterity were removed from the considered literature. Adding to this analysis, certainly, additional databases and search terms could be included, for further increased coverage. The results, however, provide evidence that the relevant literature was comprehensively covered through relevant and leading literature in the field of ambidexterity. While the literature retrieved from Scopus ranges back to the early 20th century, most articles prior to the 1960s had no relevance to ambidexterity in the management sense discussed in this thesis. Advantageous to the long-term choice in selection and filtering, extending beyond typical search windows of 10 or 20 years to 50 years in this study was the ability to capture the evolution in the extent of the publications throughout, extending on what was described already by Birkinshaw and Gupta in 2013 as a rapidly publishing field of increasing popularity by another 10 years up until 2023, exposing continued, exponential increase in the literature on ambidexterity (Birkinshaw & Gupta, 2013, p. 289) (**Figure 6**).

Substantial focus was then on the literature review, extraction of concepts, their clustering into core concept clusters (LCCCs), and further annotation with associated key success factors. Despite the limitations of such an expert-led, manual literature review, the value add to the literature on ambidexterity is not only in the resulting set of LCCCs, but also in the compendium of information provided within the enclosed full table of results from the literature review (**Supplemental Table S 4**). Of course, literature reviews can be subject to limitations or bias. Taking a systematic approach from the beginning, the literature was not extracted based on a collection of previously published reviews and their linked references but started in an un-biased manner based on an extract from a full database, namely Scopus. Next, during concept extraction and core concept clustering, perception-based or interest-driven biases may occur. Starting from the knowledge of the ambidexterity field and considering its breath, as well as deliberately including studies based on systematic meta-analyses using data-mining approaches, such as the work by Snehvrat et al. (Snehvrat et al., 2018), attention was set to ensure broad coverage of dominant and under-represented concepts, themes, and topics.

Ultimately, an independent, additional, and unbiased means of concept extraction was sought in order to serve as validation for confidence in the aforementioned LCCCs. To this end, Latent Dirichlet Allocation (LDA) was chosen, a state-of-the-art and preferably used method for topic modelling in the scientific literature. The method was also chosen, as a recent framework implementation was accessible for adaptation and customization in the statistical programming language R through the work of Asmussen and Møller (Asmussen & Møller, 2019), which was openly accessible through the Journal of Big Data as well as GitHub. Of course, other implementations of LDA exist, including in Python, as well as alternative methodologies to topic modelling, such as custom-developed algorithms. For the avoidance of doubt, it should be mentioned at this point that the abbreviation LDA for Latent Dirichlet Allocation is not to be confused with its use for "Linear Discriminant Analysis", a statistical method used for the elucidation of linear combinations of object features. To the best of my knowledge, this is the first comprehensive application of LDA-based topic modelling in literature review on ambidexterity. Various data-mining approaches, such as the work by Snehvrat et al have used abstract-based language processing and text mining. LDA topic modelling however was chosen for its power in considering full PDF documents across an entire literature body of, in this case ~100 papers, but as shown in other use cases, possible also with thousands of articles. While the LDA results (LDATs) serve as a supporting, independent validation and confirmation, they may not fully, or only partially, recapitulate concept representation within the literature as extracted by the expert reader. On the other hand, they do well serve as an exploratory guide during review of large literature bodies. In this case, rather than using the LDATs as a starting

set of topics, putting trust and emphasis on the LDA outcome, a semi-conventional approach was taken, prioritizing expert-review, concept identification, clustering and naming, yielding the LCCCs, with an additional subsequent alignment for validation with the LDA-derived machine learning result, the LDATs. Thereby, further topics, or concept families, albeit fully similar, linked and overlapping as shown during the analyses, are presented, adding breadth and reference to the available toolkit on ambidexterity. These results do open the possibility of consideration of an alternative prioritisation of LCCCs or LDATs, based on either LCCCs primary rank-sorting, as presented here, or based on LDATs primary weighting in relevance rank-sorting. In another approach, a high-confidence sub-set of only the highest mutually associated LCCC – LDAT pairs could be considered for practical implementation. This has been achieved through bi-partite association of both sets with each other, and through presentation of the mutually linked concepts and topics, which matches with the literature prevalence prioritisation of LCCCs, included in the resulting framework (**Figure 18**). To conclude, for completeness and relevance for this purpose, the primary relevance is attributed to the expert derived LCCCs, with the resulting set of LDATs serving as additional validation for supporting confidence in the manual literature review results.

6.5 Outlook

Clearly, an unambiguously robust, reproducible and predictive understanding of the link between scholarly research and management practitioners' theories, understanding and findings on organizational ambidexterity and their benefit and practical implications on business performance will require further analysis and validation studies in order to improve the translation of theories and concepts on ambidexterity to practice. Here, primary weight and importance was put on the translation between novel concepts and theories and the translation to practice, motivated based on the challenges in start-up ventures, and considering recognition of the importance of translating winning technologies and promising products or platforms to society, such as ultimately patients in the case of biotech and biopharma. This study therefore made the attempt to contribute to this link, by extracting core concepts and associated key success factors from a broad body of literature into a guiding framework for founders, entrepreneurs and managers, primarily in young and growing organizations, in order to support their pursuit of implementation and optimization of organizational capability towards ambidexterity and sustainable, commercial success of the firm. Further studies shall provide additional evidence, validation and guidance towards harnessing the concepts on ambidexterity towards increased rates of success of venture foundation and translation to sustained, commercial market success.

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List of Abbreviations

50Y-HCAC	50-Year Highly Cited Ambidexterity Corpus
KSF	Key Success Factor
LCCC	Literature Core Concept Cluster
LDA	Latent Dirichlet Allocation
LDAT	LDA-Topic
NLP	Natural language processing
RBVF	Resource-based View of the Firm
RFS	Release for Sale
R&D	Research & Development
SME	Small or Medium Enterprise
TMT	Top Management Team
TPP	Target Product Profile

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Annex 1 Supplemental Tables

Supplemental Table S 1. The 50 most highly cited research articles on ambidexterity

Rank	Authors	Journal	Year	Volume	Issue	Cited by
1	Gibson, C.B., Birkinshaw, J.	Acad Manage J	2004	47	2	**2542**
2	Gupta, A.K., Smith, K.G., Shalley, C.E.	Acad Manage J	2006	49	4	**2011**
3	Raisch, S., Birkinshaw, J., Probst, G., Tushman, M.L.	Organ Sci	2009	20	4	**1328**
4	Lubatkin, M.H., Simsek, Z., Ling, Y., Veiga, J.F.	J Manage	2006	32	5	**1324**
5	Andriopoulos, C., Lewis, M.W.	Organ Sci	2009	20	4	**1244**
6	O'Reilly Iii, C.A., Tushman, M.L.	Acad Manage Perspect	2013	27	4	**1159**
7	Adler, P.S., Goldoftas, B., Levine, D.I.	Organ Sci	1999	10	1	**978**
8	Cao, Q., Gedajlovic, E., Zhang, H.	Organ Sci	2009	20	4	**860**
9	Helfat, C.E., Winter, S.G.	Strategic Manage J	2011	32	11	**711**
10	Jansen, J.J.P., Tempelaar, M.P., van den Bosch, F.A.J., Volb	Organ Sci	2009	20	4	**648**
11	Rothaermel, F.T., Alexandre, M.T.	Organ Sci	2009	20	4	**593**
12	Rosing, K., Frese, M., Bausch, A.	Leadership Quart	2011	22	5	**578**
13	Junni, P., Sarala, R.M., Taras, V., Tarba, S.Y.	Academy of Manage Pe	2013	27	4	**526**
14	Simsek, Z.	Journal Manage Stud	2009	46	4	**497**
15	Eisenhardt, K.M., Furr, N.R., Bingham, C.B.	Organ Sci	2010	21	6	**473**
16	Tiwana, A.	Strategic Manage J	2008	29	3	**442**
17	Mom, T.J.M., van den Bosch, F.A.J., Volberda, H.W.	Organ Sci	2009	20	4	**440**
18	Beckman, C.M.	Acad Manage J	2006	49	4	**424**
19	Simsek, Z., Heavey, C., Veiga, J.F., Souder, D.	Journal Manage Stud	2009	46	5	**411**
20	Pavlou, P.A., Sawy, O.A.E.	Inform Syst Res	2010	21	3	**404**
21	Birkinshaw, J., Gupta, K.	Academy of Manage Pe	2013	27	4	**395**
22	Rapp, A., Beitelspacher, L.S., Grewal, D., Hughes, D.E.	J Acad Market Sci	2013	41	5	**372**
23	Jansen, J.J.P., George, G., Van Den Bosch, F.A.J., Volberda,	Journal Manage Stud	2008	45	5	**370**
24	O'Reilly III, C.A., Tushman, M.L.	Calif Manage Rev	2011	53	4	**352**
25	Im, G., Rai, A.	Manage Science	2008	54	7	**339**
26	Kristal, M.M., Huang, X., Roth, A.V.	J Oper Manag	2010	28	5	**322**
27	Turner, N., Swart, J., Maylor, H.	Int J Manag Rev	2013	15	3	**315**
28	Lin, Z., Yang, H., Demirkan, I.	Manage Science	2007	53	10	**312**
29	Patel, P.C., Messersmith, J.G., Lepak, D.P.	Acad of Manage J	2013	56	5	**310**
30	Hoang, H., Rothaermel, F.T.	Strategic Manage J	2010	31	7	**307**
31	Sidhu, J.S., Commandeur, H.R., Volberda, H.W.	Organ Sci	2007	18	1	**288**
32	Stettner, U., Lavie, D.	Strategic Manage J	2014	35	13	**285**
33	Schreyögg, G., Sydow, J.	Organ Sci	2010	21	6	**282**
34	Luo, Y., Rui, H.	Academy of Manage Pe	2009	23	4	**282**
35	Gulati, R., Puranam, P.	Organ Sci	2009	20	2	**278**
36	Webb, J.W., Kistruck, G.M., Ireland, R.D., Ketchen, D.J.	Entrepreneurship Theor	2010	34	3	**276**
37	Ambos, T.C., Mäkelä, K., Birkinshaw, J., D'Este, P.	J Manage Stud	2008	45	8	**274**
38	Taylor, A., Helfat, C.E.	Organ Sci	2009	20	4	**271**
39	Voss, G.B., Voss, Z.G.	Organ Sci	2013	24	5	**251**
40	O'Connor, G.C., DeMartino, R.	J Prod Innovat Manag	2006	23	6	**250**
41	Tarafdar, M., Gordon, S.R.	J Strategic Inf Syst	2007	16	4	**232**
42	Lee, O.-K., Sambamurthy, V., Lim, K.H., Wei, K.K.	Inform Syst Res	2015	26	2	**229**
43	Bresciani, S., Ferraris, A., Del Giudice, M.	Technol Forecast Soc	2018	136		**228**
44	Vorhies, D.W., Orr, L.M., Bush, V.D.	J Acad Market Sci	2011	39	5	**225**
45	Markides, C.C.	Academy of Manage Pe	2013	27	4	**223**
46	Jansen, J.J.P., Simsek, Z., Cao, Q.	Strategic Manage J	2012	33	11	**222**
47	Vrontis, D., Thrassou, A., Santoro, G., Papa, A.	J Technol Transfer	2017	42	2	**217**
48	Andriopoulos, C., Lewis, M.W.	Long Range Plann	2010	43	1	**216**
49	Nemanich, L.A., Vera, D.	Leadership Quart	2009	20	1	**211**
50	Lin, H.-E., McDonough III, E.F., Lin, S.-J., Lin, C.Y.-Y.	J Prod Innovat Manag	2013	30	2	**208**

Supplemental Table S 2. The 25 most highly cited review articles on ambidexterity

Rank	Authors	Journal	Year	Vol.	Issue	Cited by
1	He Z.-L., Wong P.-K.	Organ Sci	2004	15	4	**2324**
2	Raisch S., Birkinshaw J.	J Manag	2008	34	3	**1527**
3	O'Reilly III C.A., Tushman M.L.	Res Organ Behav	2008	28		**1263**
4	Birkinshaw J., Gibson C.	MIT Sloan ManagReview	2004	45	4	**518**
5	Parker S.K.	Annu Rev Psychol	2014	65		**328**
6	Luo Y., Tung R.L.	J Int Bus Stud	2018	49	2	**274**
7	Parmigiani A., Howard-Grenville J.	Acad Manag Ann	2011	5	1	**257**
8	Boumgarden P., Nickerson J., Zenger T.R.	Strat Manag J	2012	33	6	**224**
9	Yu T., Patterson P.G., de Ruyter K.	J Serv Res	2013	16	1	**86**
10	Bui T.-D., Tsai F.M. et al.	Sust Prod and Consumpt	2021	26		**71**
11	Wan X., Cenamor J., Parker G., Van Alstyne M.	Sustainability	2017	9	5	**52**
12	Lin H.-E., McDonough E.F., III	J Prod Innovat Manag	2014	31	S1	**49**
13	Melewar T.C., Nguyen B.	J Brand Manag	2015	21	9	**36**
14	Poutanen P., Soliman W., Ståhle P.	Eur J Innovat Manag	2016	19	2	**32**
15	Steiber A., Alänge S.	Total Qual Manag Bus Excel	2013	24		**32**
16	Mueller J., Renzl B., Will M.G.	Rev Manag Science	2020	14	1	**22**
17	Konlechner S., Müller B., Güttel W.H.	Int J Tech Manag	2018	76		**22**
18	Pertusa-Ortega E.M., Molina-Azorín J.F. et al.	BRQ Bus Res Quarterly	2020	24	4	**21**
19	Chen M.-H., Wang H.-Y., Wang M.-C.	Knowl Manag Res Pract	2018	16	1	**21**
20	Petro Y., Ojiako U., Williams T., Marshall A.	J Manag Eng	2019	35	3	**16**
21	Parikh M.	Manag Decis	2016	54	5	**16**
22	Mishra A.N., Pani A.K.	VINE J Inform Knowl Manag Sys	2020	51	3	**13**
23	Lièvre P.	Rev Francaise de Gestion	2016	257	4	**13**
24	Liu H., Luo J.-H., Huang J.X.-F.	Asian J Bus Manag	2011	10	4	**12**
25	Eriksson Y., Fundin A.	J Organ Change Manag	2018	31	3	**11**
26	Tushman, M.L.	J Bus Strat	1997	18		-

** Tushman, 1997 not retrieved from Scopus, but included given its relevance as pioneering review article on the topic.*

Supplemental Table S 3. The 35 most similar publications by similarity network association (Source: Connected Papers)

Rank	Authors	Journal	Year	Cited by*	Similarity Score	OVERLAP
1	M. Tushman, C. O'Reilly	Calif Manage Rev	1996	4242	100,0	Seed
2	C. Gibson, J. Birkinshaw	Acad Manage J	2004	2860	43,8	Articles
3	Zi-Lin He, P. Wong	Organ Sci	2004	3309	41,6	Reviews
4	Sebastian Raisch, J. Birkinshaw	J Manage	2008	2271	40,0	Reviews
5	Sebastian Raisch, J. Birkinshaw, G. Probst, M. Tushman	Organ Sci	2009	2008	34,6	Articles
6	M. Lubatkin, Zeki Simsek, Yan Ling, J. F. Veiga	J Manage	2006	1812	34,2	Articles
7	C. O'Reilly, M. Tushman	Res Organ Behav	2007	2061	31,7	New
8	C. O'Reilly, M. Tushman	Harvard Bus Rev	2004	2200	31,5	New
9	C. O'Reilly, M. Tushman	Acad Manage Perspect	2013	1607	28,4	Articles
10	Q. Cao, Eric Gedajlovic, Hongping Zhang	Organ Sci	2009	1158	26,6	Articles
11	C. Andriopoulos, Marianne W. Lewis	Organ Sci	2009	1668	26,2	Articles
12	Dovev Lavie, Uriel Stettner, M. Tushman	Acad Manag Ann	2010	1304	25,6	New
13	Zeki Simsek	J Manage Stud	2009	740	25,4	Articles
14	Justin J. P. Jansen, Michiel P. Tempelaar, F. Bosch, H. Volberda	Organ Sci	2009	903	25,0	Articles
15	March, JG	Organ Sci	1991	8703	24,0	New
16	Tom J. M. Mom, F. V. D. Bosch, H. Volberda	Organ Sci	2009	630	22,4	Articles
17	J. Uotila, Markku V. J. Maula, T. Keil, S. Zahra	South Med J	2009	779	21,4	New
18	Tom J. M. Mom, Frans A. J. Van Den Bosch, H. Volberda	J Manage Stud	2006	618	21,2	New
19	Justin J. P. Jansen, G. George, Frans A. J. Van Den Bosch, H. Volberda	J Manage Stud	2008	530	20,5	Articles
20	Paulina Junni, R. Sarala, V. Taras, S. Tarba	Acad Manage Perspect	2013	674	19,7	Articles
21	C. O'Reilly, M. Tushman	Calif Manage Rev	2011	559	19,5	Articles
22	F. García-Lillo, M. Úbeda-García, B. Marco-Lajara	Scientometrics	2016	24	19,1	New
23	N. Turner, J. Swart, H. Maylor	Int J Manag Rev	2013	417	18,8	Articles
24	Susan A. Hill, J. Birkinshaw	J Manage	2014	272	18,6	New
25	Nina Gusenleitner	Junior Management Science	2016	3	18,3	New
26	Wolfgang H. Güttel, Stefan Konlechner	Schmalenbach Business Review	2009	122	18,2	New
27	C. Gibson, J. Birkinshaw, T. Williams, Jim W. O'toole	USC Marshall CEO	2002	8	17,7	New
28	C. Andriopoulos, Marianne W. Lewis	Long Range Plann	2010	308	17,7	Articles
29	A. Nosella, Silvia Cantarello, R. Filippini	Strateg Organ	2012	158	17,7	New
30	Sabyasachi Sinha	Vikalpa: J Decision Makers	2015	21	17,7	New
31	Silvia Cantarello, A. Martini, A. Nosella	Entrepreneurship	2012	84	17,6	New
32	M. Hughes	J Marketing Manage	2018	49	17,4	New
33	A. Carmeli, Meyrav Yitzack Halevi	Leadership Quart	2009	311	17,2	New
34	K. Eisenhardt, Nathan R. Furr, Christopher B. Bingham	Organ Sci	2010	630	17,2	Articles
35	Zhiang Lin, Haibin Yang, Irem Demirkan	Manage Sci	2007	451	16,9	Articles

* Connected Papers citation counts derived from Semantic Scholar Paper Corpus

Supplemental Table S 4. Systematic Literature Review, Core Concept Cluster (LCCC) Extraction & Annotation

Full table listing results from the literature review on the systematically Scopus-derived, citation-ranked and network proximity-expanded literature body comprising about 100 PDF documents, the "50-Year Highly Cited Ambidexterity Corpus (50Y-HCAC)". LCCC = Literature Core Concept Cluster.

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 5. Foster & Harness Dynamic Capabilities	Mid - Late Series A-B+	1.) Need for Ambidextrous Organization. 2.) Test ambidexterity hypothesis on firm performance. 3.) Approach to technological innovation. 4.) Balanced interaction of explorative & exploitative innovation strategies has positive effect on sales growth in manufacturing firms.	1.) Balance between exploration and exploitation. 2.) Interaction between explorative and exploitative innovation strategies positively related to Sales Growth Rate 3.) Imbalance between explorative and exploitative innovation strategies negatively relates to Sales Growth Rate.	He Z.-L., Wong P.-K.	2004	Organization Science	2324	1	Top 25 Review
1. Organizational Ambidexterity Strategy 5. Foster & Harness Dynamic Capabilities 10. Environmental Risk & Change Management	Mid - Late Series A-B+	Organizational Ambidexterity as determinant of organizational capability to respond to and adapt to changing requirements in business demands.	Adaptability to changes in environment.	Raisch S., Birkinshaw J.	2008	Journal of Management	1527	2	Top 25 Review
1. Organizational Ambidexterity Strategy 5. Foster & Harness Dynamic Capabilities 10. Environmental Risk & Change Management	Mid - Late Series A-B+	1.) Inertia leads to failure 2.) Strategy needs to focus on Dynamic Capabilities -> firm's ability to reconfigure assets and existing capabilities -> explains long-term competitive advantage 3.) Organizational Design towards Ambidexterity Ambidexterity = Dynamic Capability	1.) Dynamic Capabilities - adaptability to shifting environmental contexts 2.) Ambidexterity - simultaneous exploitation & exploration - adapt over time	O'Reilly III C.A., Tushman M.L.	2008	Research in Organizational Behavior	1263	3	Top 25 Review
1. Organizational Ambidexterity Strategyy 2. Ambidextrous Management & Leadership 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 5. Foster & Harness Dynamic Capabilities	Mid - Late Series A-B+	1.) Importance of adaptability. Successful companies are nimble, innovative and proactive, but also exploit value of their proprietary assets, "alignment" capability", the sense of how value is created and how activities should be coordinated and focused in order to deliver on that value, i.e. adaptability and alignment = ambidexterity. 2.) Ambidexterity correlates with performance. 3.) 2 Forms of Ambidexterity complementary: a) Structural Ambidexterity b) Contextual Ambidexterity 4.) Path to Ambidexterity - 5 Key Concepts a) Diagnose Organizational Context b) Focus on Few Levers & Employ them c) Build understanding at all levels d) Contextual ambidexterity initiatives as "driving leadership", not as being "leadership-driven"	1.) Business Unit Performance. ambidexterity correlation with performance. 2.) Organizational Context (comprising performance management and social support) is correlated with ambidexterity. 3.) Organizational Context is correlated with performance. 4.) When ambidexterity and organizational context jointly are analyzed as predictors of performance, only ambidexterity has a significant fluence. 5.) Full mediation, i.e., influence of organizational context on performance only occurs through the creation of ambidexterity. -> High Performance Context	Birkinshaw J., Gibson C.	2004	MIT Sloan Management Review	518	4	Top 25 Review

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 12. HR, Team Management, Diversity & Culture	Early - Late Seed-Series B+	1.) Motivational work design as powerful vehicle for learning and development. 2.) Enhancing employee's health. 3.) Simultaneous control and flexibility, e.g., ambidexterity.	Employee health and motivation.	Parker S.K.	2014	Annual Review of Psychology	328	5	Top 25 Review
1. Organizational Ambidexterity Strategy 14. Uncertainty, External Competition & Vulnerability 10. Environmental Risk & Change Management	Late Series B+	1,) Springboard Theory (Luo and Tung, 2007) Amalgamation, ambidexterity and adaptability (AAA) as unique advantage to springboard firms. 2.) Beyond exploitation and exploration, the authors highlight co-competence (unique skills in utilizing transactional competence and relational competence together), co-evolution (perform both local compliance and local influence simultaneously in host country), co-opetition (superiority in balancing or harmonizing competition & cooperation with other business players) & co-orientation (firm's ability to concurrently pursue short-term survival and evolving competitiveness when competing overseas) as important for EMNEs, as advantages for expansion, balancing short-term gains & long-term competitiveness.	1.) Springboard as strategic means by which firms capture values of ambidexterity, acquiring global resources and augmenting global competitiveness further. 2.) Ambidexterity contributes to long-term success. The ability to expand and successfully adapt locally in short-term to foster long-term expansion. 3.) Reduction of vulnerability and increase of sustained competitiveness.	Luo Y., Tung R.L.	2018	Journal of International Business Studies	274	6	Top 25 Review
1. Organizational Ambidexterity Strategy 5. Foster & Harness Dynamic Capabilities	Mid - Late Series A-B+	1.) Organizational routines are repetitive patterns of interdependent organizational actions. Two perspective lenses on organiz. routines: a) Capabilities - Organizational Economics -> Emphasis on "What" and "Why" b) Practice: Organization Theory -> "How"? 2,) Empirical literature review and summary of common themes; ambidexterity included in the comparison of both perspectives. Both perspectives are found complementary for holistic understanding of Organizational Routines, also "Dynamic Capabilities" and "Routine Dynamics".	Importance to view organizational routines through the lenses of capabilities and practice, based on organizational economic and organization theory, respectively. Also referred to as "Dynamic Capabilities" and "Routine Dynamics", both are complementary towards the understanding of organizational routines as repetitive patterns of interdependent organizational actions.	Parmigiani A., Howard-Grenville J.	2011	Academy of Management Annals	257	7	Top 25 Review
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership	Late Series B+	1.) Sustainable performance requires ambidexterity, i.e., simult. explore & exploit. 2.) Review of two approaches, a) organizational ambidexterity and b) organizational vacillation. 3.) For comparability, both approaches are mapped to common performance landscape, to answer which delivers the more long-term performance. Analysis of literature on both areas, patterns of decision making, and long-term performance concludes that both are complementary, through different mechanisms.	Consider Ambidexterity in combination with Vacillation, since both are complementary. While vacillation may lead to ambidexterity, too frequent or too small or large scale of change are not desirable. Vacillation may serve to move a low-performance ambidexterity to high-performance ambidexterity state.	Boumgarden P., Nickerson J., Zenger T.R.	2012	Strategic Management Journal	224	8	Top 25 Review

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
2. Ambidextrous Management & Leadership	Late Series B+	1.) Challenge in customer service between quality service vs. productivity, i.e. the need for service-sales ambidexterity 2.) Significant relationship between ambidexterity and financial performance in bank sector	Empowerment and transformational leadership positively associate with service-sales ambidexterity.	Yu T., Patterson P.G., de Ruyter K.	2013	Journal of Service Research	86	9	Top 25 Review
7. Business Model, Commercial Operations & Performance 11. Product, Supply Chain, Marketing & Sales	Late Series B+	1.) Sustainable supply chains prioritize efficiency and economies of scale and are vulnerable to disruptive events 2.) Supply chain agility, coordination, finance, flexibility, resilience, and sustainability are important indicators towards balancing sustainability and disruption of supply chains.	Organizational ambidexterity supports supply chain sustainability beyond disruptive events.	Bui T.-D., Tsai F.M., Tseng M.-L., Tan R.R., Yu K.D.S., Lim M.K.	2021	Sustainable Production and Consumption	71	10	Top 25 Review
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 7. Business Model, Commercial Operations & Performance 11. Product, Supply Chain, Marketing & Sales	Mid - Late Series A-B+	1.) Platform strategies are increasingly relevant for sustainable business models in the digital era. 2.) Organizational ambidexterity is conducive to firm sustainability. 3.) Platform strategies can help platform owners achieve ambidexterity by domain, temporal, and organizational separation.	Use platform strategies to achieve ambidexterity.	Wan X., Cenamor J., Parker G., Van Alstyne M.	2017	Sustainability (Switzerland)	52	11	Top 25 Review
8. Cognitive Frames, Organizational Learning & Knowledge Sharing 7. Business Model, Commercial Operations & Performance	Mid - Late Series A-B+	1.) Empirical validation of the notion that ambidextrous cognitive frames plan important role in generating innovation ambidexterity. 2.) Ambidextrous cognitive frames, combining independent and reflective cognitive styles, foster innovation ambidexterity.	Manage tension from exploiting and exploring by supporting towards ambidextrous cognitive frames.	Lin H.-E., McDonough E.F., III	2014	Journal of Product Innovation Management	49	12	Top 25 Review
1. Organizational Ambidexterity Strategy 11. Product, Supply Chain, Marketing & Sales	Late Series B+	1) Brand ambidexterity as ability to pursue two contrasting strategic directions simultaneously 2.) Focusing on higher education sector in management of competing resources towards ambidexterity in linking brand reputation and performance.	Ambidexterity to improve brand reputation and performance in higher education and non-profit sector.	Melewar T.C., Nguyen B.	2015	Journal of Brand Management	36	13	Top 25 Review
4. R&D, Innovation, Product & Technology Development Cycle	Early - Late Seed-Series B+	Literature review on complexity theory (CT) in innovation research and management identifies ambidexterity as a key concept for practice.	Embrace complexity, ambidexterity and failure in innovation research and management.	Poutanen P., Soliman W., Ståhle P.	2016	European Journal of Innovation Management	32	14	Top 25 Review
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 13. Lead by Mission, Vision & Core Values	Late Series B+	1.) TQM focus on efficiency, effectiveness, & continuous improvement, may hinder innovation. 2.) Organizational Characteristics for Continuous Innovation (OCCI) in comparison to TQM is more related to ambidexterity	Change TQM concept to contribute to continuous improvements and innovation, beyond quality.	Steiber A., Alänge S.	2013	Total Quality Management and Business Excellence	32	15	Top 25 Review

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
2. Ambidextrous Management & Leadership	Mid - Late Series A-B+	1.) Development of static and dynamic multi-level models in mgmt & sociological research. 2.) Multi-level characteristics of the concept of ambidextrous leadership 3.) Macro-to-Micro-Link as Implementation of Ambidextrous Leadership 4.) New agenda for systematizing leadership research, considering org. micro- / macro levels.	Achieve ambidexterity to sustain competitive advantage and improved corporate outcome.	Mueller J., Renzl B., Will M.G.	2020	Review of Managerial Science	22	16	Top 25 Review
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 3. Manage & Balance Internal Competition & Resources 5. Foster & Harness Dynamic Capabilities 9. Diversification, Cross-Boundary, Alliances, M&A	Mid - Late Series A-B+	1.) Dynamic capabilities support technological innovation and change. 2.) Role of ambidexterity, absorptive capacity, & technology management for dynamic capability-driven adaptation to technological change 3.) Comprehensive framework with integrative perspective on how dynamic capabilities support the management of technological change, such as digital transformation.	Dynamic capabilities in ambidexterity, absorptive capacity and technology management facilitate technological change through strategic managerial decision-making, resource-configuration and continuous learning.	Konlechner S., Müller B., Güttel W.H.	2018	International Journal of Technology Management	22	17	Top 25 Review
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 12. HR, Team Management, Diversity & Culture 3. Manage & Balance Internal Competition & Resources 6. Team, Network & Organizational Integration Mechanisms	Mid - Late Series A-B+	Multilevel framework of individual ambidexterity relationships, i.e. managers and employees, including antecedents such as organizational and individual characteristics and the consequences, such as organizational ambidexterity, individual and firm performance.	Analyze ambidexterity also at individual level, antecedents and consequences, to explain the micro-foundations and achieve organizational ambidexterity.	Pertusa-Ortega E.M., Molina-Azorín J.F., Tarí J.J., Pereira-Moliner J., López-Gamero M.D.	2020	BRQ Business Research Quarterly	21	18	Top 25 Review
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 9. Diversification, Cross-Boundary, Alliances, M&A	Mid - Late Series A-B+	1.) Knowledge sharing and social capital as antecedents and parameters of innovation strategy, its effects on financial performance and customer satisfaction. 2.) Evidence if hybrid strategy/ ambidexterity, enhances complementarity by balancing contradictions in knowledge acquisition.	Ambidexterity helps balancing contradictions between internal and external knowledge acquisition during innovation strategy in technology firms.	Chen M.-H., Wang H.-Y., Wang M.-C.	2018	Knowledge Management Research and Practice	21	19	Top 25 Review
2. Ambidextrous Management & Leadership 6. Team, Network & Organizational Integration Mechanisms	Early - Late Seed-Series B+	1.) Taxonomical analysis of elements and components of the concept of organizational ambidexterity towards understanding of project-focused understanding 2.) Platform for more holistic understanding of organizational ambidexterity applicable to project management.	Project-focused notion of organizational ambidexterity involves different levels (strategic, projects, organization, individual), dimensions (knowledge, behavior, technology, process), and mechanisms (structural, learning, selection, communication).	Petro Y., Ojiako U., Williams T., Marshall A.	2019	Journal of Management in Engineering	16	20	Top 25 Review
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership	Mid - Late Series A-B+	1.) Comparison of the concepts of adhocracy and ambidexterity as regards focus on innovation and flexibility. 2.) Ambidexterity more comprehensive concept including crux of adhocracy but offering wider range of approaches & methods for balancing contradictory goals.	Adopt ambidexterity, in place of adhocracy, towards organizational effectiveness.	Parikh M.	2016	Management Decision	16	21	Top 25 Review

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
4. R&D, Innovation, Product & Technology Development Cycle 9. Diversification, Cross-Boundary, Alliances, M&A 15. Information Systems & Information Technology	Early - Mid Seed, Series A	1.) Model of knowledge management, innovation and performance at product and process level. 2.) Technology transformation roadmap, through linking learning and ambidexterity for exploration and exploitation of AI & value for organization.	Link ambidexterity and learning to harness the usefulness of AI in organizational learning and competency development for new technology.	Mishra A.N., Pani A.K.	2020	VINE Journal of Information and Knowledge Management Systems	13	22	Top 25 Review
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 14. Uncertainty, External Competition & Vulnerability 10. Environmental Risk & Change Management	Mid Series A	1.) In a knowledge-based innovation economy, managers exposed to extreme situations that occur in evolutionary, uncertain, risky environment. 2.) Experience from polar expeditions as extreme examples distilled into guiding principles for managers to cope with such situations.	Results highlight three of focus for managers and research: sensemaking within collectives, organizational ambidexterity and expansion devices knowledge.	Lièvre P.	2016	Revue Francaise de Gestion	13	23	Top 25 Review
14. Uncertainty, External Competition & Vulnerability 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 11. Product, Supply Chain, Marketing & Sales	Mid - Late Series A-B+	1.) both explorative and exploitative learning have inverted U-shape relationships with firm performance 2.) new product development (NPD) works as a key mediator between explorative learning and firm performance 3.) relationships between the two types of learning and firm performance are differently moderated by external environmental uncertainty	1.) Explorative and exploitative learning complement each other- 2.) New Product Development (NPD) mediates exploration into firm performance.	Liu H., Luo J.-H., Huang J.X.-F.	2011	Asian Business and Management	12	24	Top 25 Review
2. Ambidextrous Management & Leadership 10. Environmental Risk & Change Management 13. Lead by Mission, Vision & Core Values	Mid - Late Series A-B+	1.) Strategic changes in an organization are challenging not only because of the change as such but with regards to how the vision of the future is interpreted by the organization. 2.) Model proposing how a dynamic episodic change process can be managed by visual management, pitfalls avoided, and what ambidextrous capabilities are needed.	Use visual management to strategically manage change in combination with ambidexterity theoretic principles.	Eriksson Y., Fundin A.	2018	Journal of Organizational Change Management	11	25	Top 25 Review
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 12. HR, Team Management, Diversity & Culture 3. Manage & Balance Internal Competition & Resources 5. Foster & Harness Dynamic Capabilities	Mid - Late Series A-B+	1.) Contextual ambidexterity defined as capacity to simultaneously achieve alignment and adaptability at business-unit level 2.) Context combining stretch, discipline, support and trust facilitates contextual ambidexterity 3.) Ambidexterity mediates contextual features and performance	1.) Ability to simultaneously combine stretch, discipline, support, and trust between business units. 2.) Business Unit Performance	Gibson, C.B., Birkinshaw, J.	2004	Acad Manage J	2542	1	Top 50 Article
1. Organizational Ambidexterity Strategy 3. Manage & Balance Internal Competition & Resources	Late Series B+	1.) Scarcity of resources level required for exploration and exploitation makes them mutually exclusive 2.) Exploration and exploitation are mutually exclusive within a single domain (e.g. individual) 3.) Across different or loosely coupled domains, exploration and exploitation are orthogonal, allowing coexistence	1.) Resource allocation and balancing 2.) Long Run Performance	Gupta, A.K., Smith, K.G., Shalley, C.E.	2006	Acad Manage J	2011	2	Top 50 Article

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1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 3. Manage & Balance Internal Competition & Resources 6. Team, Network & Organizational Integration Mechanisms	Early - Late Seed-Series B+	Four central tensions around ambidexterity: 1.) Ambidexterity through differentiation or integration? 2.) Ambidexterity at individual or organiz. level? 3.) Static or dynamic perspective on ambidexterity? 4.) Can ambidexterity arise internally, or need to externalize?	1.) Active management of the tensions between differentiation and integration 2.) Foster and implement ambidexterity at individual and organizational level 3.) Simultaneous & subsequent attention to exploitation/exploration in dynamic process 4.) Ability to integrate internal and external knowledge bases for synergistic benefits.	Raisch, S., Birkinshaw, J., Probst, G., Tushman, M.L.	2009	Organ Sci	1328	3	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 12. HR, Team Management, Diversity & Culture 6. Team, Network & Organizational Integration Mechanisms	Early - Mid Seed, Series A	1.) Top Mgmt team (for the lack of middle management layer in SMEs) has pivotal role in driving behavioral integration within itself to then 2.) be facilitating ambidexterity orientation in the SME beyond disparities, thereby 3.) achieving higher levels of relative subsequent performance	1.) Achieving behavioral integration as core driver of ambidexterity. 2.) Degree of ambidextrous orientation 3.) Relative firm (SME) performance.	Lubatkin, M.H., Simsek, Z., Ling, Y., Veiga, J.F.	2006	J Manage	1324	4	Top 50 Article
2. Ambidextrous Management & Leadership 6. Team, Network & Organizational Integration Mechanisms 5. Foster & Harness Dynamic Capabilities 13. Lead by Mission, Vision & Core Values	Mid - Late Series A-B+	1.) Pursuit to ambidexterity raises tensions 2.) Framework for examining exploitation-exploration tensions Paradoxes are identified as aggregate dimensions as: a) strategic intent: profit-breakthroughs b) customer orientation: tight-loose coupling c) personal drivers: discipline-passion	1.) Integration and differentiation tactics to manage paradoxes/tensions 2.) Management approaches to tackle paradoxes as shared responsibility across organizational levels, beyond the TMT	Andriopoulos, C., Lewis, M.W.	2009	Organ Sci	1244	5	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 5. Foster & Harness Dynamic Capabilities	Early - Late Seed-Series B+	1.) In uncertain environments, organizational ambidexterity appears positively associated with increased firm innovation, better financial performance, and higher survival rates 2.) Sequential, structural, contextual approaches to ambidexterity.	1.) Choose implementation of ambidexterity in agreement with firm's strategy and environmental conditions 2.) Foster and harness Dynamic capabilities.	O'Reilly Iii, C.A., Tushman, M.L.	2013	Acad Manage Perspect	1159	6	Top 50 Article
2. Ambidextrous Management & Leadership 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 3. Manage & Balance Internal Competition & Resources	Late Series B+	1.) Toyota production system manages paradox of efficiency (exploitation) and flexibility (exploration) 2.) Four organizational mechanisms: meta routines - partitioning - switching - ambidexterity 3) Contextual reinforcement of training and trust	Contextual reinforcement of training and trust in structures, procedures, and rules.	Adler, P.S., Goldoftas, B., Levine, D.I.	1999	Organ Sci	978	7	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 3. Manage & Balance Internal Competition & Resources	Early - Mid Seed, Series A	1.) Balance dimension of ambidexterity (BD), maintaining close relative balance between exploration and exploitation and has more beneficial effect on resource-constrained firms. 2.) Combined dimension of ambidexterity (CD), represents combined magnitude of exploration and exploitation and is more beneficial to firms with sufficient access to resources	Concurrent high levels of BD and CD yield synergistic effects on performance. Management focus on trade-offs (BD) in times of resource constraints. Management focus on simultaneous ambidexterity (CD), when resources are not limiting.	Cao, Q., Gedajlovic, E., Zhang, H.	2009	Organ Sci	860	8	Top 50 Article

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5. Foster & Harness Dynamic Capabilities 9. Diversification, Cross-Boundary, Alliances, M&A	Mid - Late Series A-B+	1.) Operational capability enables firm to perform ongoing activities 2.) A dynamic capability enables altering the mode of profit-making, e.g. through acquisition, alliances, new product development 3.) Line between dynamic and operational capabilities is blurry 4.) Non-radical vs. radical change, new vs. existing business 5.) Capabilities promote economically important gradual change	Dynamic capabilities assume prime importance in changing world.	Helfat, C.E., Winter, S.G.	2011	Strategic Manage J	711	9	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 6. Team, Network & Organizational Integration Mechanisms	Mid - Late Series A-B+	1.) Senior team integration mechanisms (contingency rewards, social integration) 2.) Organizational integration mechanisms (cross-functional interfaces, connectedness 3.) Direct effect of structural differentiation on ambidexterity through informal senior team and formal organizational integration mechanisms.	Integration mechanisms mediate to support effective ambidexterity.	Jansen, J.J.P., Tempelaar, M.P., van den Bosch, F.A.J., Volberda, H.W.	2009	Organ Sci	648	10	Top 50 Article
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 5. Foster & Harness Dynamic Capabilities	Mid - Late Series A-B+	Four possible combinations of exploration and exploitation: 1.) Curvilinear relationship between tech sourcing mix and performance 2.) Firm absorptive capacity exerts positive moderating effect 3.) Relationship between tech sourcing mix and performance is inverted U-shape 4.) Higher levels of absorptive capacity allow better benefits capture from ambidexterity in tech sourcing	Absorptive capacity allows benefits capture resulting from ambidexterity in tech sourcing.	Rothaermel, F.T., Alexandre, M.T.	2009	Organ Sci	593	11	Top 50 Article
2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle	Early - Late Seed-Series B+	Ambidexterity theory of leadership for innovation that specifies two complementary sets of leadership behavior that foster exploration and exploitation in individuals and teams.	Ambidextrous Leadership for effectively dealing with changing requirements of innovation process.	Rosing, K., Frese, M., Bausch, A.	2011	Leadership Quart	578	12	Top 50 Article
2. Ambidextrous Management & Leadership 7. Business Model, Commercial Operations & Performance	Late Series B+	1.) Positive, significant organizational ambidexterity-performance relationships are moderated by context. factors & methodological choices 2.) Organizational ambidexterity important for performance in non-manufacturing industries 3.) Performance effects are stronger when "combined" measures of organizational ambidexterity and perceptual performance are used and when cross-sectional or multimethod research design is applied.	Focus on contextual factors and methodological choices in assessment of ambidexterity-performance relationship.	Junni, P., Sarala, R.M., Taras, V., Tarba, S.Y.	2013	Academy of Manage Perspect	526	13	Top 50 Article

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1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 7. Business Model, Commercial Operations & Performance 9. Diversification, Cross-Boundary, Alliances, M&A	Mid - Late Series A-B+	1.) Input-Process-Output view on organizational ambidexterity, considering antecedents, components, and consequences of ambidexterity. 2.) Multi-level model of organizational ambidexterity, incl. organization, interfirm and environment levels impacting on organizational ambidexterity and performance.	1.) Diversity and centrality is positively related to organizational ambidexterity. 2.) Dual structural architecture & management behavioral context strengthens diversity and centrality and org. ambidexterity. 3) At environment level, dynamism and complexity impact on org. ambidexterity and performance.	Simsek, Z.	2009	Journal Manage Stud	497	14	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 10. Environmental Risk & Change Management 5. Foster & Harness Dynamic Capabilities	Late Series B+	1.) Clarification of micro-foundations of performance in dynamic environments. 2.) Micro-foundational link from organization, strategy, and dynamic capabilities to performance on how leaders manage tension between efficiency & flexibility 3.) Organizations often drift towards efficiency 4.) Environmental dynamism is a multidimensional construct with dimensions that uniquely influence importance and ease of balancing efficiency and flexibility 5.) Executives balance efficiency & flexibility through cognitively sophisticated, single solutions rather simply holding contradictions.	Unbalance to favor flexibility. Lead and effectively balance efficiency and flexibility via heuristics-based simple rules strategies and expert cognition.	Eisenhardt, K.M., Furr, N.R., Bingham, C.B.	2010	Organ Sci	473	15	Top 50 Article
1. Organizational Ambidexterity Strategy 6. Team, Network & Organizational Integration Mechanisms	Mid - Late Series A-B+	1.) In innovation-seeking alliances, bridging ties span structural holes for innovation but lack integration capacity; strong ties provide integration capacity but lack innovation potential 2.) Strong ties complement bridging ties towards alliance ambidexterity at project level; strong ties help knowledge integration to foster innovation	Combine bridging ties with strong ties in the firm's network to support knowledge integration and alliance ambidexterity for increased performance.	Tiwana, A.	2008	Strategic Manage J	442	16	Top 50 Article
1. Organizational Ambidexterity Strategy 6. Team, Network & Organizational Integration Mechanisms	Mid - Late Series A-B+	Three characteristics of ambidextrous managers and model on effects of coordination mechanisms on managers' ambidexterity: 1.) Managers' decision-making authority positively relates to managers' ambidexterity. 2.) Managers' participation in cross-functional interfaces & connectedness to others positively relates to managers' ambidexterity. 3.) Positive interaction effects between formal structural and personal coordination mechanisms on managers' ambidexterity.	Ensure decision-making authority, interface participation and combinations of formal and personal coordination mechanisms to support managers' ambidexterity.	Mom, T.J.M., van den Bosch, F.A.J., Volberda, H.W.	2009	Organ Sci	440	17	Top 50 Article

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1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership	Early Seed	1.) Founders team composition and their prior company affiliations shapes new firm behaviors. 2.) Founders from same company tend to exploitation as they share understandings. 3.) Founders from different prior companies have unique ideas & contacts; favors exploration. 4.) Founders' teams with both common and diverse prior affiliations have growth advantages. 5.) Founders team composition is an important antecedent of firm ambidexterity.	Mix different prior employment history in founders' team to set a basis for successful ambidexterity.	Beckman, C.M.	2006	Acad Manage J	424	18	Top 50 Article
1. Organizational Ambidexterity Strategy	Early - Late Seed-Series B+	Typology of organizational ambidexterity, delineating four archetypes of ambidexterity by two primary dimensions, structural and temporal: 1. Structural: Independent or Interdependent 2. Temporal: Sequential or Simultaneous Four archetypes resulting: 1) Harmonic = Simultaneous + Independent 2) Partitional = Simultaneous + Interdependent 3) Cyclical = Sequential + Independent 4) Reciprocal = Sequential + Interdependent	Typology types help mapping antecedents, ambidexterity and its outcomes.	Simsek, Z., Heavey, C., Veiga, J.F., Souder, D.	2009	Journal Manage Stud	411	19	Top 50 Article
10. Environmental Risk & Change Management 7. Business Model, Commercial Operations & Performance 5. Foster & Harness Dynamic Capabilities 9. Diversification, Cross-Boundary, Alliances, M&A 15. Information Systems & Information Technology	Mid - Late Series A-B+	1.) IT leverages capability on competitive advantage in new product development (NPD) 2.) IT-leveraging capability drives improvisational capabilities alongside dynamic capabilities, driving performance, operational capabilities and competitive advantage. 3.) Dynamic capabilities primary predictor of competitive advantage in turbulent times 4.) Improvisational capabilities fully dominate in highly turbulent environments.	Improvisational Capabilities as an alternative means for managing highly turbulent environments; besides dynamic capabilities for planned reconfiguration of existing operational capabilities.	Pavlou, P.A., Sawy, O.A.E.	2010	Inform Syst Res	404	20	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 3. Manage & Balance Internal Competition & Resources	Early - Late Seed-Series B+	1.) Growing appeal of organizational ambidexterity is in its versatility; which however carries risk of lack of clarity in meaning and measurement 2.) Perspective on ambidexterity through documented growth and usage in scholarly work; charting evolution of ambidexterity, analyzing diversity in the views. 3.) Ambidexterity research can benefit from greater focus.	Versatility in usage of ambidexterity. Focus, to ensure proper understanding of meaning, usage, and measurement. Ambidexterity is achieved through managerial capability.	Birkinshaw, J., Gupta, K.	2013	Academy of Manage Perspect	395	21	Top 50 Article
7. Business Model, Commercial Operations & Performance 11. Product, Supply Chain, Marketing & Sales	Late Series B+	1.) A contagion effect of social media use across business suppliers, retailers, and customers is proposed. 2.) Effect of supplier social media usage on retailer social media usage and in turn on customer social media usage is moderated by brand reputation and service ambidexterity.	Service ambidexterity interacts with social media usage towards sails and supply performance outcomes.	Rapp, A., Beitelspacher, L.S., Grewal, D., Hughes, D.E.	2013	J Acad Market Sci	372	22	Top 50 Article

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2. Ambidextrous Management & Leadership 3. Manage & Balance Internal Competition & Resources 6. Team, Network & Organizational Integration Mechanisms	Late Series B+	Conceptual model, where senior team shared vision, social integration, and contingency rewards feed into organizational ambidexterity through transformational leadership.	Transformational leadership carries a moderating role in organizational ambidexterity.	Jansen, J.J.P., George, G., Van Den Bosch, F.A.J., Volberda, H.W.	2008	Journal Manage Stud	370	23	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 3. Manage & Balance Internal Competition & Resources 6. Team, Network & Organizational Integration Mechanisms 13. Lead by Mission, Vision & Core Values	Early - Late Seed-Series B+	1.) The authors highlight that only about 10% of companies survive 10 years and that only < 0.1% of US companies survive to age 40. 2.) According to March ambidexterity, combining asset exploitation and exploration of the new, is central to firm survival. 3.) Proposition1: Strategize need f. ambidexterity 4.) Proposition2: Guiding vision and values 5.) Proposition3: Senior team that owns ambidextrous strategy explicitly 6.) Proposition4: Organizational structures, separate, aligned, for exploitative & explorative units with integration for efficient asset leverage. 7.) Proposition 5: Need for leadership and senior team competent in leading by vision and values, and in strategizing and managing ambidexterity.	Leaders need to be successful in managing ambidexterity.	O'Reilly III, C.A., Tushman, M.L.	2011	Calif Manage Rev	352	24	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 7. Business Model, Commercial Operations & Performance 11. Product, Supply Chain, Marketing & Sales	Late Series B+	Proposed theoretical model for impact of ambidexterity on interorganizational relationships, where relationship performance is driven by exploratory knowledge sharing and exploitative knowledge sharing, both of which resulting from organizational design for contextual ambidexterity and IT design for ontological commitment.	Consideration of ambidextrous knowledge sharing as part of the organizational ambidexterity strategy lead to relationship performance gains.	Im, G., Rai, A.	2008	Manage Science	339	25	Top 50 Article
1. Organizational Ambidexterity Strategy 7. Business Model, Commercial Operations & Performance 11. Product, Supply Chain, Marketing & Sales 5. Foster & Harness Dynamic Capabilities	Late Series B+	1.) Conceptual Model on influence of ambidextrous supply chain strategy on combinative competitive capabilities of quality, delivery, flexibility, and cost for improved business performance finds coincidence. 2.) Results contract conventional wisdom that highlights need for tradeoffs between exploration and exploitation. 3.) Results highlight feasibility of ambidexterity in supply chain strategy and management and highlight the role of combinative capabilities.	Combinative capabilities and an ambidextrous strategy can positively influence supply chain management and business performance.	Kristal, M.M., Huang, X., Roth, A.V.	2010	J Oper Manag	322	26	Top 50 Article

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1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 12. HR, Team Management, Diversity & Culture 6. Team, Network & Organizational Integration Mechanisms 5. Foster & Harness Dynamic Capabilities	Early - Late Seed-Series B+	1.) Ambidexterity is of central importance to competitive management of the firm, despite limited understanding of how it is managed. 2.) Ambidexterity theory is inadequate for complexity of practical realities. 3.) Exploring mechanisms for achieving ambidexterity through systematic review yields framework that integrates intellectual capital resources, organizational, social & human capital, across levels of analysis.	Intellectual capital, combining organizational, social, and human capital is fundamental to achieving ambidexterity.	Turner, N., Swart, J., Maylor, H.	2013	Int J Manag Rev	315	27	Top 50 Article
1. Organizational Ambidexterity Strategy 9. Diversification, Cross-Boundary, Alliances, M&A	Mid - Late Series A-B+	1.) Contingencies between ambidexterity hypothesis in alliance formation, benefits large firms. 2.) Focused formation of exploratory or exploitative alliances benefits also smaller firms. 3.) In uncertain environment, ambidextrous formation enhances firm performance, but also a focused formation in a stable environment.	Ambidexterity is beneficial for alliance formation. The firm's network in network relations moderates relationships between alliance choices and firm performance.	Lin, Z., Yang, H., Demirkan, I.	2007	Manage Science	312	28	Top 50 Article
12. HR, Team Management, Diversity & Culture 3. Manage & Balance Internal Competition & Resources 6. Team, Network & Organizational Integration Mechanisms	Early - Mid Seed, Series A	1.) Connections between human resources (HR) and ability to exhibit organizational ambidexterity. 2.) HR practice utilization and ist link to discipline, stretch, trust, and support. 3.) Combination in high-perf. work system (HPWS) allowing ambidexterity alignment.	High-performance work system (HPWS) integrating HR practice with discipline, stretch, trust, and support as systematic tool for achieving ambidexterity alignment.	Patel, P.C., Messersmith, J.G., Lepak, D.P.	2013	Acad of Manage J	310	29	Top 50 Article
2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 9. Diversification, Cross-Boundary, Alliances, M&A	Mid - Late Series A-B+	1.) Alliance exploitation experience has positive effects on R&D project performance, while alliance exploration experience has neg. effects. 2.) Internal exploration competence allows leverage of external exploitation experience. 3.) In contrast, internal exploitation experience combined with external exploration, aggravates negative effect on R&D project performance.	Leveraging alliance exploitation experience and internal exploration competence for improved performance.	Hoang, H., Rothaermel, F.T.	2010	Strategic Manage J	307	30	Top 50 Article
4. R&D, Innovation, Product & Technology Development Cycle 11. Product, Supply Chain, Marketing & Sales	Mid - Late Series A-B+	1.) Value of supply-, demand-side & spatial exploration & exploitation contingent on environment. 2.) Boundary-spanning supply-side search positively associates with innovation in high-dynamic environments, while exploration hurts innovation in less dynamic environments. 3.) Spatial boundary-spanning search fosters innovation in dynamic environments.	Depending on environment, both technology and market are relevant in driving innovation and commercial success in production introductions.	Sidhu, J.S., Commandeur, H.R., Volberda, H.W.	2007	Organ Sci	288	31	Top 50 Article
1. Organizational Ambidexterity Strategy 3. Manage & Balance Internal Competition & Resources 9. Diversification, Cross-Boundary, Alliances, M&A	Late Series B+	1.) During interplay between exploitation and exploration, balancing within internal organization, alliance, and acquisition modes can undermine performance due to conflicting routines, negative transfer, limited specialization. 2.) Balancing across these modes enhances performance more than balance within modes.	1.) Balance across organization, alliance, and acquisition modes to enhance performance. 2.) Explore via external modes such as alliance, while exploiting via internal organization to boost firm performance.	Stettner, U., Lavie, D.	2014	Strategic Manage J	285	32	Top 50 Article

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14. Uncertainty, External Competition & Vulnerability 10. Environmental Risk & Change Management 3. Manage & Balance Internal Competition & Resources 5. Foster & Harness Dynamic Capabilities	Mid - Late Series A-B+	1.) Promoting organizational fluidity may threaten organizing, while organizational flexibility is imperative in increasing volatile environments. 2.) Alternative approach via balancing countervailing processes in organizations with respect to conflicting demands of organizational efficiency and fluidity.	Success through balancing conflicting demands of organizational efficiency and fluidity.	Schreyögg, G., Sydow, J.	2010	Organ Sci	282	33	Top 50 Article
1. Organizational Ambidexterity Strategy 14. Uncertainty, External Competition & Vulnerability 10. Environmental Risk & Change Management 7. Business Model, Commercial Operations & Performance	Late Series B+	1) Ambidexterity concept as multidimensional term comprising co-evolution; co-competence; co-opetition; and co-orientation. 2.) MNEs need ambidexterity to offset late mover disadvantages, and behave co-evolutionarily to deal with external environment	Multinational enterprises (MNEs) use ambidexterity to co-evolve during international growth, including co-evolution, co-competence, co-opetition, and co-orientation principles.	Luo, Y., Rui, H.	2009	Academy of Manage Perspect	282	34	Top 50 Article
1. Organizational Ambidexterity Strategy 6. Team, Network & Organizational Integration Mechanisms 5. Foster & Harness Dynamic Capabilities 15. Information Systems & Information Technology	Mid - Late Series A-B+	1.) Inconsistencies between formal and information organization resulting from reorganization can help create an ambidextrous organization. 2.) Informal can compensate for formal organization by motivating valuable employee behavior and vice versa, resulting in compensatory fit.	Open to informal organization during reorganizations to check for compensatory fit but do not rely on it as it may backfire.	Gulati, R., Puranam, P.	2009	Organ Sci	278	35	Top 50 Article
1. Organizational Ambidexterity Strategy 14. Uncertainty, External Competition & Vulnerability 10. Environmental Risk & Change Management 9. Diversification, Cross-Boundary, Alliances, M&A	Mid - Late Series A-B+	1.) Integration of entrepreneurship, institutional, and network theories in relation to how entrepreneurship process of MNEs is negatively affected in base of pyramid markets. 2.) Partnerships with NGOs can offset negative effects due to NGOs localized knowledge degree, social embeddedness with informal networks, and ambidexterity in dealing with stakeholders, resulting in beneficial partnerships.	Alliances and partnerships with locally connected and experienced NGOs support ambidexterity and sustainable entrepreneurial success.	Webb, J.W., Kistruck, G.M., Ireland, R.D., Ketchen, D.J.	2010	Entrepreneurship Theory and Practice	276	36	Top 50 Article
1. Organizational Ambidexterity Strategy 3. Manage & Balance Internal Competition & Resources 5. Foster & Harness Dynamic Capabilities	Early - Late Seed-Series B+	1.) Tensions between academic and commercially oriented activities make it difficult for research-oriented universities to achieve commercial outcomes. 2.) Hypotheses are developed that link organizational and individual researchers' aspects to likelihood of them generating commercial outcome. 3.) Tension is salient at individual rather than organizational level. Universities manage tensions e.g., through dual structures, while at individual level, tensions are more acute.	Individuals should be focused when aiming at improved exploitation-aspects within ambidexterity in research-focused universities.	Ambos, T.C., Mäkelä, K., Birkinshaw, J., D'Este, P.	2008	J Manage Stud	274	37	Top 50 Article

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1. Organizational Ambidexterity Strategy 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 6. Team, Network & Organizational Integration Mechanisms 5. Foster & Harness Dynamic Capabilities	Late Series B+	1.) Firms often face ambidexterity challenge during technological transitions; here, industry incumbents require linkages between organizational units in exploration & exploitation. 2.) Conceptual framework towards organizational linkages for successful tech transition. 3.) Importance of middle mgmt creating & maintaining linkages, critical to dynamic capabilities.	Organizational linkages and dynamic capabilities driven by middle management are substantial to successful tech transitions.	Taylor, A., Helfat, C.E.	2009	Organ Sci	271	38	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 3. Manage & Balance Internal Competition & Resources 7. Business Model, Commercial Operations & Performance	Early - Late Seed-Series B+	1.) Balancing exploration & exploitation difficult for SMEs for lack of resources, capabilities, experience necessary for ambidexterity. 2.) Concept of impact of product-market exploration & exploitation on revenue. 3.) Two ambidexterity paradoxes: large companies have the resources but rarely implement product ambidexterity; only larger firms have resources for market ambidexterity strategy but developing it is necessary to develop long-term growth.	SMEs should not dilute limited resources by pursuing product or market ambidexterity. Managers of SMEs are more successful implementing simple, focused strategies.	Voss, G.B., Voss, Z.G.	2013	Organ Sci	251	39	Top 50 Article
4. R&D, Innovation, Product & Technology Development Cycle 5. Foster & Harness Dynamic Capabilities	Late Series B+	1.) Radical innovation (RI) as a means for large companies to compete in growth. 2.) Holistic Sequential Model of structural aspects of RI management systems in large established firms - organizational structure as venue for capability development 3.) Discovery-Incubation-Acceleration framework as centerpiece of competencies for RI capability.	Senior leadership capability and business unit ambidexterity is important for RI management, following a discovery - incubation - acceleration framework for RI capability.	O'Connor, G.C., DeMartino, R.	2006	J Prod Innovat Manag	250	40	Top 50 Article
1. Organizational Ambidexterity Strategy 6. Team, Network & Organizational Integration Mechanisms 15. Information Systems & Information Technology	Mid - Late Series A-B+	1.) Exploration of how Information systems (IS) competencies affect process innovation in org. based on resource-based view of firms. 2.) Six (6) IS competencies affect process innovations: knowledge management, collaboration, project management, ambidexterity, IT/Innovation Governance, Business-IS Linkages.	Ambidexterity is one key competence required for process innovations.	Tarafdar, M., Gordon, S.R.	2007	J Strategic Inf Syst	232	41	Top 50 Article
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 3. Manage & Balance Internal Competition & Resources 15. Information Systems & Information Technology	Mid - Late Series A-B+	1.) Organizational agility is recognized as a significant business capability. 2.) IT ambidexterity, the dual capacity to explore and exploit IT resources, has enabling effect by enhancing organizational agility by facilitating operational ambidexterity, with dependency on environmental dynamisms.	Focus on IT ambidexterity as upstream driver of operational ambidexterity and resulting organizational agility.	Lee, O.-K., Sambamurthy, V., Lim, K.H., Wei, K.K.	2015	Inform Syst Res	229	42	Top 50 Article

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 6. Team, Network & Organizational Integration Mechanisms 9. Diversification, Cross-Boundary, Alliances, M&A 15. Information Systems & Information Technology	Early - Late Seed-Series B+	1.) Multinational enterprises are exploring IoT solutions to profit from during alliance building. 2.) Companies need to manage & integrate different types of knowledge to efficiently and effectively support simultaneous exploration and exploitation at project portfolio level. 3.) MNEs need to develop knowledge management (KM) and ICT capabilities for ambidexterity performance. 2.) Conceptual model, centering ICT (information & communication technologies) capabilities & drivers of ICT internal use, collaboration & communication, mediating role betw. knowledge management (creation and integration of knowledge) & alliance ambidexterity.	1.) Knowledge Management (KM) capabilities enhance alliance ambidexterity indirectly through ICT capabilities. 2.) Managers should design KM tools and ICT skills.	Bresciani, S., Ferraris, A., Del Giudice, M.	2018	Technol Forecast Soc	228	43	Top 50 Article
11. Product, Supply Chain, Marketing & Sales	Mid - Late Series A-B+	1.) Organizational learning theory informs on how customer-focused marketing capabilities may be improved or created a new via marketing exploitation and exploration capabilities. 2.) Firms cannot do both marketing exploration & exploitation at high levels without negative impact on customer-focused marketing.	Improving, through well-balanced exploration and exploitation, customer-focused marketing capabilities, brand management and customer relationship management impacts objective financial performance.	Vorhies, D.W., Orr, L.M., Bush, V.D.	2011	J Acad Market Sci	225	44	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 7. Business Model, Commercial Operations & Performance 6. Team, Network & Organizational Integration Mechanisms 13. Lead by Mission, Vision & Core Values	Mid - Late Series A-B+	1.) Question on how compete with two business models simultaneously during business model innovation is framed as ambidexterity challenge. 2.) Spatial- and temporal separation, contextual ambidexterity and firm-specific separation with integrating mechanisms discussed as solutions.	Importance on integrating mechanisms between two business models, including a common general manager for main and new business, allowing different cultures to emerge while maintaining a strong shared vision.	Markides, C.C.	2013	Academy of Manage Perspect	223	45	Top 50 Article
1. Organizational Ambidexterity Strategy 3. Manage & Balance Internal Competition & Resources 7. Business Model, Commercial Operations & Performance 6. Team, Network & Organizational Integration Mechanisms	Late Series B+	1.) Unit-level ambidexterity in multi-unit contexts positively impacts unit performance. 2.) Cross-level model suggests that structural and resource attributes of organizational context significantly shape relationship between unit ambidexterity and performance. 3.) Relationship between ambidexterity and performance is boosted when organization is decentralized, more resource munificent, or less resource interdependent. 4.) Structural differentiation of the organization does not condition unit ambidexterity-performance relationship.	Decentralize and reduce resource interdependence to optimize organizational context for unit-level ambidexterity in multi-level contexts.	Jansen, J.J.P., Simsek, Z., Cao, Q.	2012	Strategic Manage J	222	46	Top 50 Article

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 8. Cognitive Frames, Organizational Learning & Knowledge Sharing	Early - Late Seed-Series B+	1.) Organizational Ambidexterity relates to firm performance. 2.) In knowledge-intensive firms organizational ambidexterity is found to not have an impact on firm performance. 3) Organizational ambidexterity has positive and significant mediating effect on firm performance when considering external knowledge sourcing.	When operating in a knowledge-intensive firm, consider that in the open innovation and external knowledge sourcing context, organizational ambidexterity is a positive mediator of firm performance.	Vrontis, D., Thrassou, A., Santoro, G., Papa, A.	2017	J Technol Transfer	217	47	Top 50 Article
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 14. Uncertainty, External Competition & Vulnerability 3. Manage & Balance Internal Competition & Resources 6. Team, Network & Organizational Integration Mechanisms 9. Diversification, Cross-Boundary, Alliances, M&A	Early - Late Seed-Series B+	1.) Paradoxes can fuel and frustrate innovation, such as in long-term adaptability vs short-term survival, possibilities vs. Constraints, diversity vs. Cohesiveness, & passion vs. discipline. 2.) Innovation paradoxes require paradoxical management approaches, using integration approaches, stressing both and thinking to foster synergy, and splitting techniques, separating tensions to focus resources and action. 3.) Paradox guides a common managerial approach but enables contextual variations.	For organizational ambidexterity, paradoxes need to be tackled through paradoxical management approaches, using integration or splitting approaches. Integration and splitting practices should be customized according to company size.	Andriopoulos, C., Lewis, M.W.	2010	Long Range Plann	216	48	Top 50 Article
2. Ambidextrous Management & Leadership 9. Diversification, Cross-Boundary, Alliances, M&A	Late Series B+	In transformational leadership during acquisitions, incl. inspirational motivation, installation of learning culture incl. associated key values such as psychological safety, openness to diverse opinions & participation in decision-making promotes ambidexterity.	Especially in a context of acquisitions, ensure to adopt a transformational leadership style including focus on learning culture and attributed values such as openness and participatory.	Nemanich, L.A., Vera, D.	2009	Leadership Quart	211	49	Top 50 Article
4. R&D, Innovation, Product & Technology Development Cycle 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 9. Diversification, Cross-Boundary, Alliances, M&A	Early - Late Seed-Series B+	1.) Innovation ambidexterity (IA) describes simultaneous achievement of incremental & radical innovation. 2.) Learning capability describes combined promotion of intraorganizational learning, partnerships with organizations, and open knowledge sharing culture. 3.) Learning capability impacts innovation ambidexterity and innovation ambidexterity's effect on business performance. 4.) Innovation ambidexterity mediates learning capability and business performance.	1.) Invest in and support learning capability and innovation ambidexterity. 2.) Innovation ambidexterity, via learning capability, drives business performance in form of revenues, profits, and competitive productivity growth.	Lin, H.-E., McDonough III, E.F., Lin, S.-J., Lin, C.Y.-Y.	2013	J Prod Innovat Manag	208	50	Top 50 Article

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 12. HR, Team Management, Diversity & Culture 10. Environmental Risk & Change Management 5. Foster & Harness Dynamic Capabilities	Early - Late Seed-Series B+	1.) Evolutionary theory company development. Organizational development through periods of incremental or evolutionary change. 2.) Ambidextrous Management & Adaptability Management needs to adapt company culture and strategy to current environment. Need for ability to adjust to radical change. 3.) Dynamic Capabilities & Change Management 4.) Organizational Development towards Ambidexterity. Ambidextrous organization must be built that can pursue both incremental and discontinuous innovation.	Managers able to adapt company to current environment. Avoidance of inertia. Ability to adapt to radical changes in environment. Ambidextrous capability to puruse innovation, incrementally and discontinuous. Sustainable adaptability.	Tushman and O'Reilly	1996	Calif Manage Rev	4242*	1	Top 35 Net | Seed
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 12. HR, Team Management, Diversity & Culture 3. Manage & Balance Internal Competition & Resources 13. Lead by Mission, Vision & Core Values	Early - Late Seed-Series B+	1.) Org. Ambidexterity Strategy: Structure follows strategy. Exploit existing platform & product, customers & markets. Explore into new platform advances, product, customers & markets. 2.) Ambidextrous Mgmt. & Organiz. Leadership: executives' ability to combine past experience with innovative foresight. Mgmt lead & support for implementation. Ambidextrous Managers with ability to lead ambidexterity. 3.) Organize to innovate & foster innovation Ambidextrous Organizations significantly more successful vs. cross-functional teams, unsupported teams, or functional designs. 4.) Evolve exploitation focus to support ambidexterity R&D and Exploration cannot sustain without exploitation. Platform and product cannot compete without R&D / Innovation. 5.) Manage ambidexterity. Foster cross-fertilization through sharing resources in cash, talent, expertise, customers, while preventing cross-contamination through org. separation. 6.) Manage internal competition. Avoid int. competition - counterproductive with sharing resources & transl. of innovation to exploitation. 7.) HR: create/offer incentives. R&D: inventions, patents, translation, promotion. Platform/Product: inventions, patents, performance, promotions 8.) Diversify: through innovation, early, for sustainable competitiveness, new product, new processes for manufacturing 9.) Mission & Vision: Management must communicate & integrate vision to ensure common cause, across organization, explain necessity for ambidexterity, translate to practice	Innovation through continuous explorative activity: incremental improvements and gains in technology and product, whilst pioneering radical or disruptive innovations through discontinuous innovations. Install capable project leaders and dedicate resources. Allow, support, and ensure sharing of resources. Ensure "Ambidextrous Leadership" towards building "Ambidextrous Organization". Diversification through innovation ensures sustainable competitiveness, through new products and new processes for manufacturing.	C. O'Reilly, M. Tushman	2004	Harvard Bus Rev	2200*	8	Top 35 Net Unique

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 3. Manage & Balance Internal Competition & Resources 6. Team, Network & Organizational Integration Mechanisms	Early - Late Seed-Series B+	1.) Behaviors and outcomes based on March's framework of exploration and exploitation, considering, antecedents such as environment, organization and senior management team influence ambidexterity conduct and behaviors. 2.) Tensions between exploration and exploitation are critical and need to be managed. 3.) Tradeoffs such as resource allocation constraints lead to increased tension, while balancing strategies lead to reduce tension.	Focus on balancing actions and measures to reduce tension, such as by resolving resource limitations towards exploration - exploitation balance und ultimately improved performance outcome.	Dovev Lavie, Uriel Stettner, M. Tushman	2010	Acad Manag Ann	1304*	12	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 14. Uncertainty, External Competition & Vulnerability 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 12. HR, Team Management, Diversity & Culture 10. Environmental Risk & Change Management 3. Manage & Balance Internal Competition & Resources	Early - Late Seed-Series B+	1.) Balancing Exploitation vs. Exploration; 2.) Returns form exploration are less certain than returns from exploitation; 3.) Mutual Organizational Learning & Individuals; 4.) Team Heterogeneity & Learning Advantage; 5.) Personnel Turnover Effects; 6.) Evolution & Organizational Diversity; 7.) Adaptation to Change & Competitive Advantage; 8.) Vulnerability of Exploration; 9.) Competition for Primacy; 10.) Effect of Learning on Performance Distribution.	Return on Invest (ROI); Collective Knowledge / Learning Rate Equilibrium; Socialization Rate; Turnover provides new knowledge; Essentiality of Adaptation; Relative Performance Competitive Advantage/Success	March, JG	1991	Organ Sci	8703*	15	Top 35 Net Unique
4. R&D, Innovation, Product & Technology Development Cycle 7. Business Model, Commercial Operations & Performance	Mid - Late Series A-B+	1.) Balanced exploration and exploitation for superior performance, as modeled through interaction of orthogonal activities. 2.) Trade-off exists between exploration and exploitation and that the optimal balance between exploration and exploitation depends upon environmental conditions. 3.) An inverted U-shaped relationship is found between relative share of explorative orientation and financial performance, which is positively moderated by R&D intensity.	Support R&D intensity to strengthen explorative orientation and financial performance.	J. Uotila, Markku V. J. Maula, T. Keil, S. Zahra	2009	South Med J	779*	17	Top 35 Net Unique
2. Ambidextrous Management & Leadership 8. Cognitive Frames, Organizational Learning & Knowledge Sharing	Mid - Late Series A-B+	1.) Top-down knowledge inflows of a manager positively relate to the extent to which this manager conducts exploitation activities but don't relate to manager's exploration activities. 2.) Bottom-up and horizontal knowledge inflows of a manager positively relate to this manager's exploration activities, while they do not relate to a manager's exploitation activities.	Focus on the manager-level to improve manager's exploitation vs. exploration performance if need for improved balance, through control of knowledge inflow to the manager accordingly.	Tom J. M. Mom, Frans A. J. Van Den Bosch, H. Volberda	2006	J Manage Stud	618*	18	Top 35 Net Unique

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 5. Foster & Harness Dynamic Capabilities	Early - Late Seed-Series B+	1.) Tushman & O'Reilly's publication in California Management Review 1996 identified as seminal work on ambidexterity that triggered a wave of publications, extracted and characterized. 2.) Key outcome of network-centered literature analysis is the conception that ambidexterity is a dynamic capability, enabling the firm to orient toward exploitation and exploration depending on business environment conditions.	Organization Science and Strategic Management Journal are identified as the most relevant journals in terms of publication count on most cited publications, in line with the findings of this study.	F. García-Lillo, M. Úbeda-García, B. Marco-Lajara	2016	Scientometrics	24*	22	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 6. Team, Network & Organizational Integration Mechanisms	Late Series B+	1.) Corporate venture (CV) units are vehicles through which firms may act ambidextrously to increase longevity, but failure rates are high. 2.) Some CV units last longer than others. They endure by developing an ambidextrous orientation themselves, build new capabilities while simultaneously leveraging strengths, and by nurturing strong relationships.	When dealing with a corporate venture unit (CV), establish ambidexterity within the CV to increase chances of success, including focus on strong relationships with stakeholders including executives, business unit managers, and VC community.	Susan A. Hill, J. Birkinshaw	2014	J Manage	272*	24	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 3. Manage & Balance Internal Competition & Resources 13. Lead by Mission, Vision & Core Values	Early - Late Seed-Series B+	1.) Recognition of the stark increase of publication count on ambidexterity in the past decades, in line with this study. 2.) Managers' implications towards achieving ambidexterity remain neglected field of research. 3.) Systematic literature review of academic and practitioner literature towards practical implications for managers to reconcile exploration & exploitation for achieving ambidexterity in practice.	Key practical implications: 1.) Develop ambidexterity strategy 2.) Implement measures at top management team (TMT) level to achieve ambidexterity. 3.) Identify and resolve paradoxes. 4.) Manage resource allocation and asset re-configuration. 5.) Ensure coherence in vision & strategy.	Nina Gusenleitner	2016	Junior Management Science	3*	25	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 3. Manage & Balance Internal Competition & Resources 7. Business Model, Commercial Operations & Performance 6. Team, Network & Organizational Integration Mechanisms 5. Foster & Harness Dynamic Capabilities	Late Series B+	1.) Focus on contextual ambidexterity, i.e. ambidexterity based on a context allowing simultaneous exploratory & exploitative activities. 2.) Empirical study of contextually ambidextrous organizations reveals idiosyncratic characteristics on mode of knowledge transmission between exploratory and exploitative domains based on fluid project structures for competitive advantage. 3.) Role of balancing and orchestrating capabilities to enable concurrent performance in exploration and exploitation.	Knowledge transfer through projects as knowledge bridges and balancing activities serve to contextualize explorative innovation and research activities with replication and application in contextually ambidextrous organizations.	Wolfgang H. Güttel, Stefan Konlechner	2009	Schmalenbach Business Review	122*	26	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 13. Lead by Mission, Vision & Core Values	Early - Late Seed-Series B+	1.) Empirical investigation of predictors and consequences of organizational ambidexterity, defined as simultaneous achievement of alignment and adaptability. 2.) Leadership through combination of stretch, discipline, support, & trust facilitates emergence of ambidexterity & superior performance.	Lead through a combination of stretch, discipline, support, and trust to succeed in ambidexterity establishment and to harness resulting performance.	C. Gibson, J. Birkinshaw, T. Williams, Jim W. O'toole	2002	USC Marshall CEO	8*	27	Top 35 Net Unique

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
3. Manage & Balance Internal Competition & Resources 9. Diversification, Cross-Boundary, Alliances, M&A	Early - Late Seed-Series B+	1.) Ambidexterity capability in the organization: understanding and managing tensions, simultaneously accomplishing conflicting activities or goals, despite tensions are essential to firm competitiveness and survival. 2.) Ambidexterity is organizational capability to resolve tensions within the organization. 3,) Intellectual structure of ambidexterity literature and field based on core paper analysis reveals a four-factor model, namely: antecedents/consequences, cross boundary, structural, and contextual.	Cross-boundary perspectives, beyond organizational boundaries, supports ambidexterity as arising from firm's openness towards cooperation with external players.	A. Nosella, Silvia Cantarello, R. Filippini	2012	Strateg Organ	158*	29	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 3. Manage & Balance Internal Competition & Resources 7. Business Model, Commercial Operations & Performance	Early - Mid Seed, Series A	1.) Ambidexterity as capability to excel in the present and to prepare a sustainable future. 2.) Managing this duality is a challenge considering contracting activities. 3.) Dynamic environments require startups to balance attention and resource allocation for exploration and exploitation activities.	1.) Founders of startup ventures in growth phase should pay attention not to be too focused in exploration not to lose sight of exploiting output of exploration activities and not to over-engage in exploitation, i.e. they should focus on ambidextrous orientation and multi-tasking abilities. 2.) Top management team (TMT) shall use ambidextrous orientation & complementary abilities to positively influence organiz. ambidexterity in growth phase.	Sabyasachi Sinha	2015	Vikalpa: J Decision Makers	21*	30	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 3. Manage & Balance Internal Competition & Resources 7. Business Model, Commercial Operations & Performance	Early - Mid Seed, Series A	1.) Innovation is critical in supporting and improving a firm's competitive position. 2.) Firm survival and growth potential depend on capability to balance exploitation and exploration. 3.) In the early search phase of the innovation process, a multi-level approach that integrates both operational and strategic levels can achieve balancing exploration and exploitation.	In the early search phase of the innovation process apply a multi-level approach integrating both operational and strategic levels to achieve balance between exploration and exploitation.	Silvia Cantarello, A. Martini, A. Nosella	2012	Entrepreneurship	84*	31	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 4. R&D, Innovation, Product & Technology Development Cycle 7. Business Model, Commercial Operations & Performance 11. Product, Supply Chain, Marketing & Sales	Mid - Late Series A-B+	1.) Literature review on organizational ambidexterity to address implications for the field of marketing, where ambidexterity is not sufficiently explored. 2.) Market orientation construct in marketing is seen as analogy to contextual ambidexterity.	Ensure to focus on the marketing department when it comes to ambidexterity given its importance in ensure successful product market fit en route to a firm's commercial success.	M. Hughes	2018	J Marketing Manage	49*	32	Top 35 Net Unique
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 8. Cognitive Frames, Organizational Learning & Knowledge Sharing 3. Manage & Balance Internal Competition & Resources 6. Team, Network & Organizational Integration Mechanisms 13. Lead by Mission, Vision & Core Values	Mid - Late Series A-B+	1.) Top management team (TMT)'s role in making balanced strategic decisions spearhead organizational ambidexterity. 2.) TMT's behavioral integration & behavioral complexity can build organiz. ambidexterity, moderated by contextual ambidexterity.	Towards organizational ambidexterity, TMTs should strive for behavioral integration through information sharing, collaboration and joint decision-making and consideration of contextual ambidexterity, balancing involvement and consistency.	A. Carmeli, Meyrav Yitzack Halevi	2009	Leadership Quart	311*	33	Top 35 Net Unique

Literature Core Concept Cluster (LCCC)	Stage	Concepts	Key Success Factors (KSFs)	Author	Year	Journal	Cite *	ID	Set
1. Organizational Ambidexterity Strategy 2. Ambidextrous Management & Leadership 4. R&D, Innovation, Product & Technology Development Cycle 12. HR, Team Management, Diversity & Culture 7. Business Model, Commercial Operations & Performance 11. Product, Supply Chain, Marketing & Sales 5. Foster & Harness Dynamic Capabilities	Early - Late Seed-Series B+	Eight (8) major themes identified in abstract-based text mining from 504 works, indicating current boundary of ambidexterity research. (I) Types of ambidexterity, (II) Levels of analysis, (III) New product development, (IV) Orientations, (V) Dynamic capability, (VI) Business Models, (VII) Leadership, (VIII) Networks.	Dynamic capabilities (DC) as key to achieve organizational ambidexterity.	Snehvrat et al.	2018	Intl. J. of Org. Anal.	22*	1	Extra Key Paper
2. Ambidextrous Management & Leadership	Early - Late Seed-Series B+	1.) Ambidextrous Leadership for thriving firms in constant, creative conflict. 2.) Company resources are scarce: core businesses fight over resources with speculative innovation initiatives. 3.) CEOs frequently take backseat, leaving power to middle management. 4.) Long-term failure based on research of 12 top mgmt teams. Firms thrive only when senior teams lead ambidextrously - foster state of constant creative conflict between old and new.	1.) Ambidextrous Leadership allows firms to thrive. 2.) Foster creative conflict between old and new.	Tushman, Smith and Binns	2011	Harvard Business Review	106*	2	Extra Key Paper

Supplemental Table S 5. LDA Topic Modeling Post-Processing – 15 Topic Titles

Based on the 5 most frequent words associated with 15 LDA-derived topics, considering paper titles associated with highest probability with each topic, topic titles were named. Logical associations based on topic names and topic literature content with Core Concepts derived from manual literature review are indicated.

Topic 1	**Publication Count: 8**
Top 5 Words	**PDF Titles**
knowledg	Knowledge sharing, social capital, and financial performance: The perspectives of innovation strategy in technological clusters
firm	Leveraging internal and external experience: Exploration, exploitation, and R&D Project performance
allianc	Managing the exploitation/exploration paradox: The role of a learning capability and innovation ambidexterity
technolog	Cognitive frames, learning mechanisms, and innovation ambidexterity
innov	Ambidexterity in technology sourcing: The moderating role of absorptive capacity
	Ambidexterity under scrutiny: Exploration and exploitation via internal organization, alliances, and acquisitions
	Do bridging ties complement strong ties? An empirical examination of alliance ambidexterity
	Ambidexterity, external knowledge and performance in knowledge-intensive firms
Topic Title	**Innovation and Knowledge Alliances in Technology Firms**
Core Concept Association:	**4; 8; 9**

Topic 2	**Publication Count: 5**
Top 5 Words	**PDF Titles**
market	Five areas to advance branding theory and practice
social	Understanding social media effects across seller, retailer, and consumer interactions
custom	Improving customer-focused marketing capabilities and firm financial performance via marketing exploration and exploitation
brand	Strategic ambidexterity in small and medium-sized enterprises: Implementing exploration and exploitation in product and market domains
media	Unraveling platform strategies: A review from an organizational ambidexterity perspective
Topic Title	**Customer Focused Social Media Marketing & Branding**
Core Concept Association:	**11**

Topic 3	**Publication Count: 5**
Top 5 Words	**PDF Titles**
chang	Sailing into the wind: Exploring the relationships among ambidexterity, vacillation, and organizational performance
manag	Visual management for a dynamic strategic change
organ	*Visual management for a dynamic strategic change (submitted manuscript - duplicate - positive control)*
visual	Renewal through reorganization: The value of inconsistencies between formal and informal organization
formal	Being Efficiently Fickle: A Dynamic Theory of Organizational Choice
Topic Title	**Organizational Change Management**
Core Concept Association:	**10**

Topic 4	**Publication Count: 4**
Top 5 Words	**PDF Titles**
work	Flexibility Versus Efficiency? A Case Study of Model Changeovers in the Toyota Production System
design	A model of adaptive organizational search
job	Beyond motivation: Job and work design for development, health, ambidexterity, and more
product	Do TQM principles need to change? Learning from a comparison to Google Inc.
employe	-
Topic Title	**Job and work design for production employee development, motivation & efficiency**
Core Concept Association:	**7; 8; 13**

Topic 5	**Publication Count: 11**
Top 5 Words	**PDF Titles**
explor	The interplay between exploration and exploitation
exploit	Continuously Hanging by a Thread: Managing Contextually Ambidextrous Organizations
ambidexter	Organisational ambidexterity and firm performance: burning research questions for marketing scholars
organiz	Exploration and Exploitation Within and Across Organizations
manag	Ambidexterity as a dynamic capability: Resolving the innovator's dilemma
	Organizational Ambidexterity: Past, Present, and Future
	Organizational ambidexterity: Balancing exploitation and exploration for sustained performance
	Organizational ambidexterity: Antecedents, outcomes, and moderators

	A typology for aligning organizational ambidexterity's conceptualizations, antecedents, and outcomes Organizational ambidexterity: Towards a multilevel understanding The Exploration–Exploitation Dilemma: A Review in the Context of Managing Growth of New Ventures
Topic Title	**Managing Exploration and Exploitation for Organizational Ambidexterity**
Core Concept Association:	**1; 2; 3**

Topic 6	**Publication Count: 6**
Top 5 Words	**PDF Titles**
firm **ambidexter** **content** **subject** **fromn**	The influence of founding team company affiliations on firm behavior Unpacking organizational ambidexterity: Dimensions, contingencies, and synergistic effects Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis Structural differentiation and ambidexterity: The mediating role of integration mechanisms The Performance Consequences of Ambidexterity in Strategic Alliance Formations: Empirical Investigation and Computational Theorizing
Topic Title	**Subject and Content Influences on the Ambidexterity of the Firm**
Core Concept Association:	**1; 2**

Topic 7	**Publication Count: 2**
Top 5 Words	**PDF Titles**
chain **suppli** **manag** **oper** **-**	When does university research get commercialized? Creating ambidexterity in research institutions Sustainable supply chain management towards disruption and organizational ambidexterity: A data driven analysis
Topic Title	**Supply Chain Management and Operations**
Core Concept Association:	**7; 11**

Topic 8	Publication Count: 6
Top 5 Words	**PDF Titles**
organ	Building ambidexterity into an organization
organiz	Microfoundations of performance: Balancing efficiency and flexibility in dynamic environments
learn	Organizational Learning
chang	Exploration and Exploitation in Organizational Learning
theori	Move over Mintzberg, let adhocracy give way to ambidexterity
Topic Title	**Organizational Learning Theory and Change**
Core Concept Association:	**5; 8**

Topic 9	Publication Count: 14
Top 5 Words	**PDF Titles**
manag	The antecedents, consequences, and mediating role of organizational ambidexterity
perform	Contextual determinants of organizational ambidexterity
unit	Ambidexterity and Survival in Corporate Venture Units
measur	Knowledge sharing ambidexterity in long-term interorganizational relationships
knowledg	Ambidexterity and performance in multiunit contexts: Cross-level moderating effects of structural and resource attributes
	Organizational ambidexterity and performance: A meta-analysis
	The effect of an ambidextrous supply chain strategy on combinative competitive capabilities and business performance
	How does IT ambidexterity impact organizational agility?
	Organizational learning, NPD and environmental uncertainty: An ambidexterity perspective
	Ambidexterity and Performance in Small-to Medium-Sized Firms: The Pivotal Role of Top Management Team Behavioral Integration
	Investigating Managers' Exploration and Exploitation Activities: The Influence of Top-Down, Bottom-Up, and Horizontal Knowledge Inflows
	Understanding variation in managers' ambidexterity: Investigating direct and interaction effects of formal structural and personal coordination mechanisms
	Walking the tightrope: An assessment of the relationship between high-performance work systems and organizational ambidexterity
	Exploration, exploitation, and financial performance: analysis of S&P 500 corporations
Topic Title	**Knowledge Management and Business Unit Performance Measurement**
Core Concept Association:	**2; 3; 7; 14**

Topic 10	Publication Count: 5
Top 5 Words	**PDF Titles**
team	How top management team behavioral integration and behavioral complexity enable organizational ambidexterity: The moderating role of contextual ambidexterity
leadership	Senior team attributes and organizational ambidexterity: The moderating role of transformational leadership
behavior	Transformational leadership and ambidexterity in the context of an acquisition
innov	Explaining the heterogeneity of the leadership-innovation relationship: Ambidextrous leadership
integr	Achieving Service-Sales Ambidexterity
Topic Title	**Innovation Leadership through Team Behavioral Integration**
Core Concept Association:	**2; 4; 6; 11**

Topic 11	Publication Count: 5
Top 5 Words	**PDF Titles**
market	An ambidexterity perspective toward multinational enterprises from emerging economies
intern	A general theory of springboard MNEs
global	International expansion of emerging market enterprises: A springboard perspective
institut	Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change
busi	The entrepreneurship process in base of the pyramid markets: The case of multinational enterprise/nongovernment organization alliances
Topic Title	**Business & Institutional Internationalization to Global Markets**
Core Concept Association:	**1; 9**

Topic 12	Publication Count: 9
Top 5 Words	**PDF Titles**
busi	Managing Innovation Paradoxes: Ambidexterity Lessons from Leading Product Design Companies
manag	Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation
innov	Business model innovation: What can the ambidexterity literature teach us?
compani	Organizing for radical innovation: An exploratory study of the structural aspects of RI management systems in large established firms
technolog	Organizational Ambidexterity in Action: How Managers Explore and Exploit
	The ambidextrous organization.
	Organizational linkages for surviving technological change: Complementary assets, middle management, and ambidexterity

	The Ambidextrous Organization The ambidextrous CEO
Topic Title	**Technology Company Business Model Innnovation**
Core Concept Association:	**1; 2; 7; 13**

Topic 13	**Publication Count: 13**
Top 5 Words	**PDF Titles**
manag **ambidexter** **innov** **research** **journal**	Clarifying the distinctive contribution of ambidexterity to the field of organization studies The management of organizational ambidexterity through alliances in a new context of analysis: Internet of Things (IoT) smart city projects A multi-level model for organizational ambidexterity in the search phase of the innovation process Organizational ambidexterity: exploring the knowledge base Practical Implications of the Ambidexterity Concepts Business value appropriation roadmap for artificial intelligence Ambidextrous leadership: a meta-review applying static and dynamic multi-level perspectives The intellectual structure of organizational ambidexterity: A bibliographic investigation into the state of the art The microfoundations of organizational ambidexterity: A systematic review of individual ambidexterity through a multilevel framework Organizational Ambidexterity: A Critical Review and Development of a Project-Focused Definition The complexity of innovation: an assessment and review of the complexity perspective The state of ambidexterity research: a data mining approach Mechanisms for managing ambidexterity: A review and research agenda
Topic Title	**Literature on Ambidexterity Management in Research and Innovation**
Core Concept Association:	**1; 2; 4; 15**

Topic 14	**Publication Count: 2**
Top 5 Words	**PDF Titles**
firm **manag** **learn** **heurist** **-**	How firms learn heuristics: uncovering missing components of organizational learning Capability creation: Heuristics as microfoundations
Topic Title	**Managing Organizational Learning, Capabilities and Heuristics in the Firm**

Core Concept Association:	**2; 8**

Topic 15	**Publication Count: 6**
Top 5 Words	**PDF Titles**
capabl	Dynamic Capabilities: What Are They?
dynam	Untangling dynamic and operational capabilities: Strategy for the (N)ever-changing world
routin	A dynamic capabilities perspective on managing technological change: A review, framework and research agenda
process	Routines revisited: Exploring the capabilities and practice perspectives
manag	The "third hand": IT-enabled competitive advantage in turbulence through improvisational capabilities
Topic Title	**Managing Dynamic Capabilities in Process Routines**
Core Concept Association:	**2; 5; 15**

Annex 2. Supplemental Figures

Core Concept Clusters	Company Stage: Early Seed	Early - Mid Seed - Series A	Early - Late Seed - Series B+	Mid Series A	Mid - Late Series A - B+	Late Series B+	SUM
1	1	4	19	1	24	14	63
2	1	3	19	1	14	10	48
3		4	11		6	6	27
4		3	9		9	4	25
5		2	7		9	5	23
6			6		12	5	23
7		2	2		6	8	18
8			3		8	4	15
9		1	4		8	2	15
10			2	1	6	3	12
11			1		4	5	10
12		2	6		2		10
13			4		4	1	9
14			2	1	3	2	8
15		1	1		4		6
SUM	2	22	96	4	119	69	

Supplemental Figure S 1. Detailed quantification of ambidexterity core concept association with company maturity stage

Topic Probabilities per Publication determined by LDA model		Topics (LDA)																
#	Publication	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15	Key Topic
1	Adler_1999_FlexibilityversusEfficiency.pdf	0,00	0,00	0,02	0,54	0,00	0,11	0,00	0,23	0,01	0,00	0,00	0,06	0,01	0,00	0,01	4
2	Ambos_2008_When does university research get commercialized .pdf	0,07	0,00	0,00	0,05	0,01	0,00	0,33	0,14	0,14	0,01	0,01	0,05	0,16	0,02	0,00	7
3	Andriopoulos_Lewis_2010_Managing Innovation Paradoxes Ambidexterity_Lesso.pdf	0,00	0,01	0,01	0,07	0,04	0,00	0,00	0,11	0,01	0,06	0,00	0,60	0,07	0,01	0,01	12
4	Andriopoulos_2009_ExploitationExplorationTensionsOrganizational.pdf	0,01	0,01	0,01	0,04	0,04	0,21	0,00	0,08	0,01	0,01	0,00	0,52	0,05	0,00	0,00	12
5	Beckman_2006_InfluenceFoundingTeam.pdf	0,09	0,01	0,01	0,00	0,02	0,27	0,00	0,19	0,08	0,22	0,01	0,08	0,00	0,02	0,00	6
6	Bingham_2012_StratEntrepren_HowFirmsLearnHeuristicsUncoverMissingComponentsOfOrganiz.pdf	0,02	0,01	0,01	0,01	0,00	0,02	0,00	0,14	0,01	0,00	0,01	0,03	0,01	0,74	0,01	14
7	Bingham_Howell_Ott_2019_Capability Creation_HeuristicsAMicrofoundations_Strat_Entrepren_J.pdf	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,17	0,01	0,00	0,01	0,02	0,01	0,68	0,06	14
8	Birkinshaw_Gibson_2004_expl_lead.pdf	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,08	0,06	0,06	0,06	0,06	0,08	0,06	0,08	8
9	Birkinshaw_Gupta_2013_Clarifying-Distinctive-Contribution.pdf	0,00	0,00	0,03	0,02	0,20	0,24	0,00	0,14	0,02	0,00	0,02	0,03	0,27	0,01	0,00	13
10	Boumgarden_2012_Sailing_into_the_wind_Exploring_the_rela.pdf	0,11	0,01	0,26	0,00	0,18	0,06	0,00	0,24	0,009	0,01	0,00	0,10	0,00	0,01	0,00	3
11	Bresciani_2018_The management of organizational ambidexterity thr.pdf	0,22	0,02	0,00	0,00	0,01	0,02	0,18	0,04	0,08	0,02	0,02	0,03	0,32	0,01	0,03	13
12	Bui_2021 _Sustainable supply chain management towards disrup.pdf	0,01	0,01	0,00	0,01	0,01	0,04	0,76	0,05	0,01	0,00	0,02	0,00	0,07	0,00	0,00	7
13	Cantarello_2012_A MultiLevel Model for Organizational Ambidexterity in the Search Phase of the.pdf	0,09	0,01	0,01	0,01	0,18	0,13	0,04	0,04	0,01	0,01	0,00	0,11	0,30	0,02	0,04	13
14	Cao_2009_UnpackingOrganizationalAmbidexterity.pdf	0,01	0,01	0,00	0,00	0,18	0,34	0,01	0,11	0,30	0,00	0,01	0,01	0,01	0,00	0,01	6
15	Carmeli_2009_HowToMgmtTeamBehavioIntegration&BehavComplexityEnableOrganizAmbidext.pdf	0,00	0,00	0,00	0,02	0,18	0,00	0,01	0,15	0,02	0,48	0,01	0,00	0,09	0,00	0,02	10
16	Chen_2018_KnowledgeSharingSocialCapital&FinPerf_PerspectOfInnovStratTechClusters.pdf	0,36	0,10	0,01	0,01	0,01	0,02	0,01	0,06	0,18	0,01	0,03	0,01	0,16	0,01	0,01	1
17	Eisenhardt_2000_Strategic Management Journal_Dynamic capabilities what are they.pdf	0,24	0,02	0,00	0,00	0,01	0,02	0,00	0,23	0,00	0,00	0,03	0,04	0,00	0,05	0,35	15
18	Eisenhardt_2010_MicrofoundationsPerformanceBalancing.pdf	0,01	0,00	0,01	0,01	0,13	0,26	0,00	0,27	0,00	0,00	0,01	0,01	0,00	0,24	0,05	8
19	Eriksson and Fundin_2018_Visual management for a dynamic strategic change.pdf	0,00	0,00	0,74	0,00	0,01	0,00	0,00	0,05	0,01	0,00	0,00	0,00	0,16	0,00	0,01	3
20	Eriksson_2016_Visual Management for a dynamic strategic change_JOCM.pdf	0,00	0,01	0,71	0,01	0,01	0,00	0,00	0,04	0,01	0,02	0,00	0,01	0,18	0,00	0,01	3
21	Garcia-Lillo_OrganizationalAmbidexterity_ExploringTheKnowledgeBase_2016.pdf	0,02	0,01	0,02	0,01	0,24	0,01	0,01	0,10	0,12	0,01	0,01	0,00	0,40	0,01	0,05	13
22	Gibson_ 2004 _AntecedentsConsequencesMediating.pdf	0,00	0,00	0,01	0,06	0,02	0,12	0,00	0,13	0,41	0,04	0,01	0,10	0,08	0,01	0,00	9
23	Gibson_2002_Contextual-Determinants-of-Organizational-Ambidexterity.pdf	0,00	0,01	0,02	0,11	0,02	0,00	0,00	0,14	0,41	0,01	0,02	0,12	0,15	0,00	0,00	9
24	Gulati_2009_RenewalReorganizationValue.pdf	0,00	0,01	0,40	0,01	0,01	0,20	0,00	0,27	0,01	0,00	0,00	0,07	0,00	0,00	0,00	3
25	Gupta_2006_InterplayExplorationExploitation.pdf	0,05	0,00	0,01	0,02	0,31	0,18	0,00	0,30	0,01	0,03	0,01	0,02	0,04	0,01	0,00	5
26	Gusenleitner_2016_Practical Implications of the Ambidexterity Concep.pdf	0,00	0,00	0,00	0,03	0,33	0,12	0,00	0,07	0,01	0,07	0,00	0,02	0,33	0,00	0,00	13
27	Güttel_Konlechner_2009_ContinuousHangingByAThread_ManagContextAmbidextrousOrganiz.pdf	0,02	0,00	0,01	0,02	0,26	0,01	0,01	0,15	0,01	0,08	0,01	0,10	0,22	0,01	0,09	5
28	He_Wong_2004_Exploration vs Exploitation.pdf	0,03	0,01	0,01	0,00	0,17	0,36	0,01	0,11	0,25	0,00	0,01	0,02	0,01	0,01	0,01	6
29	Helfat_Winter_2011_Untangling dynamic and operational capabilities S.pdf	0,18	0,04	0,01	0,02	0,01	0,02	0,01	0,23	0,01	0,00	0,04	0,05	0,02	0,04	0,32	15
30	Hill_Birkinshaw_2014_Ambidexterity and Survival in Corporate Venture Un.pdf	0,01	0,00	0,01	0,01	0,23	0,01	0,00	0,09	0,43	0,00	0,03	0,11	0,04	0,03	0,00	9
31	Hoang_2010_Leveraging-Internal-External.pdf	0,56	0,00	0,00	0,01	0,01	0,11	0,01	0,14	0,06	0,00	0,02	0,04	0,01	0,02	0,02	1
32	Hughes_2018_Organisational ambidexterity and firm performance.pdf	0,00	0,04	0,00	0,01	0,61	0,00	0,00	0,18	0,02	0,00	0,00	0,00	0,10	0,01	0,01	5
33	Im_Rai_2008_KnowledgeSharingAmbidexterity.pdf	0,02	0,00	0,00	0,03	0,01	0,20	0,03	0,04	0,60	0,01	0,00	0,01	0,01	0,01	0,02	9
34	Jansen_2008_Senior team attributes and organizational ambidext.pdf	0,01	0,01	0,00	0,01	0,16	0,00	0,01	0,04	0,14	0,57	0,00	0,01	0,01	0,02	0,01	10
35	Jansen_2009_StructuralDifferentiationAmbidexterity.pdf	0,01	0,00	0,00	0,00	0,24	0,29	0,00	0,02	0,19	0,19	0,00	0,01	0,00	0,00	0,02	6
36	Jansen_2012_Ambidexterity and performance in multiunit context.pdf	0,20	0,00	0,01	0,00	0,23	0,07	0,00	0,06	0,32	0,08	0,01	0,00	0,01	0,00	0,00	9
37	Junni_2013_Organizational-Ambidexterity-Performance.pdf	0,02	0,01	0,00	0,01	0,17	0,30	0,00	0,04	0,31	0,02	0,00	0,01	0,09	0,01	0,00	9
38	Konlechner_2018_IJTM_Technology Management.pdf	0,05	0,01	0,01	0,00	0,06	0,00	0,01	0,06	0,01	0,00	0,01	0,01	0,22	0,05	0,49	15
39	Kristal_2010_The effect of an ambidextrous supply chain strateg.pdf	0,03	0,01	0,00	0,01	0,09	0,01	0,27	0,08	0,32	0,00	0,01	0,01	0,07	0,00	0,08	9
40	Lavie_Stettner_Tushman_2010_AOM_Annals.pdf	0,04	0,00	0,00	0,01	0,69	0,00	0,00	0,18	0,02	0,01	0,01	0,01	0,01	0,01	0,01	5
41	Lee_2015_AmbidexterityImpactOrganizational.pdf	0,00	0,01	0,00	0,00	0,06	0,23	0,04	0,04	0,31	0,00	0,00	0,00	0,03	0,00	0,25	9
42	Levinthal_March_1982_A_Model_of_Adaptive_Organizational_Search.pdf	0,06	0,06	0,06	0,08	0,06	0,06	0,06	0,06	0,06	0,06	0,08	0,06	0,08	0,06	0,06	4
43	Levitt_March_1988_Organizational Learning_Annual Rev Sociol.pdf	0,01	0,01	0,01	0,03	0,00	0,07	0,01	0,77	0,00	0,01	0,01	0,02	0,00	0,03	0,01	8
44	Lin_2007_PerformanceConsequencesAmbidexterity.pdf	0,19	0,00	0,00	0,00	0,07	0,39	0,01	0,19	0,12	0,00	0,01	0,00	0,01	0,01	0,00	6
45	Lin_2013_Managing the exploitationexploration paradox The.pdf	0,28	0,01	0,00	0,00	0,09	0,02	0,01	0,07	0,24	0,05	0,01	0,03	0,14	0,01	0,03	1
46	Lin_2014_CognitiveFramesLearningMechanisms&InnovationAmbidexterity_J_ProductInnovManag.pd	0,35	0,00	0,00	0,01	0,06	0,02	0,00	0,11	0,15	0,11	0,00	0,02	0,15	0,02	0,00	1
47	Liu_2011_ABMambidexterityandNPD.pdf	0,07	0,02	0,01	0,01	0,23	0,01	0,01	0,16	0,30	0,01	0,08	0,00	0,03	0,02	0,05	9
48	Lubatkin_2006_Ambidexterity_and_Performance_in_Small-to_Medium-S.pdf	0,02	0,01	0,01	0,00	0,15	0,01	0,00	0,12	0,44	0,19	0,01	0,01	0,01	0,01	0,01	9
49	Luo_2009_AmbidexterityPerspectivetoward.pdf	0,00	0,00	0,01	0,01	0,01	0,19	0,00	0,11	0,01	0,00	0,57	0,05	0,02	0,01	0,01	11
50	Luo_2018_A Genearl Theory of Springboard MNEs.pdf	0,01	0,01	0,00	0,01	0,01	0,02	0,00	0,11	0,01	0,01	0,72	0,03	0,03	0,00	0,03	11
51	Luo_Tung_2007_Springboard-Theory.pdf	0,00	0,02	0,00	0,00	0,00	0,00	0,02	0,11	0,01	0,01	0,72	0,05	0,01	0,05	0,00	11
52	March_1991_Exploration and Exploitation in Organizational Learning_Organization Science.pdf	0,02	0,00	0,00	0,01	0,03	0,01	0,01	0,79	0,09	0,01	0,01	0,00	0,00	0,00	0,03	8
53	Markides_2013_BusinessModelInnovation.pdf	0,01	0,00	0,05	0,00	0,16	0,19	0,02	0,15	0,01	0,01	0,03	0,23	0,14	0,01	0,00	12
54	Melewar_Nguyen_2015_FiveAreasToAdvanceBrandingTheory&Practice_J_Brand_Mgmt.pdf	0,01	0,36	0,01	0,02	0,03	0,00	0,01	0,08	0,07	0,01	0,12	0,07	0,19	0,03	0,01	2
55	Mishra and Pani_2020_Business value appropriation roadmap for artificia.pdf	0,03	0,06	0,03	0,02	0,01	0,01	0,20	0,17	0,01	0,01	0,02	0,10	0,23	0,01	0,09	13
56	Mom_2006_Investigating Managers' Exploration and Exploitati.pdf	0,02	0,00	0,00	0,00	0,33	0,00	0,00	0,01	0,52	0,00	0,01	0,01	0,05	0,01	0,02	9
57	Mom_2009_UnderstandingVariationManagers.pdf	0,00	0,00	0,00	0,02	0,10	0,30	0,00	0,06	0,41	0,01	0,00	0,00	0,08	0,00	0,00	9
58	Mueller_2020_Ambidextrous Leadership_Meta-Review.pdf	0,00	0,00	0,01	0,02	0,07	0,04	0,01	0,09	0,00	0,15	0,00	0,01	0,55	0,02	0,01	13
59	Nemanich_Vera_2009_Transformational leadership and ambidexterity in t.pdf	0,01	0,01	0,01	0,01	0,04	0,00	0,01	0,11	0,18	0,54	0,00	0,01	0,04	0,01	0,02	10
60	Nickerson_Zenger_2002_BeingEfficientlyFickle.pdf	0,01	0,00	0,46	0,01	0,00	0,07	0,01	0,40	0,02	0,00	0,00	0,01	0,00	0,01	0,00	3
61	Nosella_2012_paperstrategicorganization.pdf	0,01	0,00	0,01	0,01	0,26	0,02	0,02	0,03	0,04	0,02	0,00	0,01	0,50	0,05	0,02	13
62	OConnor_DeMartino_2006_Organizing for radical innovation An exploratory .pdf	0,05	0,00	0,01	0,00	0,00	0,01	0,08	0,14	0,01	0,01	0,02	0,61	0,02	0,00	0,02	12
63	OReilly III and Tushman_2011_Organizational ambidexterity in action How manage.pdf	0,01	0,02	0,02	0,00	0,24	0,01	0,00	0,09	0,01	0,07	0,01	0,45	0,04	0,01	0,03	12
64	OReilly_Tushman_2004_The Ambidextrous Organization_Harvard Business Review.pdf	0,01	0,02	0,10	0,03	0,02	0,02	0,01	0,16	0,01	0,02	0,05	0,51	0,02	0,02	0,02	12
65	OReilly_Tushman_2008_Ambidexterity as a dynamic capability.pdf	0,01	0,01	0,01	0,01	0,38	0,00	0,00	0,18	0,01	0,04	0,01	0,22	0,01	0,01	0,11	5
66	OReilly_Tushman_2013_Organizational-Ambidexterity-Past-Present-Future.pdf	0,01	0,00	0,03	0,00	0,40	0,21	0,00	0,10	0,01	0,02	0,00	0,08	0,09	0,01	0,03	5
67	Parikh_Mintzberg_2016_Adhocracy_Ambidexterity.pdf	0,00	0,01	0,19	0,06	0,13	0,01	0,01	0,28	0,01	0,00	0,00	0,03	0,23	0,01	0,01	8
68	Parker_2014_Beyond motivation Job and work design for develop.pdf	0,00	0,00	0,00	0,68	0,02	0,00	0,00	0,17	0,03	0,02	0,00	0,00	0,05	0,00	0,00	4
69	Parmigiani_Howard-Grenville_2011_Exploring the Capabilities and Practice Perspectives.pdf	0,01	0,01	0,00	0,06	0,01	0,00	0,00	0,30	0,01	0,01	0,00	0,01	0,10	0,04	0,45	15
70	Patel_2013_WalkingTheTightRope_Assess_Relationship_HighPerfWorkSyst_OrgAmbidext.pdf	0,01	0,00	0,01	0,10	0,10	0,28	0,00	0,07	0,32	0,00	0,01	0,02	0,06	0,01	0,01	9
71	Pavlou_Sawy__2010_ThirdHandITEnabled.pdf	0,00	0,01	0,00	0,01	0,00	0,18	0,01	0,09	0,09	0,00	0,00	0,00	0,00	0,00	0,59	15
72	Pertusa-Ortega_2020_The microfoundations of organizational ambidexteri.pdf	0,00	0,02	0,00	0,06	0,15	0,06	0,01	0,02	0,04	0,06	0,01	0,01	0,55	0,01	0,00	13
73	Petro_2019_Organizational Ambidexterity A Critical Review an.pdf	0,00	0,01	0,01	0,01	0,24	0,00	0,01	0,04	0,01	0,01	0,00	0,04	0,59	0,01	0,02	13
74	Poutanen_2016_The complexity of innovation_2016_10-1108_EJIM-03-2014-0036.pdf	0,01	0,01	0,04	0,01	0,01	0,01	0,02	0,29	0,00	0,01	0,03	0,02	0,52	0,01	0,01	13
75	Raisch_2009_Organizational Ambidexterity.pdf	0,05	0,00	0,01	0,02	0,37	0,25	0,00	0,08	0,02	0,01	0,00	0,05	0,09	0,01	0,02	5

Figure continued on next page.

Topic Probabilities per Publication determined by LDA model		Topics (LDA)															
#	Publication	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15	Key Topic
76	Raisch_Birkinshaw_2008_Organizational-ambidexterity-antecedents-outcomes-and-moderators.pdf	0,00	0,00	0,02	0,01	0,56	0,03	0,00	0,15	0,06	0,03	0,01	0,01	0,09	0,02	0,02	5
77	Rapp_2013_Understanding social media effects across seller.pdf	0,00	0,65	0,01	0,01	0,00	0,02	0,00	0,10	0,13	0,02	0,00	0,01	0,04	0,00	0,00	2
78	Rosing_2011_Explaining the heterogeneity of the leadership-inn.pdf	0,00	0,00	0,00	0,01	0,01	0,00	0,00	0,12	0,02	0,74	0,00	0,01	0,08	0,00	0,00	10
79	Rothaermel_2009_AmbidexterityTechnologySourcing.pdf	0,47	0,00	0,00	0,00	0,05	0,23	0,00	0,10	0,08	0,00	0,01	0,02	0,00	0,00	0,01	1
80	Schreyoegg_2010_OrganizingFluidityDilemmas.pdf	0,00	0,00	0,06	0,03	0,04	0,21	0,00	0,45	0,00	0,00	0,01	0,02	0,03	0,01	0,12	8
81	Sidhu_2007_MultifacetedNatureExploration.pdf	0,02	0,02	0,01	0,01	0,03	0,45	0,01	0,19	0,19	0,00	0,03	0,02	0,00	0,01	0,01	6
82	Simsek_2009_A typology for aligning organizational ambidexteri.pdf	0,11	0,01	0,00	0,01	0,58	0,00	0,02	0,05	0,05	0,07	0,00	0,02	0,04	0,02	0,02	5
83	Simsek_2009_Organizational ambidexterity Towards a multilevel.pdf	0,07	0,00	0,00	0,00	0,39	0,00	0,03	0,24	0,05	0,13	0,01	0,01	0,04	0,00	0,02	5
84	Sinha_2015_TheExplorationExploitationDilemma_ReviewContextManagingGrowthOfNewVentures.pd	0,01	0,00	0,00	0,00	0,56	0,06	0,02	0,07	0,02	0,08	0,01	0,05	0,09	0,01	0,01	5
85	Snehvrat_2017_State of Ambidexterity Research_A Data Mining Approach_Int J of Org Analysis.pdf	0,01	0,01	0,02	0,00	0,15	0,01	0,03	0,08	0,00	0,04	0,00	0,01	0,59	0,01	0,03	13
86	Steiber_2013 - Do TQM principles need to change Learning from a .pdf	0,01	0,01	0,04	0,30	0,01	0,00	0,01	0,17	0,01	0,02	0,01	0,12	0,25	0,02	0,02	4
87	Stettner and Lavie_2014_Ambidexterity under scrutiny Exploration and expl.pdf	0,57	0,01	0,01	0,00	0,24	0,02	0,01	0,09	0,02	0,00	0,02	0,01	0,00	0,00	0,01	1
88	Tarafdar and Gordon_2007_Understanding the influence of information systems.pdf	0,01	0,00	0,00	0,01	0,00	0,00	0,03	0,04	0,02	0,02	0,01	0,18	0,14	0,01	0,52	15
89	Taylor_2009_OrganizationalLinkagesSurviving.pdf	0,01	0,01	0,01	0,01	0,00	0,15	0,00	0,13	0,00	0,01	0,00	0,63	0,00	0,00	0,01	12
90	Tiwana_2008_Do bridging ties complement strong ties An empiri.pdf	0,57	0,00	0,00	0,02	0,00	0,01	0,00	0,11	0,14	0,05	0,00	0,00	0,08	0,00	0,01	1
91	Turner_2013_Mechanisms for managing ambidexterity A review an.pdf	0,13	0,00	0,02	0,01	0,24	0,04	0,03	0,10	0,01	0,03	0,00	0,02	0,36	0,00	0,01	13
92	Tushman_1997_The Ambidextrous Organization_Journal of Business Strategy.pdf	0,01	0,00	0,07	0,03	0,01	0,07	0,01	0,23	0,01	0,03	0,02	0,46	0,01	0,01	0,01	12
93	Tushman_OReilly_1996_Ambidextrous_Organizations.pdf	0,01	0,02	0,01	0,02	0,02	0,01	0,01	0,02	0,01	0,01	0,77	0,03	0,01	0,01	0,02	11
94	Tushman_Smith_Binns_2011_The Ambidextrous CEO_HBR.pdf	0,01	0,03	0,03	0,04	0,01	0,02	0,00	0,11	0,01	0,02	0,02	0,63	0,03	0,03	0,01	12
95	Uotila_2009_ExplorationExploitationFinancial.pdf	0,15	0,01	0,02	0,01	0,18	0,20	0,00	0,11	0,23	0,00	0,01	0,02	0,03	0,02	0,00	9
96	Vorhies_2011_Improving customer-focused marketing capabilities .pdf	0,02	0,45	0,00	0,00	0,04	0,01	0,00	0,07	0,24	0,00	0,01	0,00	0,04	0,00	0,11	2
97	Voss_Voss_2013_StrategicAmbidexteritySmall.pdf	0,01	0,33	0,01	0,00	0,15	0,28	0,00	0,11	0,09	0,00	0,00	0,01	0,00	0,00	0,01	2
98	Vrontis_2017_Ambidexterity external knowledge and performance .pdf	0,25	0,01	0,00	0,00	0,19	0,02	0,01	0,03	0,17	0,01	0,03	0,01	0,24	0,01	0,03	1
99	Wan_2017_Unraveling platform strategies A review from an o.pdf	0,01	0,47	0,00	0,01	0,05	0,01	0,07	0,09	0,00	0,00	0,04	0,03	0,20	0,00	0,01	2
100	Webb_2010_TheEntrepreneurshipProcessInBaseOfThePyramidMarkets_MNEsNGOsAlliances.pdf	0,00	0,06	0,00	0,02	0,00	0,00	0,00	0,17	0,05	0,00	0,59	0,04	0,02	0,03	0,01	11
101	Yu_2012_Achieving Service-Sales Ambidexterity_JSRAmbidexterity.pdf	0,00	0,08	0,01	0,10	0,01	0,05	0,01	0,06	0,26	0,29	0,00	0,05	0,07	0,02	0,00	10

Supplemental Figure S 2. Topic probabilities for each publication (PDF) as determined by LDA model.

Most likely topic assigned for each publication indicated as "Key Topic".

Annex 3. LDA Model – R Code

LDA model was performed customized to this thesis using R version 4.2.0 (2022-04-22) – "Vigorous Calisthenics", executed on an aarch64-apple-darwin20 (64-bit) platform using RStudio Version 2023.06.1+524 software, and based on the methodology as described by (Asmussen & Møller, 2019), who provided their original source code for their LDA framework on GitHub under: https://github.com/clausba/Smart-Literature-Review.

The R script as executed to obtain the described results is as follows:

```
#MBA Thesis Dr. Marc J. Brehme
#A Literature-Derived Entrepreneurial Framework for Organizational Development
 towards Ambidexterity

#Ambidexterity LDA Topic Modelling

#Method according to Asmussen, C.B., Møller, C. Smart literature review:
#a practical topic modelling approach to exploratory literature review.
#J Big Data 6, 93 (2019). https://doi.org/10.1186/s40537-019-0255-7

#Install Packages

install.packages("tm", repos = "http://cran.us.r-project.org")
install.packages("pdftools", repos = "http://cran.us.r-project.org")
install.packages("tidyverse", repos = "http://cran.us.r-project.org")
install.packages("topicmodels", repos = "http://cran.us.r-project.org")
install.packages("tidytext", repos = "http://cran.us.r-project.org")
install.packages("ggraph", repos = "http://cran.us.r-project.org")
install.packages("igraph", repos = "http://cran.us.r-project.org")
install.packages("kableExtra", repos = "http://cran.us.r-project.org")
install.packages("doParallel", repos = "http://cran.us.r-project.org")

#Load Libraries

library(tm)
library(pdftools)
library(tidyverse)
library(topicmodels)
library(tidytext)
library(ggraph)
library(igraph)
library(kableExtra)
library(doParallel)

#Get and load PDFs

files <- list.files(path = "/Users/marcintosh/OneDrive/MBA_TU-Vienna/MBA-
 Thesis/Literature", pattern = "pdf$", include.dirs = TRUE)

Rpdf <- readPDF(control = list(text = "-layout"))

###Remember to manually set working directory
setwd("/Users/marcintosh/OneDrive/MBA_TU-Vienna/MBA-Thesis/Literature")

documents <- lapply(files, pdf_text)  #%>% read_lines())
```

```
corp <- Corpus(VectorSource(documents))

##Clean text
corp <-tm_map(corp,content_transformer(tolower))

#remove punctuation
corp <- tm_map(corp, removePunctuation)

#Strip digits
corp <- tm_map(corp, removeNumbers)

#remove stopwords
corp <- tm_map(corp, removeWords, stopwords("english"))

#remove whitespace
corp <- tm_map(corp, stripWhitespace)

#Remove URL
urlPat<-function(x) gsub("(ftp|http)(s?)://.*\\b", "", x)
corp<-tm_map(corp, urlPat)

#Remove Email
emlPat<-function(x) gsub("\\b[A-Z a-z 0-9._ - ]*[@](.*?)[.]{1,3} \\b", "", x)
corp<- tm_map(corp, emlPat)

#Stem document
corp <- tm_map(corp,stemDocument)

#Remove stopwords
myStopwords <- c("can", "say","one","way","use", "an",
                 "also","however","tell","will", "is", "which",
                 "much","need","take","tend","even", "the",
                 "like","particular","rather","said", "key",
                 "get","well","make","ask","come","end", "'",
                 "first","two","help","often","may", "journal",
                 "might","see","something","thing","point", "from",
                 "post","look", "right" , "now","think","have",
                 "anoth","put","set","new","good", "download", "onlin",
                 "want","sure","kind","large","yes","day","etc", "librari",
                 "quit","since","attempt","lack","seen","aware", "tie",
                 "little","ever","moreover","though","found","able", "-",
                 "enough","far","earlier", "early", "away","achieve","draw",
                 "last","never","brief","bit","entire","briefly",
                 "great","lot","figure", "let", "follow", "pattern",
                 "des","vol","Äò","les",",Äí","mnes","dan", "most",
                 "une",",Ä¢","qui","rev",",Äú","que",",Äú", "took", "strong",
                 ",Äì","pour","par","wiley","Ô¨Åeld", "tushman", "O'Reilly",
 "Raisch", "March")

corp <- tm_map(corp, removeWords, myStopwords)

#inspect a document as a check
#Good practice to check every now and then
writeLines(as.character(corp[[35]]))

#Convert to document matrix
dtm <- DocumentTermMatrix(corp)

#remove sparse words
dtm <- removeSparseTerms(dtm,0.99)

#Alternative way to check words for several documents:
```

```
inspect(dtm[1:5,500:510])


#Run LDA

#convert rownames to filenames
rownames(dtm) <- files

#collapse matrix by summing over columns
freq <- colSums(as.matrix(dtm))

#length should be total number of terms
length(freq)

#create sort order (descending)
ord <- order(freq,decreasing=TRUE)

#List all terms in decreasing order of freq and write to disk
freq[ord]

#Set parameters for Gibbs sampling
burnin <- 4000
iter <- 4000
thin <- 500
seed <-list(3024,547,67,100000457,844)
nstart <- 5
keep <- 50
best <- TRUE

#For loop choosing different number of topics
#Currently selected 20 topics
system.time({
  for (index in 1:1) {

    #Number of topics
    # original version was if(index == 1) {k=20} else if (index==2) {k=50} else if
(index==3) {k=100}
    if(index == 1) {k=15} else if (index==2) {k=20} else if (index==3) {k=25}

    #Run LDA using Gibbs sampling
    ldaOut <-LDA(dtm,k, method= "Gibbs", control=list(nstart=nstart, seed = seed,
best=best, burnin = burnin, iter = iter, thin=thin))

    #write out results
    #docs to topics
    ldaOut.topics <- as.matrix(topics(ldaOut))

    kable(ldaOut.topics) %>%
      kable_styling(bootstrap_options = c("condensed", "hover", "striped"),
full_width = F, position ="center" )

    #top 5 terms in each topic

    ldaOut.terms <- as.matrix(terms(ldaOut,5))
    kable(ldaOut.terms) %>%
      kable_styling(bootstrap_options = c("condensed", "hover", "striped"),
full_width = F, position ="center")

    #probabilities associated with each topic assignment
    #add names to prop table
    rownames(ldaOut@gamma) <- files
    topicProbabilities <- as.data.frame(ldaOut@gamma)
```

```
    kable(topicProbabilities, rownames =files) %>%
      kable_styling(bootstrap_options = c("condensed", "hover", "striped"),
full_width = F, position ="center")

    #Find relative importance of top 2 topics
    topic1ToTopic2 <- lapply(1:nrow(dtm),function(x)
      sort(topicProbabilities[x,])[k]/sort(topicProbabilities[x,])[k-1])
    kable(topic1ToTopic2) %>%
      kable_styling(bootstrap_options = c("condensed", "hover", "striped"),
full_width = F, position ="center")

    #Find relative importance of second and third most important topics
    topic2ToTopic3 <- lapply(1:nrow(dtm),function(x)
      sort(topicProbabilities[x,])[k-1]/sort(topicProbabilities[x,])[k-2])

    kable(topic1ToTopic2) %>%
      kable_styling(bootstrap_options = c("condensed", "hover", "striped"),
full_width = F, position ="center")
    #manually set working directory, to specify where the files should be saved.
    setwd("/Users/marcintosh/OneDrive/MBA_TU-Vienna/MBA-Thesis/Thesis/LDA-
Model/Ambidexterity_LDA/Results")
    if(index==1) {write.csv(files, file="document names.csv")}
    write.csv(as.matrix(unlist(topic1ToTopic2)),file=paste("Topics", k,
"Topic1ToTopic2.csv"))
    write.csv(ldaOut.terms,file=paste("Topics", k, "Topic Overview.csv"))
    write.csv(as.matrix(unlist(topic2ToTopic3)),file=paste("Topics",
k,"Topic2ToTopic3.csv"))
    write.csv(topicProbabilities,file=paste("Topics", k,"topicProbabilities.csv"))
    write.csv(unlist(ldaOut.terms),file=paste("Topics", k,"Top10Words.csv"))
  } # end for loop
})


# Cross validation

n <- nrow(dtm)

#Create training and test dataset
#in this case 75% is in the training set and 25% in the testset
splitter <- sample(1:n, round(n * 0.75))
train_set <- dtm[splitter, ]
test_set <- dtm[-splitter, ]

#----------------5-fold cross-validation, different numbers of topics--------------
 --
#Use multiple cores for faster runtime
cluster <- makeCluster(detectCores(logical = TRUE) - 1) # leave one CPU spare...
registerDoParallel(cluster)

clusterEvalQ(cluster, {
  library(topicmodels)
})

#select parameters for cross validation
burnin <- 4000
iter <- 4000
thin <- 500
seed <-list(3024,547,67,100000457,844)
keep <- 50
best <- TRUE
folds <- 5
splitfolds <- sample(1:folds, n, replace = TRUE)
```

```
candidate_k <- c(2,3,4,5,10,20,30,40,50)
#c(2, 3, 4, 5, 10, 20, 30, 40, 50, 75, 100, 200, 300) candidates for how many
 topics
clusterExport(cluster, c("dtm", "burnin", "iter", "keep", "splitfolds", "folds",
 "candidate_k", "LDA"))

# we parallelize by the different number of topics.  A processor is allocated a
 value
# of k, and does the cross-validation serially.  This is because it is assumed
 there
# are more candidate values of k than there are cross-validation folds, hence it
# will be more efficient to parallelise
system.time({
  results <- foreach(j = 1:length(candidate_k), .combine = rbind) %dopar%{
    k <- candidate_k[j]
    results_1k <- matrix(0, nrow = folds, ncol = 2)
    colnames(results_1k) <- c("k", "perplexity")
    for(i in 1:folds){
      train_set <- dtm[splitfolds != i , ]
      valid_set <- dtm[splitfolds == i, ]

      fitted <- LDA(train_set, k = k, method = "Gibbs",
                    control = list(burnin = burnin, iter = iter, keep=keep ) )
      results_1k[i,] <- c(k, perplexity(fitted, newdata = valid_set))
    }
    return(results_1k)
  }
})
stopCluster(cluster)

results_df <- as.data.frame(results)


#Export results to csv
write.csv(results_df,file=paste("cluster analysis.csv"))


#Plot

ggplot(results_df, aes(x = k, y = perplexity)) +
  geom_point() +
  geom_smooth(se = FALSE) +
  ggtitle("5-fold cross-validation of topic modelling ",
          "(ie five different models fit for each candidate number of topics)") +
  labs(x = "Candidate number of topics", y = "Perplexity")


# Write ltout.topics - most significant topic per paper
write.csv(unlist(ldaOut.topics),file=paste("Topics", k,"PapersToTopics.csv"))
```