

The Moderating Effects of Dynamic Capabilities on Radical Innovation and Incremental Innovation Teams in the Global Pharmaceutical Biotechnology Industry

Heather A. Johnson

heather57johnson@gmail.com | University of Maryland Global Campus 3501 University Blvd East
Adelphi, MD 20783 USA

Abstract. The purpose of this paper was to conduct a qualitative, integrative systematic literature review of the moderating effects of dynamic capabilities associated with radical innovation and incremental innovation teams in the global pharmaceutical biotechnology industry. This paper utilizes a conceptual framework of dynamic capabilities and socio-technical theory to underpin the study. The study includes reading 250 peer reviewed articles which were originally surveyed from a larger set of articles, and then a final selection of 66 articles was based on a structured quality assessment tool and coding system. The study outcome reveals that knowledge sharing strengthens existing professional knowledge and enhances internal work coordination and consistency in employees' behavior, and effectively integrates diverse team knowledge and experience. Open innovation has a positive effect on radical innovation and enables knowledge acquisition to form a symbiotic relationship with knowledge sharing. Learning orientation has a stronger effect on incremental innovation than on radical innovation. The limitations of the study are intrinsic to a systematic literature review as this research approach does not uncover causality. The mediating effects of dynamic capability on teams are not explored for this research. The implications for management practice could be highlighted as follows: teams must be given the autonomy to make decisions from a technical perspective; tacit knowledge, open innovation, knowledge acquisition and learning orientation are areas in which priority must be given during and after acquisitions in the global pharmaceutical biotechnology industry.

Keywords. Innovation; Knowledge Management; Pharmaceutical Industry; Biotechnology; Open Innovation.

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1 Introduction

“A strong team can take any crazy vision and turn it into reality”, John Carmack. The pharmaceutical biotechnology business environment is a very complex one, some of its traits are: many decision makers; fierce competition; and very difficult to transmit the value proposition to all stakeholders (Perez la Rotta and Herrera, 2011). The complexity is exacerbated by the existence of complicated regulatory requirements which all organizations must contend with to get their products to market. The question is: “how to communicate value and connect with customers in this context?” (Perez la Rotta and Herrera, 2011, p.77). The United States of America Government Accountability Office (GAO’s) analysis of revenue, profit margin, and merger and acquisition deals within the worldwide drug industry from 2006 through 2015 identified key trends: (1) Estimated pharmaceutical and biotechnology sales revenue increased from \$534 billion to \$775 billion in 2015 dollars; (2) 67 percent of all drug companies saw an increase in their annual average profit margins from 2006 to 2015. Among the largest 25 companies, annual average profit margin fluctuated between 15 and 20 percent. For comparison, the annual average profit margin across nondrug companies among the largest 500 globally fluctuated between 4 and 9 percent; (3) The number of reported mergers and acquisitions generally held steady during this period, but the median disclosed deal value increased. (United States Government Accountability Office, 2017).

In the face of disruptive innovation, the pharmaceutical biotechnology corporations not only have to support radical innovation, but they must support incremental innovation. Radical innovation has to do with explorative areas of future products or services within an industry. While incremental innovation has to do with exploitative areas of current products or services. Ambidexterity has been purported to be the management mechanism to address the organizational duality of radical innovation and incremental innovation. Several leadership types, organizational structures, conceptual frameworks and associated theories have evolved over the past 20 years on ambidextrous innovation research.

1.1 Problem statement

Global corporations, small and medium enterprises, non-profits and other businesses are faced with the constant onslaught of disruptive innovation in order to survive in the 21st century. This has led to these entities being forced to support ambidextrous innovation (explorative and exploitative) to remain competitive within their industries (Rosing et al., 2011; Soosay and Hyland, 2008). The precise problem for many pharmaceutical biotechnology corporations, they have not survived the competitive environment of both radical innovation and incremental innovation (Shin, et al., 2016). As a result, these organizations have become extinct or have been surpassed in terms of performance by their competitors (Visscher and De Weerd-Nederhof, 2006; Hannachi, 2016).

1.2 Gaps in the literature

The significance of this research is, for over the past 20 years, there has been a proliferation of articles written on ambidextrous innovation (Tushman and O'Reilly, 1997; Rothaermel and Deeds, 2004; Van Looy et al., 2005; Jansen et al., 2005; Grover et al., 2007; O'Reilly and Tushman, 2008; O'Reilly and Tushman, 2013; Ferrary 2011; Wang and Rafiq, 2014; Lee et al., 2019; Vorraber et al., 2019). However, most of the literature has focused on leadership and organizations as complete entities. There has been very little focus on *teams* and the dynamics of how *teams* perform in the ambidextrous innovation management environment within the global Pharmaceutical Biotechnology Industry (PBI). As mentioned in the outset of this paper, *teams* are an essential element in any organization and even more so in the global PBI. Hence an analysis of what “makes or breaks” a *team's* ability to thrive in the innovation management environment within the PBI is critical to understanding survival. In addition, the impact of mergers and acquisitions is a composite part of the gap being analyzed in the current context of the global PBI.

1.3 Research question

The purpose of this paper was to conduct a qualitative, integrative systematic literature review of the dynamic capabilities associated with radical innovation and incremental innovation *teams* in the global PBI. There will be a structuring of the current knowledge and an appraisal of the gap in the literature to help formulate new knowledge in the innovation management research environment.

After looking at the gaps, the decision was made to use “dynamic capabilities” as a mechanism to explore its impact on ambidextrous innovation. The specific population chosen was *teams* in the PBI. The resulting main research question is: What are the moderating effects of dynamic capability on radical innovation and incremental innovation teams in the global PBI? Figure 1 shows an overview of the conceptual model of the constructs associated with the research question.

The additional supporting questions formulated are:

1. What constructs play strategic roles on the performance of innovative teams?
2. How are enterprises able to remain competitive in the tenuous environment of radical and incremental innovation in the PBI?

2 Method

2.1 Integrative systematic literature review

Govindan et al. (2015) stated that an integrative systematic literature review should involve several steps such as:

1. Conducting a survey of the available articles published on the subject.

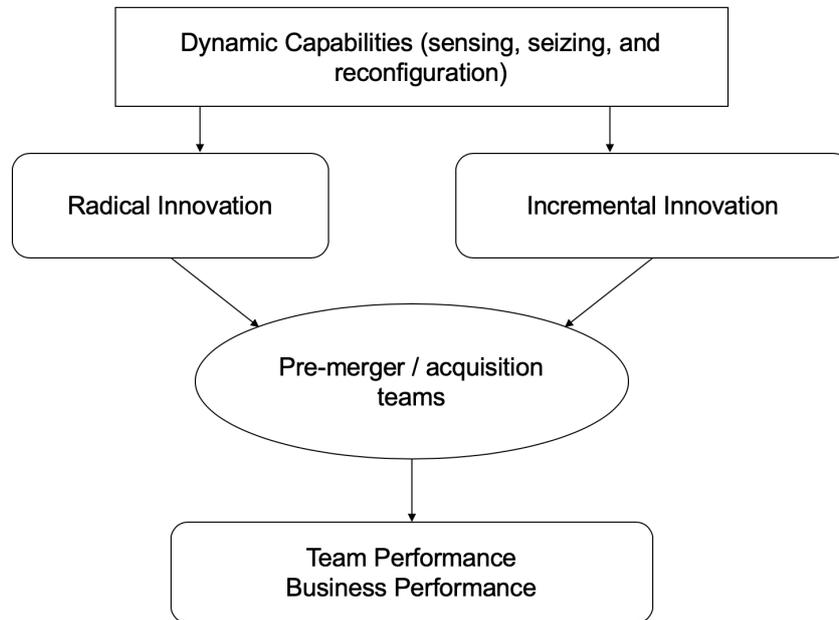


Fig. 1. Model of dynamic capabilities, radical and incremental (ambidextrous) innovation and teams conceptualized pre-research analysis.

2. Developing and use a structured classification coding system to clarify and provide structure to the existing knowledge on the subject.
3. Identifying the main results of the articles based on the coding system.
4. Analyzing the gaps as well as the opportunities and challenges for future studies.

Boolean search strings using keywords were developed and executed utilizing the University of Maryland Global Campus One Search tool. (See Table 1 for examples of search strings). The University of Maryland One Search tool consists of over 50 reputable databases such as Emerald Insight; Business Source Complete; JSTOR; Oxford Reference; PsycINFO; SAGE knowledge and ScienceDirect. In addition, the following other highly respected databases were explored: ABI/INFORM Collection; Dissertation and Theses Global (PROQUEST); Mendeley and Scopus. A few articles were found using snowballing after reading articles which would make up the final set of articles for analysis.

Table 1. Boolean search criteria utilized through University Maryland Global Campus One Search database tool.

| Search# | Boolean search strings | Results |
|---------|--|---------|
| 1 | Ambidextrous innovation peer reviewed only English | 833 |
| 2 | Radical Innovation and Incremental Innovation | 2518 |
| 3 | Radical Innovation and Incremental Innovation and Dynamic capabilities | 78 |
| 4 | Dynamic capabilities | 119,772 |
| 5 | Dynamic capabilities limiter 1995-2019 | 116,757 |

| Search# | Boolean search strings | Results |
|---------|---|---------|
| 6 | Dynamic capabilities and Innovation | 7,334 |
| 7 | Dynamic capabilities and Innovation and team* | 311 |
| 8 | Dynamic capabilities and Innovation and Ambidexter* | 169 |
| 9 | Dynamic capabilities and Radical innovation and Incremental Innovation | 74 |
| 10 | Dynamic capabilities and pharmaceutical | 1,172 |
| 11 | Dynamic capabilities and pharmaceutical and innovation | 143 |
| 12 | Dynamic capabilities and biotechnology | 2,261 |
| 13 | Dynamic capabilities and biotechnology and innovation | 284 |
| 14 | Socio-technical theory | 3,644 |
| 15 | Socio-technical theory and innovation | 921 |
| 16 | Team and Innovation and Ambidexter* | 168 |
| 17 | Knowledge management and radical innovation and incremental innovation | 489 |
| 18 | Exploration and exploitation and innovation | 2,522 |
| 19 | Radical innovation* and incremental innovation* and “team*”(2009-2019) peer reviewed only | 99 |
| 20 | ("dynamic capabilit*) AND (radical OR incremental OR ambidext* OR explorator* OR exploitat*) n5 innovat* (2009-2019) peer reviewed only | 306 |

After utilizing the Boolean operations two (2) final comprehensive search strings were developed. Final search string one (1) was for “targeted articles” using key study variables and search string two (2) was to ensure the search was comprehensive.

1. "radical innovation*" AND “incremental innovation*” AND “team*"
2. ("dynamic capabilit*) AND (radical OR incremental OR ambidext* OR explorator* OR exploitat*) n5 innovat*

Figure 2 captures the overall method applied for analysis of articles utilized in the research. After initial phase 1 exploration, the search for literature was narrowed down to 10 years from 2009 through 2019. The search criteria were narrowed even further to 2014 through 2019 to better understand the gaps in the literature and areas of opportunities for future studies. The following limiters were established for phase 2 of the search: (a) Peer reviewed only articles and (b) English only. Exclusion criteria were: (a) not education; (b) not university and (c) not school. In addition, no grey literature was included. Articles were then chosen based on an in-depth review of abstracts looking for empirical studies and strong conceptual/theoretical papers. A systematic checklist was used to further evaluate articles which would be surveyed/read in depth; the checklist looked at the following features: year of publication; sample size; study validity such as internal/external or scale reliability such as Cronbach’s alpha; study design; sample characteristics such as longitudinal study or cross sectional studies; findings and conclusions; limitations and constraints; research hypotheses and relevance of the article to the research question for this research paper. After the in-depth analysis of over 250 articles, a quality assessment tool was employed to choose the final primary articles for the research paper. The quality assessment

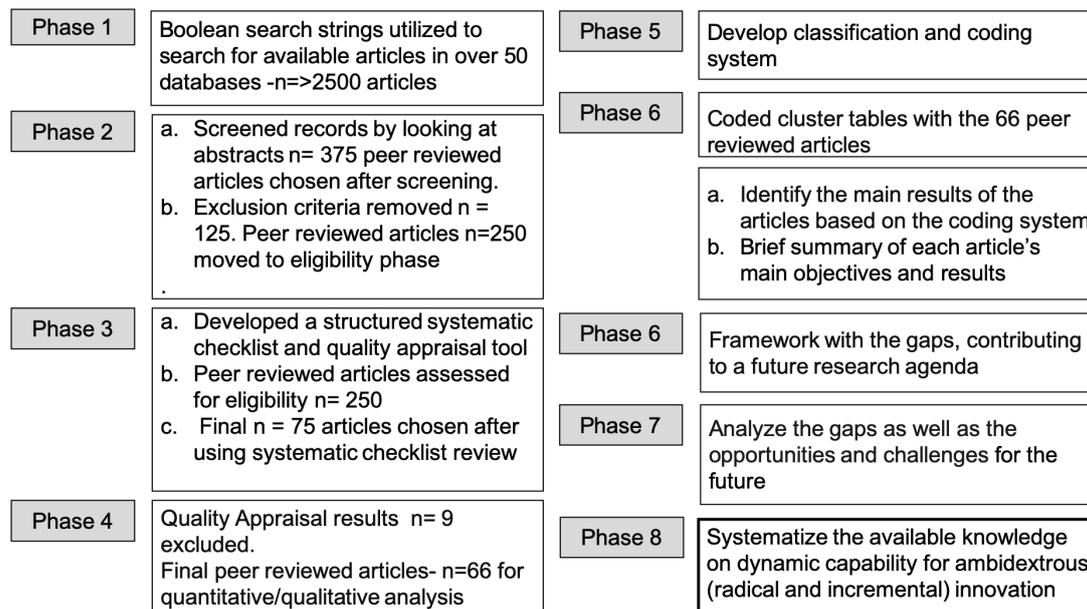


Fig. 2. The methodology phases of the integrative systematic research.

tool looked at the following features to establish rigor: transparency; accuracy; purposivity; utility; propriety; accessibility and specificity. Then the number of articles were narrowed down to 66 articles. A structured classification coding system was established; this included looking at SCOPUS citations as a criterion to establish credibility. Appendix A, Tables A.1 through A.8 features cluster tables with the coding of each article. Clusters were formed using titles and abstracts of the 66 articles chosen as final data set for the research. The methodology was rounded out by: (a) Identifying and analyzing findings; (b) Evaluating gaps; and (c) Challenges and opportunities for future studies. The value of the synthesis of scholarly articles was articulated by Vance et al. (2013). Vance et al. (2013) mentioned it was important not to be swayed by any single article, rather it was important to look at several articles. This look should be to the point of understanding that studies which could be regarded as “scientifically flawed” may in fact “energize the field” of study and drive researchers to “examine their phenomenon of interest in new ways” (p. 69).

2.2 Definitions

- *Radical Innovation* – (Sheng and Chien, 2016) defines radical innovation as involving “the acquisition of new knowledge and the development of new products for new customers or emerging markets” (p.2303). While Norman and Verganti (2014) views radial innovation as a change of frame (i.e., “doing what we did not do before”) (p.82). An example in the pharmaceutical biotechnology industry was moving from small molecules to large molecules such as biologics to cell-based therapy and now in the 21st century to gene therapy (modifying genetic coding) to cure diseases.
- *Incremental Innovation* – (Sheng, 2016) defines incremental innovation as “to enhance the

firm's existing knowledge and improve existing products" (p.2303). On the other hand, Norman (2014) views incremental innovation as improvements within a given frame of solutions (i.e., "doing better what we already do") (p.82). An example of this in the PBI is the improvements of vaccines, from a pentavalent vaccine to an 18 valent vaccine. A single dose of vaccine covering 18 different diseases.

- *Ambidextrous Innovation* - Zacher et al. (2016) elaborated that in the management literature, that ambidextrous innovation is the term employed to refer to an "organization's ability to explore new capabilities and, at the same time, to exploit their existing competencies".
- *Exploration* is defined as "generates new knowledge that supports disruptive innovations" (Ferrary 2011).
- *Exploitation* is defined as "industrializes and commercializes them [current innovations]" (Ferrary, 2011).

3 Background

3.1 Theoretical framework

Socio-technical theory (STT) was explored along with dynamic capabilities for this research paper. Dynamic capabilities were viewed as a mechanism or intervention for the research question which was being explored. The research question being analyzed is associated with *teams* hence there was the need to look at a theory associated with *team* behaviors. STT was chosen because it emphasizes the strong relationship between people, task, behavior and technology, which will be explored both from the STT vantage point but also the connection of STT to dynamic capabilities from a behavioral and technology perspective. Slayton and Spinardi (2016) contended that companies which operate under competitive innovative spaces must contend with being "compatible with a broader *sociotechnical* regime—a complex, heterogeneous, and interdependent network of organizations, artifacts, engineering practices, skilled workers, government policies, financing systems and consumers" (p.47).

Xiang et al. (2014) observed that STT perceives the group or company as a work structure with two interconnected substructures: the technical structure and the social structure. The technical structure is concerned with the "processes, tasks, and technology" needed to convert inputs such as drug substances to outputs such as drug products; the social structure is concerned with the interactions among "people and their attitudes, skills, and values". The outputs of a work structure are a result of the shared interface between these two structures (p.775).

While Klein (2014) made the critical observation, STT "makes explicit" that technology and people are "interdependent" (p.138). Technology affects the behavior of the people and the behavior of the people affects the "working of the technology". This connection begins at the design and development stages of the technology. Klein (2014) furthers the examination by stating that factors which impact the outputs at the end of a technology implementation also affect the inputs at the beginning. This interdependence becomes a crucial part of the argument

being constructed to support innovation management in the presence of ambidextrous activities. The distinction between the "social" constructs and the "technology" constructs in the PBI must be understood along with its impact to *teams*. The research in this area lends support to understanding the underpinnings of STT when supported by a framework. This lends more value to *teams* existing in a radical innovation space within the PBI. The underpinnings of *socio-technology* constructs with the dynamic capabilities conceptual framework becomes the basis for this research paper.

3.2 Conceptual Framework

There are multiple definitions associated with dynamic capabilities. Dynamic capabilities were defined by Dora (2015) as a new construct with "the ability of firms to innovate and create value for the company's resources to deal with environmental changes both inside and outside the company" (p.9). A strategic management researcher, (the originator of the term dynamic capabilities), Teece et al. (1997) referred to dynamic capabilities as the "the capacity to renew competencies so as to achieve congruence with the changing business environment". This is done by "adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competencies" (p.515).

Teece (2007) conceptualizes dynamic capabilities from four (4) distinct yet pivotal angles as illustrated in the conceptual diagram in Figure 3. For this study dynamic capabilities and its moderating effects are being explored from the perspective of *teams* in the PBI using the core elements of Knowledge Management; Co-specialization; Governance and Decentralization/Decomposability. Teece (2007) further proposed three organizational and managerial processes: (1) Coordinating or integrating; (2) Learning; and (3) Reconfiguring as core elements of dynamic capabilities. These processes are a subset of the ones that support "sensing, seizing, and managing threats". Together they might be thought of as "asset 'orchestration" processes (Lessard et al, 2016, p. 222). The conceptual framework makes abundantly clear the complex nature of innovation in the PBI.

Teece (2007) updated his 1997 definition of dynamic capabilities by stating that it "refers to the capabilities of a company to integrate, build, and reconfigure internal and external resources/competencies to innovate in rapidly changing environments. Teece (2007) is renowned (over 3,500 Scopus citations) for the further definition of dynamic capabilities which states:

For analytical purposes, dynamic capabilities can be disaggregated into the capacity (1) to sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets (p.1319).

On the other hand, (Wang and Ahmed 2007) made the connection between dynamic capabilities and behavior by defining dynamic capabilities:

As a firm's behavioral orientation to constantly integrate, reconfigure, renew and recreate its resources and capabilities, and most importantly, upgrade and reconstruct its core capabilities in response to the changing environment to attain and sustain competitive advantage (p.31).

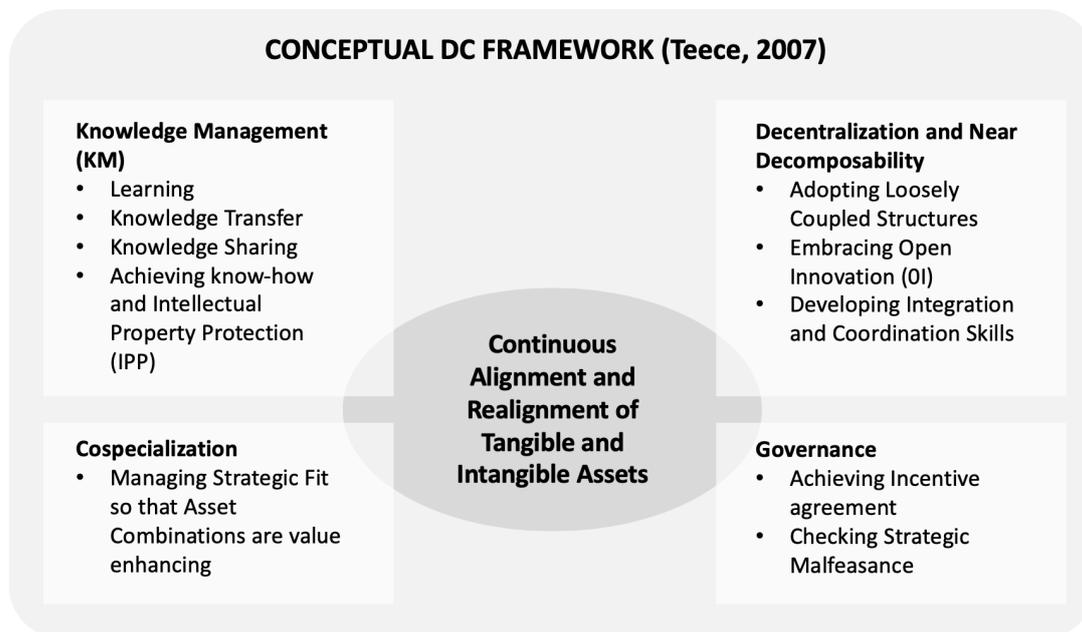


Fig. 3. The dynamic capabilities model “Combination, reconfiguration, and asset protection skills”. (D. Teece, 2007, p.1340)

This connection to behavior will also be used to underpin STT to the research and its association with dynamic capabilities for this research paper.

At the core of dynamic capabilities is the ability of senior managers to “seize opportunities through orchestration and integration” (O’Reilly, 2008, p.188). The ability to learn new routines is seen as an “underpinning of long-term competitive advantage” associated with senior *teams* (p.187). The current research for this paper can thereby take the argument further to posit that ambidextrous innovation *teams* must search for synergy between the radical innovation teams and the incremental innovation teams by “sensing and seizing opportunities and managing threats” (Teece, 2007, p.1341).

According to Teece’s (2007) model, knowledge management covers the following: (a) Knowledge transfer; (b) Knowledge sharing; (c) Learning; (d) Know-how integration; and (e) Achieving know-how and intellectual property protection. This larger focus on knowledge management is a direct match for the associated activities within the knowledge intensive arena of the global PBI. This understanding is critical when analyzing the dynamics being faced by the PBI with the never-ending quest for acquisitions and mergers.

4 Literature review

Christensen (1997; 2016) seminal work makes the case for *teams* in line with this research paper. He posited that organizations capabilities lie with “its people” (p.168). Further, he theorized that in the innovation space that *teams* and in particular “heavyweight teams” perform best

in the dynamic environment of radical innovation (p.178). This conjecture supports the idea of creating two (2) separate *teams* in the innovation management of the PBI. One would be centered around radical innovation (exploratory) and other to support incremental innovation (exploitative) capabilities.

Christensen (1997; 2016) further discusses the special needs of *teams* who operate within the scope of mergers and acquisitions by noting that the *team* members are not only learning “new processes, new ways of working” which in turn switches over to “new capabilities” but they are “charged to act like general managers, making decisions and trade-offs” in the innovation space (p.178). This autonomy is the crux of the argument associated with this research paper, challenging that more research is needed in the global PBI to examine the dynamic capabilities of *teams* in the environment of ambidextrous innovation. The seminal work by Christensen (1997; 2016) only dedicated one (1) chapter to *teams*, the rest of the research was centered on the organizational and leadership aspects of innovation management. This observation also supports the gap recognized in the literature as alluded to earlier in this research paper.

4.1 Radical Innovation

Evaluation of the data showed, eight (8) of the 66 articles out of the bibliographic database centered on radical innovation. Many of the articles accentuated the relevance of radical innovation to the PBI. Slayton (2016) findings are particularly relevant to understanding the challenges facing “commercialization of radical innovations (for example, biotechnology)” (p.55). Slayton further made a salient point that “classic distinction between process and product innovations maybe misleading in such emerging areas” such as the PBI (p.56). This article was a unique article because of its significance to this research paper due to the research looking at STT (people, behavior, skills) and radical innovation simultaneously. On the other hand, (Cheng et al., 2016) results revealed that the effects of open innovation inbound and outbound activities on radical innovation are contingent on both *knowledge acquisition* and sharing capabilities. While, Carlo et al. (2012), evaluated knowledge diversity, depth, and linkages which are tied to the level of radical innovation in the organization. In addition, Fores and Camison (2016), study emphasized the multi-dimensional nature of this complex construct, and explicitly recognizes the importance of transformation capability. This capability is the combination of new external knowledge with the existing knowledge base and mental models. The purpose of doing so is to create a more tacit and specific knowledge that is not observable easily and thus imitated by competitors. Zhou and Li (2012), determined that firms with a broad and deep knowledge base could develop radical innovation in the presence of internal knowledge sharing rather than external focused market knowledge acquisition. Norman (2014) observed that radical innovation is “what everyone wants” given its significant potential to differentiate successful organizations. Further observation by Norman (2014) was, “successful radical innovation is surprisingly rare, and most attempts at it fail” (p.83). Lassen et al. (2006), study solidifies the discussion of radical innovation by linking it to “proactiveness, risk-taking, autonomy, and competitive aggressiveness” which causes stimulation and development of radical innovation (p.363). Kelley et al. (2011), research resonates with this research paper by identifying that not only must *team* members have high expertise and diverse thinking, but their behaviors must be considered. Kelley (2011)

positioned that “innovative capabilities are more than an orientation, but also a skill that can be identified and observed in one’s behavior, and perhaps developed” (p.260). It is therefore critical for managers in the radical innovation environment to understand this concept and ensure *teams* are structured based on this knowledge. One of the most profound findings in this study was the feedback from the participants in the research. It was proposed that management and organizations needed to support and accept “failure” in a radical innovation environment (p.264). Only when this happens can *team* members surmount many obstacles to bring cutting edge technology to the market.

4.2 Incremental Innovation

Further evaluation revealed that seven (7) of the 66 articles from the bibliographic database centered on incremental innovation and its relevance to the PBI. Several studies examined *team* efforts for incremental innovation “encourage teamwork, *team* decision making, and internal communication” (Doran and Ryan, 2014; Beck et al., 2016; Sheng, 2016). The studies made the connection of incremental innovation to learning. Learning orientation in high-technology firms occurs when core organizational competencies continually develop and refine, thereby maintaining the competitive advantage of a firm within the focal market (Sheng, 2016). Learning orientation in high-tech firms such as the PBI can thus cause them to fail to appreciate the wider context in which learning takes place such as the need to move away from incremental innovation and pivot towards radical innovation. The creation of procedures enables incremental innovation *teams* to “sense” or are alerted to “threats and opportunities” as part of maintaining a strategic competitive edge (Beck et al. 2016, p.872). This becomes a critical decision-making intersection for *team* managers to support incremental innovation.

Doran and Ryan (2014) postulated that several skills are critical for incremental innovation, “problem solving skills, market research skills and management skills” (p.107; p.109) The process of learning orientation involves responding to market conditions. This is a critical point to take into consideration when forming *teams* in the PBI. Most scientists in the PBI arena need to acquire or learn marketing and management skills. Doran (2014) further expounded on the need to distribute the resulting knowledge within the organization and take responsive actions internally and externally. This point supports the mergers and acquisitions constructs which are routine in the PBI.

Fores and Camison (2016) findings provided support for the view that as “firms develop their internal knowledge creation capability, they are better able to apply the new knowledge created to refine and extend product, process and management methods” (p.844). This argument supports the “generation of incremental innovation performance, but not radical innovation performance” (Fores, 2016, p.844). Norman and Verganti (2014) further positioned that incremental innovation refers to the “small changes in a product that help to improve its performance, lower its costs, and enhance its desirability, or simply result in a new model release” (p.84). This study made a strong statement in support of incremental innovation by noting that “successful products undergo continual incremental innovation, intended to lower their costs and enhance effectiveness” (Norman, 2014, p.84). Further postulation by (Chen et al, 2014; Mei et al., 2013) supported that there was need for balance of ambidextrous (radical and incremental) innovation. Chen et

al. (2014) further contended that “pursuit of both exploration and exploitation (ambidexterity) is one of the key determinants of innovation outcomes” (p.7792). This need recognizes that there is “short term efficiency” to be gained by improving “existing products”. However, as noted incremental innovation is not sustainable in the face of market and technological shifts (Mei, 2013, p.5). This observation puts more onus on *team* managers to recognize the delicate balance needed between radical innovation and incremental innovation.

4.3 Dynamic capabilities

Among the 66 articles from the bibliographic database, the total of 15 articles were chosen under the topic of dynamic capabilities. The articles featured in this discussion (Teece, 2007; O’Reilly and Tushman, 2008; Ambrosini et al., 2009; Cetindamar et al., 2009; Hung, et al., 2010; Gao and Tian, 2014; Tseng and Pei-Shan, 2014; Arifin and Frmanzah, 2015; Lessard et al., 2016; Shin, et al. 2016; Prescott, 2016; Dangelico, et al., 2017; Hasegan, et al., 2018; Wang and Hsu, 2018; Shan, et al., 2018;) viewed dynamic capabilities as the mechanism by which innovation is driven or hindered. These articles ran the gamut in terms of types of studies over a 10-year period solidifying the strong tie between dynamic capabilities and innovation. Prescott (2016) captured the essence of dynamic capabilities in the PBI by stating that they include “capabilities and routines for acquisitions or mergers, for research and development, for business process reengineering, for quality control, and for technology transfer” (p.94).

There are several good examples of the effects of dynamic capabilities in the PBI. Gillespie et al., (2019) detailed the collaborative efforts of Pfizer, Novartis, Takeda, Johnson & Johnson, Astra Zeneca, Sanofi and Merck to name a few multinational global pharmaceutical biotechnology companies. Many of these organizations had to use Open Innovation, going as far as setting up global platforms to support research and development while forming affiliations and consortiums with academia (pp. 68-69). Furthermore, use of social media platforms, crowdsourcing and outsourcing became the new age way of doing business in the 21st century (p.63).

In addition, Pfizer, Novartis and other top-ranking pharmaceutical organizations decided to move away from historical pharmaceutical small molecule products to large molecules biotechnology products. There has been a more recent leap towards gene therapy, the cutting-edge technology utilizing genetic modification to treat patients both in oncology and rare disease settings. Pfizer who is renowned for its vaccines sensed the change in the types of medicine and treatment for oncology and the unmet needs of rare disease, it quickly acquired a small gene therapy biotechnology company, Bamboo Therapeutic, in 2016 with rapid expansion as part of its acquisition vision (pharmaceutical-technology.com, 2018). Novartis renowned for its deep pipeline of oncology drugs sensed the rapid growth in the gene therapy arena and acquired the gene therapy company, AveXis, in 2018 (Novartis.com, 2018). Both Pfizer and Novartis sensed the threat of medicines going off patent as well as the trajectory in different treatment plans for oncology patients and rare diseases. They both had to seize the opportunities either to acquire organizations using cutting edge technology such as gene therapy and reconfigure their areas of expertise by way of mergers and acquisitions. Divestment of their portfolios was a strategic effort on the part of both Pfizer and Novartis to ensure both entities could remain competitive and solvent.

Wang and Hsu (2018) posited that critical theory and practice of dynamic capabilities indicates a firms' competitive advantages, particularly in complex, volatile, and uncertain external environments such as the PBI. Furthermore, capabilities are shared within organization *teams* before being distributed across the firm. A firm's ability to absorb knowledge or its absorptive capacity proves that it possesses learning capability. The data indicated that learning capability is the most critical interaction factor for firms in the PBI. The most interesting part of this finding is that organizational *teams* are being associated with *learning*, a dynamic capability moderator as noted in Teece's work.

Lessard et al (2016) expounded on the effect of dynamic capabilities that allow a firm to "sense and seize opportunities or threats, and integrate, build, and reconfigure" internal and external resources and routines to address rapidly changing environments. Dynamic capabilities are rooted in high-level routines and analytical methodologies that determine the speed and degree of aligning specific resources. This enables modification or even transformation continuously in order to match the requirements of the business environment (p.214). Lessard et al., (2016) stated that dynamic capabilities are reliant on the organization's values, culture, and collective ability, which mainly result from past management efforts and are embedded in the organization's habitual domains. This argument is quite profound because *teams* are not being recognized as part of the intangible or tangible assets of the organization. It also supports the gap noted earlier in the research paper. Furthermore, it should be mentioned that "analytical methodologies" indicated earlier are performed by highly skilled *teams*. Hence during mergers and acquisitions it is important to ensure that this aspect of dynamic capabilities is addressed appropriately.

4.4 Teams

Quite striking in the research was the fact that only four (4) articles of the 66 articles in the bibliographic database for this research paper focused on *teams* in radical innovation and incremental innovation. This lends support to the gaps observed in the literature within the radical innovation and incremental innovation in the global PBI previously stated in this paper. The research by Patanakul et al. (2012) confirmed that "heavyweight *teams*" consist of a core group of people who are typically dedicated and physically located near each other. The distinguishing feature of this *team* is the authority or weight of the project manager. Advantages of "heavyweight *teams*" include effective coordination across disciplines, a feeling of being on a *team* with a shared sense of purpose and mission, and the authority to complete the job (p.736). These observations are in sync with the writings of Christensen (1997;2016) around the importance of "heavyweight *teams*" in innovative spaces in radical innovation.

Heavey and Simsek (2014) recognized the behavioral element of *teams* was important to radical innovation and incremental innovation by stating that "behavioral integration explains how top management *teams* meet the integrative challenges of ambidexterity" (p.19). In addition, it was noted in the study that "knowledge can be cultivated and exchanged" in the ambidextrous environment due to the intellectual capacity of the *teams*. The study did not emphasize *teams* at the cellular level, at the technical specialist levels but focused more on *teams* at the senior managerial level and CEOs. This observation lends more credibility to the fact that there is

a gap in the literature for radical innovation and incremental innovation *teams* in the global PBI.

The study by Alexander and van Knippenberg (2014) underscored that the more radical the innovation, the less *teams* can rely on prior competencies, knowledge, and experience, because these may in part or whole be inadequate or extraneous. This means that *teams* must invest in developing new competencies and knowledge to be able to successfully pursue radical innovation. Learning and development are integral parts of the radical innovation process. Learning from failure is essential, if not *teams* may take the option of less radical alternatives. Therefore, unless *teams* pursuing radical innovations respond effectively to negative feedback and rejection from senior management and view failure as an opportunity to learn, the stream of radically new innovative ideas critical for organizational growth will decline (p.428). *Teams* must act as dynamic systems that respond to shifting demands (p.434).

Another study by Nissen et al. (2014) recognized that “knowledge sharing, and the building of a shared knowledge base are needed to deal with [team] heterogeneity” (p.479). It is important to effectively balance the “different complementary knowledge bases” which are attached to “tacit knowledge held by *team* members”. The study underscores that “re-establishment or re-creation of shared knowledge” bases are needed because shared knowledge bases are not “static” communal pools of knowledge (p.480).

4.5 Knowledge Management

Subsequent evaluation revealed that nine (9) articles out of the 66 articles in the bibliographic database featured knowledge management and its link with innovation. Early into the research for this paper, and as noted in previous sections of the paper, the connection of knowledge with innovation was made in past research. However, it is critical to understand the different facets of knowledge to be able to understand the types of connections to innovation. Knowledge is categorized into tacit and explicit patterns. Tacit knowledge is defined as personal knowledge embedded in individual experience that involves intangible factors such as personal belief, perspective, and value system (Yu et al., 2013, p.146). This type of knowledge is not easily transferred or cannot be written down. In contrast, explicit knowledge is defined as knowledge which can be articulated in formal language including grammatical statements, mathematical expressions, specifications, manuals, and so forth (Yu et al., 2013, p.146). A key facet of the study by (Yu et al, 2013) is the moderating effects of knowledge and by deduction dynamic capabilities is quite striking in the innovation space. In addition, the association of innovative behavior and its effects not only at the individual level but at the *team* level. This supports the use of the STT used to underpin the current research paper due to behavior and culture being associated with knowledge management a dynamic capability moderator.

It is imperative with this understanding of tacit knowledge for the PBI to codify and convert tacit knowledge to explicit knowledge in the form of data capturing tools, operational manuals, operating procedures and other learning tools after mergers and acquisitions. In addition, with the advent of Big Data, most pharmaceutical and biotechnology must have data analytics tools

in place to capture the tacit knowledge and convert it to knowledge which can be replicated and used for decision making.

Schneckenberg et al. (2015) study revealed that innovative capabilities of firms in fast moving, fast markets rely more on creating and sharing higher-level contextual knowledge than on reusing existing knowledge. This focus on contextual knowledge is essential for innovative performance, as firms in fast-moving markets require a continuous evolution of dynamic capabilities (p.359). Work organization in innovation projects occurs mostly at the group level while project *teams* define targets and specify resource requirements. It is important to take note of the power of *teams* in this context.

Basnayaka & Jayakody (2018) study showed that knowledge management practices resulted in *team* performance. Furthermore, the study showed that the theory of dynamic capabilities may be a useful conceptual framework for understanding the relationship between a *team's* knowledge management practices and its performance (p.22). The connection of dynamic capabilities to acquisitions and mergers further underpins the connection of dynamic capabilities to “resource endowment” in response to external partners. This connection ultimately determines *teams* and associated organizational competitive edge.

Learning. The observation was made by (Sheng, 2016) that there was the “need to resolve the strategic dilemma and overcome the myopia of learning orientation, high-technology firms can implement exploratory learning, which involves learning and acquiring knowledge outside existing customer boundaries and often entails experimentation and risk-prone behavior” (p.2307). Hannachi (2016) expounded on the value of learning and the connection to *teams*. This idea of acquiring, sharing and developing knowledge is recognized as value that organizations is carried out in the *team* environment (pp.51-52). Therefore, this needs to be nurtured and promoted at the individual and *team* level for competitive edge. Overall, learning is critical to innovation and particularly in high technology organizations like the global PBI.

Knowledge Transfer. In knowledge transfer, an enterprise should encourage their employees to proactively retrieve, filter, store, transfer, and share knowledge from individuals to the organization (Tseng, 2014, p.172). Knowledge management capability is significantly associated with the degree of dynamic capabilities and organizational performance and by extension *team* performance. The factors of knowledge management capability show a significantly positive correlation with dynamic capabilities and organizational performance. This means that if the knowledge management capability factors in knowledge transfer and knowledge protection as superior, it can significantly enhance dynamic capabilities. This implies that knowledge transfer can effectively enhance dynamic capabilities and organizational performance rather than knowledge protection.

Knowledge Sharing. Yu, et al., (2013) observed that “to survive in a highly competitive environment, enterprises must continue to focus on innovation derived from knowledge” (p.143). The authors further theorized that

when organizations are facing a competitive environment with trans-national and trans-team characteristics, knowledge sharing should achieve trans-disciplinary integration and those working to promote knowledge sharing in their organization should identify and utilize factors that

promote knowledge sharing at multiple levels instead of focusing only on sharing and transfer itself” (p.144).

The magnitude of knowledge sharing therefore is critical to sustainability particularly in “fast industrial and technological shifts” such as in the global PBI. Thus, organizations can convert tacit and explicit knowledge into strengths.

Knowledge sharing interactions of *team* members often reach beyond the work group to expert communities, for example to access complementary knowledge inflows or to evaluate the potential value of innovative technologies for the project context (Schneckenberg et al., 2015, p.364). One area of dilemma that is being faced at this juncture is when *team* orientations become very rigid or unyielding. This run counter to the idea of knowledge sharing hence an awareness need surfaces and must be tended by managers in this environment to support knowledge sharing.

Tseng (2014) stated that the “knowledge infrastructure includes technology, structure, and culture; while knowledge management processes include the organizational capabilities of knowledge acquisition, conversion, application, and protection. Simultaneously, in order to effectively leverage knowledge infrastructure, it is crucial to rely on knowledge management processes, which makes it possible to store, transform, and transfer knowledge” (p.159). This is yet another observation which ties together the underpinnings of the chosen theory STT with dynamic capabilities as being integral to understanding how *teams* operate in the PBI innovation arena

Knowledge sharing promotes internalization of a greater amount of knowledge. Such conditions benefit innovative behavior. Personal innovation is affected by cognitive ability, character, knowledge, inner motives, and social networks; noted that faster knowledge transfer through sharing helps cultivate the ability to think and create. Socialization, externalization, combination and internalization have been identified as conducive to knowledge creation and exchange showed that top-down, bottom-up, and horizontal knowledge flows all affect the innovative behavior of midlevel managers (Tseng, 2014, p.145). An organization itself is unable to create knowledge and individuals are the medium to spread knowledge through sharing. The organizational culture in each department may cause variations in organizational atmosphere among departments. Such variations influence employees’ perceptions of atmosphere and their behavior (Tseng, 2014, pp. 146-147). Therefore, managers in the global PBI should actively strengthen employees’ understanding of knowledge sharing so that employees can share knowledge in an unrestricted manner. The more that employees are involved in individual knowledge sharing, the more such knowledge is internalized (Tseng, 2014, p.152). Organizational innovation climate is an organizational-level issue, whereas knowledge sharing, and employees’ innovative behavior are individual-level issues. These issues should not be treated as a single-level problem (Tseng, 2014, p.153).

4.6 Open Innovation

This topic featured eight (8) papers out of the total 66 articles from the bibliographic database. Cheng et al., (2016) and Ferrary (2011) studies observed very specific findings associated with open innovation, *knowledge acquisition* and knowledge sharing:

1. In the open innovation paradigm, specialized organizations that outsource innovation and focus on exploitation can be more competitive than ambidextrous organizations.

2. Innovation life cycle should be understood and managed as an inter-organizational process instead of as an intra-organizational one.
3. The effectiveness of an acquisitive strategy depends partly on the firm's capability to nurture informal social ties with the network of organizations bearing innovations, such as research labs.
4. Implementation of an outsourcing strategy of innovation depends on the embeddedness of the firm in its business environment.
5. Organizations should have an embedding strategy to access information on innovation.

Amponsah and Adams (2017); Shi and Zhang (2018); Kang and Hwang (2019) studies confirmed the strong relationship with knowledge, ambidextrous innovation and open innovation. Amponsah (2017) concluded that classification of "open innovation requires a balancing act of knowledge exploration and exploitation (ambidexterity) for commercialisation of the firm" (p. 1750027-18). This was one (1) of the few studies that made the connection between systemization and open innovation at all levels of the organization including the individual level and group level (*teams*). Shi and Zhang (2018) observed the need for "open innovation networks" and the development of strong relationships with "knowledge transfer" being a top priority (p.592). Peris-Ortiz et al (2018) study confirmed the connection of open innovation to radical and incremental innovation in knowledge-based companies. These findings are quite relevant to the PBI because open innovation has become one (1) of the strategic mechanisms to support competitive edge.

Gassmann et al., (2012) observed that network building comprises measures to establish personal networks between senior and middle managers of exploration units (teams) and operational business based on social platforms. Direct exchange and communication are regarded crucial for the formation of personal linkages. The personal contacts are used to identify and interact with innovation champions throughout the company. This network discussion ties in with the STT theory utilized for this research as well the open innovation, dynamic capabilities and knowledge management discussions. The synergy in these areas must be captured and nurtured during mergers and acquisitions in the PBI.

4.7 Ambidextrous (Explorative and Exploitative) Innovation

The final clusters of 15 articles within the 66 articles for the bibliography database were related to ambidextrous innovation also known as exploitative innovation and explorative innovation. These articles were accessed and reviewed together because of the inter-connectedness of the subject areas associated with innovation. One observation which was a common theme was the need for effective *team* leaders to foster both exploitation and exploration, and switch flexibly between them (Rosing et al., 2011). Hoang and Rothaermel, 2010; Soosay and Hyland, 2008; Wang and Rafiq, 2014; Andriopoulos and Lewis, 2009; Wang et al., 2014; Martini et al., 2013; Gilsing and Nooteboom, 2006; Dunlap et al, 2016; examined exploratory innovation and exploitative innovation from the following perspective: (a) meeting the emerging market and customer needs; (b) carrying out new designs; and (c) developing new markets or opening new distribution channels relying on new knowledge. By doing these activities organizations can accomplish the following: (a) broaden the breadth of knowledge; (b) produce a series of product and process

innovations; and (c) improve the flexibility and diversity of the organization. It therefore becomes critical for leaders and managers to understand how to position *teams* to be exploitative and explorative simultaneously in the PBI.

On the topic of ambidextrous innovation, (Yi et al. 2019; Martini et al., 2013; O'Reilly and Tushman, 2008; Lee et al., 2019; Vorraber et al., 2019; Dunlap et al., 2016; Jansen et al., 2012), postulated that ambidextrous innovation requires both "opening and closing" capabilities to remain competitive. In addition, Zacher et al. (2016) verified that *team* leaders needed to engage in both "opening and closing" or ambidextrous behaviors to produce high levels of innovation. However, risk tolerance plays a role in the effectiveness of *team* leaders. The research found that risk-taking managers tended towards exploratory (radical) innovation and risk-intolerant managers tended towards exploitative (incremental) innovation. This knowledge should help leaders to position the risk tolerant managers and *teams* in the radical innovation environment or explorative innovation space not in the incremental innovation space.

5 Analysis

Two (2) areas closely connected came to the surface during the quest for answering the research question and it was the deep connection between *knowledge acquisition* and open innovation. These two elements are closely associated with the Teece's framework and the conceptual framework being featured in this research paper. However, *knowledge acquisition* was not specifically called out in the Teece framework. This deep and profound connection was not evident at the outset of the research but in looking more in depth at the research being explored this connection surfaced in the literature. Gedvilaitė (2015) and Fores (2016) among other studies observed the close-knit connection to *knowledge acquisition* and innovation, Fores (2016) used the word "symbiosis" which gives the connotation that both knowledge acquisition (internal and external) and radical innovation feeds and thrives directly off of each other (p.835). In addition, Gedvilaitė (2015) saw that "*knowledge acquisition* is important to apply, store, share and preserve vital knowledge resources" (p.25) and view "*knowledge acquisition* as partnerships, recruitments or organic growth, company acquisitions and internal learning" (p.45). Therefore, the conclusion one can draw from this analysis is that *knowledge acquisition* has been identified as a source of competitive edge.

This observation should not be lost on organizations, managers and leaders in the global PBI. The management and care of knowledge that is acquired should be on the top agenda of any CEO and manager of *teams* in the PBI. The ability to harness this source of power in any organization by hiring a Chief Information Officer to oversee *knowledge acquisition* aspects of the organizations being merged or acquired. Prioritization of this often-overlooked area should be given and be added to the overall vision and strategy of organizations in the PBI.

Several articles featured in this systematic literature review transcended major key areas being explored in this study, for example several articles researched featured knowledge management, dynamic capability and ambidexterity in combination. Thereby reinforcing the deep connectivity of the conceptual framework to this area of research. This lends credibility to the research method and search criteria employed for this study. The following studies: (Jansen et al., 2005; Jansen

et al., 2008; Bierly, et al., 2009; Jansen et al., 2009; Faffery, 2011; Jansen et al., 2012; Norman and Verganti, 2014; Fores, 2016; Kang and Hwang, 2019a; Kang and Kim, 2019b); encompassed several of the keywords, constructs and key ideas as can be noted in their abstracts. This connection was on a multi-dimensional level such as looking at radical innovation, open innovation in combination with knowledge management and/or dynamic capabilities. These studies were comprehensive in nature and helped to determine that there is opportunity for future studies associated with ambidextrous innovation *teams* in the PBI. The gap in the literature was quite evident that *teams* and the dynamics of *teams* operating and functioning in the global PBI is lacking. Furthermore, this gap needs to be addressed to create new knowledge and support *knowledge acquisitions* during mergers and acquisitions. These areas having been identified in this study serves as precursors for future research.

6 Findings and managerial implications

The moderating effects of dynamic capabilities on *teams* in the PBI are centered on rapid team alignment with the triplex of sensing, seizing and managing threats [reconfiguring] (Teece, 2007). Table 2 captures the research findings. Figure 4 is the updated conceptual model post research analysis of Figure 1.

Table 2. Research finding showing relationships of innovation to knowledge management and moderating effects

| Innovation type | Knowledge management type | Moderating effect |
|------------------------|---|--------------------------------|
| Radical innovation | Knowledge transfer Knowledge share Knowledge creation | Positive |
| Incremental Innovation | Learning | Positive |
| Open Innovation | Knowledge acquisition | Positive on radical innovation |

Knowledge management is the most impactful element of dynamic capabilities in the PBI followed closely by intellectual property protection. By seizing new knowledge, sensing tacit knowledge, reconfiguring explicit knowledge and implicit knowledge, *teams* constantly seek the advantage through radical innovation. This is accomplished by *teams* through transferring, sharing and creating knowledge which determines the success of *teams*. Knowledge sharing strengthens existing professional knowledge, enhances internal work coordination and consistency in employees' behavior, and effectively integrates diverse *team* knowledge and experience (Yi et al., 2019). This huge responsibility is borne by technologists or specialists, but their role is not emphasized in the literature. The literature is extant on how teams are affected by governance, a dynamic capability element. Open innovation, another critical dynamic capability element, enables knowledge acquisition from external sources, knowledge sharing and know-how (internal sources) into a symbiotic relationship (Fores, 2016). Open Innovation has a positive effect on radical innovation (Cheng et al., 2016). Learning orientation which is refining existing knowledge and processes has a stronger effect on incremental innovation than on radical innovation (Sheng, 2016).

Zacher et al. (2016) along with other researchers have proposed that ambidextrous organizations are more successful because of their greater capacity to innovate. The research has shown that organizations with high levels of both exploration and exploitation activities have higher sales growth rates and organizational performance than organizations with low levels in either or both activities. Senior leaders must give *teams* the autonomy to make decisions from a technical perspective even if this means failure (Alexander, 2014). Due to the nature of the technology, *teams* must be allowed to explore and exploit simultaneously in the innovation space for organizations in the PBI to outperform their rivals. This requires managers to be sensitive to balancing *team* activities of radical innovation and incremental innovation.

Knowledge sharing and knowledge transfer must be managed in a systematic way to retain authenticity of information. Tacit knowledge by its very nature will need to be transferred on a larger scale to help with new knowledge creation. Based on the findings, open innovation, must be promoted during mergers and acquisitions and should be a value enhancing activity. On the other hand, investments in learning orientation for teams should be given priority during and after acquisitions and mergers. The value of knowledge acquisition must be explored, quantified and become a core central element of innovation particularly in the open innovation spaces after mergers and acquisitions have taken place. The global PBI environment is ripe with knowledge intensive *teams* and managers need to recognize and capitalize on this to be successful and remain competitive.

The PBI outranks all other industries in terms of mergers and acquisitions as previously stated by the United States of America Government Accountability Office. Therefore, this research paper is bringing to the forefront the salient message that innovation at all levels (radical, incremental, open) must be addressed in terms of knowledge management. The need for pharmaceutical and biotechnology entities to remain competitive should motivate leaders within the industry to support *knowledge acquisition* not only in words but also by actions such as providing resources for data protection. Consequently, this research should serve as impetus to garner knowledge in its various forms (sharing, transferring, acquiring) and treating it as tangible assets during mergers and acquisitions.

The case history of Pfizer and Novartis mentioned earlier in this research paper plays into the management implications. The acquisitions and mergers entail the merger of *teams* across an established entity and a newer organization. It is therefore of great value to ensure that both entities on either side of the paradigm shift maximize the opportunities for growth within and outside of the *teams* involved in these transactions. This can be done by ensuring the dynamic capabilities of open innovation, knowledge management, and most critically *knowledge acquisition*, are given the greatest priority. Gillespie, et al (2019) concurred with this deduction by stating both open innovation and knowledge management must be viewed as “strategic capability alignment” (p. 70) towards a sustainable business model in support of radical innovation and incremental innovation (ambidextrous innovation).

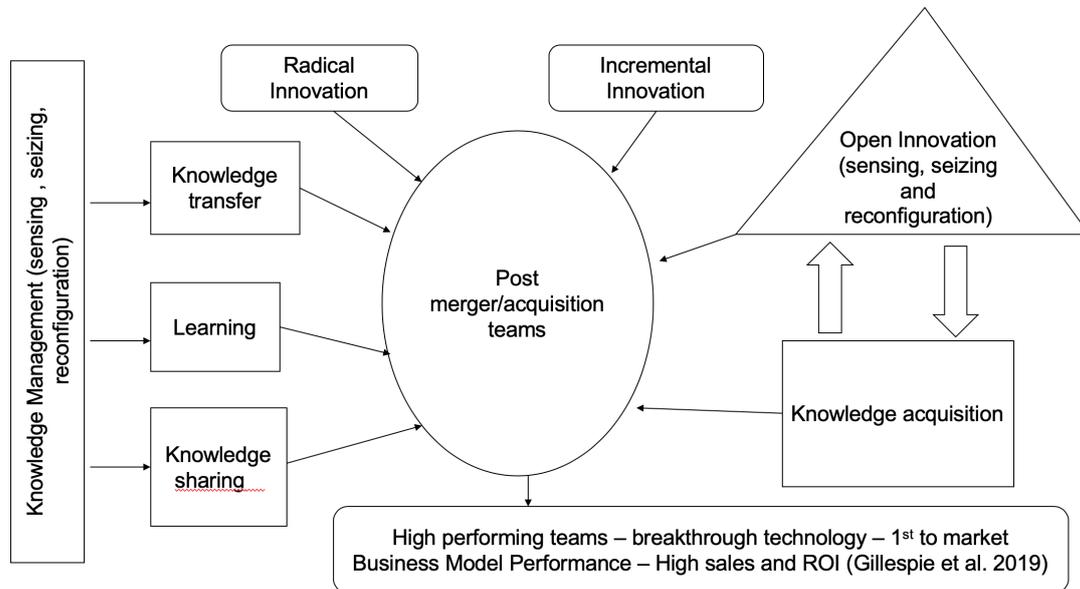


Fig. 4. Model of dynamic “knowledge management” capabilities, radical and incremental (ambidextrous) innovation and *teams* conceptualized post research analysis.

7 Limitations and future research

The limitations of the study are intrinsic to a systematic literature review, as this research approach does not uncover causality. Hence a longitudinal study of *teams* in the PBI would support a deeper understanding of dynamic capabilities and its moderating effects on radical innovation and incremental innovation. The mediating effects of dynamic capabilities on *teams* in the PBI were not explored for this research. There exist opportunities for future research in this area. The depth and magnitude of dynamic capabilities’ effects on teams in the global PBI were not measured, this is an opportunity for future research. The unique skills and traits of *team* members in the ambidextrous innovation *team* environment of the PBI is also another topic for future research. In addition, the research was conducted through the theoretical lens of STT. Future studies could utilize other theoretical frameworks to understand impact to *teams* in the ambidextrous innovation arena.

8 Conclusions

The wide-ranging review, analysis, and synthesis of the moderating effects of dynamic capabilities on radical innovation and incremental innovation in the PBI represents an important contribution to *teams* in this area of research. Success in the PBI is measured in terms of market share. The *team* or entity which gets to market fastest with the most cutting-edge technology is positioned to gain the most financially and have a competitive edge due to intellectual property protection. New knowledge acquired from this study has resulted in the conceptual work done by Teece

(2007) needing to be expanded and updated to incorporate *knowledge acquisition* as a dynamic capability moderator. Hence further research needs to be conducted to fully comprehend the extent of impact *knowledge acquisition* has on radical innovation and incremental innovation in the context of *teams* in the PBI.

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10 References

Alexander, L., & van Knippenberg, D. (2014). Teams in pursuit of radical innovation: A goal orientation perspective. *Academy of Management Review*, 39(4), 423-438.

Ambrosini, V., Bowman, C., & Collier, N. (2009). Dynamic Capabilities: An Exploration of How Firms Renew their Resource Base. *British Journal of Management*, 20, S9-S24.

Amponsah, C. T., & Adams, S. (2017). Open innovation: Systematisation of knowledge exploration and exploitation for commercialisation. *International Journal of Innovation Management*, 21(3).

Andriopoulos, C., & Lewis, M. W. (2009). Exploitation-Exploration Tensions and Organizational Ambidexterity: Managing Paradoxes of Innovation. *Organization Science*, 20(4), 696.

Ardito, L., Messeni Petruzzelli, A., Dezi, L., & Castellano, S. (2018). The influence of inbound open innovation on ambidexterity performance: Does it pay to source knowledge from supply chain stakeholders? *Journal of Business Research*. Online. <https://www.sciencedirect.com/science/article/abs/pii/S0148296318300000>

Arifin, Z., & Frmanzah. (2015). The Effect of Dynamic Capability to Technology Adoption and its Determinant Factors for Improving Firm's Performance; Toward a Conceptual Model. *Procedia - Social and Behavioral Sciences*, 207, 786-796.

Basnayaka, W. B. M. D., & Jayakody, J. A. S. K. (2018). The Effect of Team Knowledge Management Practices on Team Performance: The Moderating Effect of Transformational Leadership and Team Cohesiveness. *Sri Lankan Journal of Management*, 23(2), 1-33

Beck, M., Lopes-Bento, C., & Schenker-Wicki, A. (2016). Radical or incremental: Where does R&D policy hit? *Research Policy*, 45(4), 869-883.

Bianchi M, Croce A, Dell'Era C, Di Benedetto C, Frattini F. (2016) Organizing for Inbound Open Innovation: How External Consultants and a Dedicated R& D Unit Influence Product Innovation Performance. *Journal of Product Innovation Management*;33(4):492.

Bierly, P. E., Damanpour, F., & Santoro, M. D. (2009). The Application of External Knowledge: Organizational Conditions for Exploration and Exploitation. *Journal of Management Studies (Wiley-Blackwell)*, 46(3), 481-509.

Campos, E. B., & Sánchez, M. P. S. (2003). Knowledge management in the emerging strategic

business process: Information, complexity and imagination. *Journal of Knowledge Management*, 7(2), 5–17.

Carlo, J. L., Lyytinen, K., & Rose, G. M. (2012). A Knowledge-Based Model of Radical Innovation in Small Software Firms. *MIS Quarterly*, 36(3), 865-A10.

Cetindamar, D., Phaal, R., & Probert, D. (2009). Understanding technology management as a dynamic capability: A framework for technology management activities. *Technovation*, 29(4), 237–246.

Chen, Y-U., Chang, C-H & Lin, Y-H. (2014). The Determinants of Green Radical and Incremental Innovation Performance: Green Shared Vision, Green Absorptive Capacity, and Green Organizational Ambidexterity. *Sustainability*, (11), 7787.

Cheng, C. C. J., Yang, C., & Sheu, C. (2016). Effects of open innovation and knowledge-based dynamic capabilities on radical innovation: An empirical study. *Journal of Engineering and Technology Management*, 41, 79–91.

Christensen, C. M. (1997: 2016) *The Innovator's Dilemma: When new technologies cause great firms to fail*. Boston, MA: Harvard Business Review Press.

Dangelico, R. M., Pujari, D., & Pontrandolfo, P. (2017). Green product innovation in manufacturing firms: A sustainability-oriented dynamic capability perspective. *Business Strategy and the Environment*, 26(4), 490–506.

Donate, M. J., & Sánchez de Pablo, J. D. (2015). The role of knowledge-oriented leadership in knowledge management practices and innovation. *Journal of Business Research*, 68(2), 360–370.

Dora, Y. M. (2015) The development of dimensions dynamic capabilities. International conference on social science and management (ICSSAM). Japan. Accessed August 2019. <https://www.researchgate.net>

Doran, J., & Ryan, G. (2014). Firms' skills as drivers of radical and incremental innovation. *Economics Letters*, 125(1), 107–109.

Dunlap, D., Parente, R., Geleilate, J.-M., & Marion, T. J. (2016). Organizing for Innovation Ambidexterity in Emerging Markets. *Journal of Leadership & Organizational Studies*, 23(2), 175–190.

Ferrary, M. (2011). Specialized organizations and ambidextrous clusters in the open innovation paradigm. *European Management Journal*, 29(3), 181-192.

Fores, B. & Camison, C. (2016). Does incremental and radical innovation performance depend on different types of knowledge accumulation capabilities and organizational size? *Journal of Business Research*, 69(2), 831-848.

Gao, I. & Tian, Y. (2014). Mechanism of supply chain coordination based on dynamic capability framework-the mediating role of manufacturing capabilities. *Journal of Industrial Engineering and Management*, (5), 1250.

García Sánchez, E., García Morales, V. J., & Martín-Rojas, R. (2017). Do social networks and

technological capabilities help knowledge management? *Journal of Technology Management & Innovation*, 12(4), 65–69.

Gassmann, O., Widenmayer, B., & Zeschky, M. (2012). Implementing radical innovation in the business: the role of transition modes in large firms. *R&D Management*, 42(2), 120–132.

Gedvilaite, D. & Paul, S. (2015) Knowledge Acquisition for a New Business Model Creation and Enabling Factors. (2015). *Lund University Library*. Accessed November 2019. <https://lup.lub.lu.se/student-papers/search/publication?q=author+exact+tkal2dgc>.

Gillespie, J. J., Privitera, G. J. & Gaspero, J. (2019). Biopharmaceutical Entrepreneurship, Open Innovation, and the Knowledge Economy. *Journal of Innovation Management*, (2), 59.

Gilsing, V., & Nooteboom, B. (2006). Exploration and exploitation in innovation systems: The case of pharmaceutical biotechnology. *Research Policy*, 35(1), 1–23.

Govindan, K., Soleimani, H. & Kannan, D. (2015). Reverse logistics and closed-loop supply chain A comprehensive review to explore the future. *European Journal of Operational Research*, 240(3), 603-626.

Grover, V., Purvis, R. L., & Segars, A. H. (2007). Exploring ambidextrous innovation tendencies in the adoption of telecommunications technologies. *IEEE Transactions on Engineering Management*, 54(2), 268–285.

Grundstein, M. (2013). Towards a technological, organizational, and socio-technical well-balanced KM initiative strategy: A pragmatic approach to knowledge management. *Knowledge Management Research & Practice*, 11(1), 41-52.

Hannachi, Y. (2016). The Impact of the Learning Organization on Product Innovation Performance: An Empirical Assessment in the French Biotechnology Industry. *Management International / International Management / Gestión Internacional*, 20(3), 49-61.

Hasegan, M. F., Nudurupati, S. S., & Childe, S. J. (2018). Predicting performance – a dynamic capability view. *International Journal of Operations & Production Management*, 38(11), 2192–2213.

Heavey, C., & Simsek, Z. (2014). Distributed Cognition in Top Management Teams and Organizational Ambidexterity: The Influence of Transactive Memory Systems. *Journal of Management*, 43(3), 919–945.

Hoang, H., & Rothaermel, F. T. (2010). Leveraging internal and external experience: exploration, exploitation, and R&D project performance. *Strategic Management Journal (John Wiley & Sons, Inc.)*, 31(7), 734–758.

Hung, R. Y. Y., Yang, B., Lien, B. Y.-H., McLean, G. N., & Kuo, Y.-M. (2010). Dynamic capability: Impact of process alignment and organizational learning culture on performance. *Journal of World Business*, 45(3), 285–294.

Jansen, J. J. P., Van den Bosch, F. A. J., & Volberda, H. W. (2005). Exploratory innovation, exploitative innovation and ambidexterity: The impact of environmental and organizational antecedents. *Schmalenbach Business Review (SBR)*, 57(4), 351-363.

- Jansen, J. J. P., George, G., Van den Bosch, F. A. J., & Volberda, H. W. (2008). Senior Team Attributes and Organizational Ambidexterity: The Moderating Role of Transformational Leadership. *Journal of Management Studies (Wiley-Blackwell)*, 45(5), 982–1007.
- Jansen, J. J. P., Vera, D., & Crossan, M. (2009). Strategic leadership for exploration and exploitation: The moderating role of environmental dynamism. *Leadership Quarterly*, 20(1), 5–18.
- Jansen, J. J. P., Simsek, Z., & Cao, Q. (2012). Ambidexterity and performance in multiunit contexts: Cross-level moderating effects of structural and resource attributes. *Strategic Management Journal*, 33(11), 1286–1303.
- Kang, S., & Hwang, J. (2019). An Investigation into the Performance of an Ambidextrously Balanced Innovator and Its Relatedness to Open Innovation. *Journal of Open Innovation*, 5(2), 23.
- Kang, H. & Kim, M. (2019). The Differential Effect of Exploration and Exploitation on Work Performances. *Sustainability*, 11(7), 2074.
- Kelley, D. J., O, C. G. C., Neck, H., & Peters, L. (2011). Building an organizational capability for radical innovation: The direct managerial role. *Journal of Engineering and Technology Management*, 28(4), 249–267.
- Klein, L. (2014). What do we actually mean by ‘sociotechnical’? On values, boundaries and the problems of language. *Applied Ergonomics*, 45(2), 137–142.
- Lassen, A. H., Gertsen, F. & Riis, J. O. (2006). The nexus of corporate entrepreneurship and radical innovation. *Creativity & Innovation Management*, 15(4), 359-372.
- Lee, Y.J., Shin, K., & Kim, E. (2019). The Influence of a Firm’s Capability and Dyadic Relationship of the Knowledge Base on Ambidextrous Innovation in Biopharmaceutical M&As. *Sustainability*, 18, 4920.
- Lessard, D., Teece, D. J., & Leih, S. (2016). The Dynamic Capabilities of Meta-Multinationals. *Global Strategy Journal*, 6(3), 211–224.
- Martini, A., Laugen, B. T., Gastaldi, L., & Corso, M. (2013). Continuous innovation: towards a paradoxical, ambidextrous combination of exploration and exploitation. *International Journal of Technology Management*, 61(1), 1–22.
- Mei, M., Laursen, K., & Atuahene-Gima, K. (2013). Learning to Innovate: How Does Ambidextrous Learning Matter to Radical and Incremental Innovation Capabilities?. Paper presented at The 35th DRUID Celebration Conference 2013: Innovation, Strategy and Entrepreneurship, Barcelona, Spain. In 35th DRUID Celebration Conference (pp. 1-35). Barcelona. Accessed 18th July 2019. http://druid8.sit.aau.dk/druid/acc_papers/sqovmqjil4ot05j9t81opesodanv.pdf
- Nielsen, A. P. (2006). Understanding dynamic capabilities through knowledge management. *Journal of Knowledge Management*, 10(4), 59–71.
- Nissen, H. A., Evald, M. R., & Clarke, A. H. (2014). Knowledge sharing in heterogeneous teams through collaboration and cooperation: Exemplified through Public–Private–Innovation partnerships. *Industrial Marketing Management*, 43(3), 473–482.

- Norman, D.A. & Verganti, R. (2014). Incremental and radical innovation: Design research vs technology and meaning change. *Design Issues*, 30(1), 78-96.
- Novartis successfully completes acquisition of AveXis, Inc. Accessed 15th February 2020. <https://www.novartis.com/news/media-releases/novartis-successfully-completes-acquisition-avexis-inc>.
- O'Reilly, C. A., & Tushman, M. L. (2008). Ambidexterity as a dynamic capability: Resolving the innovator's dilemma. *Research in Organizational Behavior*, 28, 185–206.
- O'Reilly, C. A., & Tushman, M. L. (2013). Organizational ambidexterity: Past, present, and future. *Academy of Management Perspectives*, 27(4), 324–338.
- Patanakul, P., Chen, J., & Lynn, G. S. (2012). Autonomous Teams and New Product Development Autonomous Teams and New Product Development. *Journal of Product Innovation Management*, 29(5), 734.
- Pérez la Rotta, A., & Herrera, L.C. (2011) Integral business transformation: a global case study. *Industrial and Commercial Training*. 43 (2), 75-78.
- Peris-Ortiz, M., Devece-Carañana, C. A., & Navarro-Garcia, A. (2018). Organizational learning capability and open innovation. *Management Decision*, 56(6), 1217–1231.
- Pfizer's Gene Therapy Manufacturing Facility Expansion, North Carolina. Accessed 15th February 2020. <https://www.pharmaceutical-technology.com/projects/pfizers-gene-therapy-manufacturing-facility>.
- Prescott, M. E. (2016). Big Data: Innovation and Competitive Advantage in an Information Media Analytics Company. *Journal of Innovation Management*, 1, 92.
- Rothaermel, F. T., & Deeds, D. L. (2004). Exploration and Exploitation Alliances in Biotechnology: A System of New Product Development. *Strategic Management Journal (John Wiley & Sons, Inc.)*, 25(3), 201–221.
- Rosing, K., Frese, M., & Bausch, A. (2011). Explaining the heterogeneity of the leadership-innovation relationship: Ambidextrous leadership. *Leadership Quarterly*, 22(5), 956–974.
- Schneckenberg, D., Truong, Y., & Mazloomi, H. (2015). Microfoundations of innovative capabilities: The leverage of collaborative technologies on organizational learning and knowledge management in a multinational corporation. *Technological Forecasting & Social Change*, 100, 356–368.
- Shan, S., Luo, Y., Zhou, Y., & Wei, Y. (2018). Big data analysis adaptation and enterprises' competitive advantages: the perspective of dynamic capability and resource-based theories. *Technology Analysis & Strategic Management*, 31(4), 406–420.
- Sheng, M. L., & Chien, I. (2016). Rethinking organizational learning orientation on radical and incremental innovation in high-tech firms. *Journal of Business Research*, 69(6), 2302–2308.
- Shi, X., & Zhang, Q. (2018). Inbound open innovation and radical innovation capability: The moderating role of organizational inertia. *Journal of Organizational Change Management*, 31(3), 581–597.
- Shin, K., Kim, S. J., & Park, G. (2016). How does the partner type in R&D alliances impact

- technological innovation performance? A study on the Korean biotechnology industry. *Asia Pacific Journal of Management*, 33(1), 141-164.
- Slayton, R., & Spinardi, G. (2016). Radical innovation in scaling up: Boeing's Dreamliner and the challenge of socio-technical transitions. *Technovation*, 47, 47-58.
- Soosay, C., & Hyland, P. (2008). Exploration and exploitation: the interplay between knowledge and continuous innovation. *International Journal of Technology Management*, 42(1-2), 20-35.
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal (John Wiley & Sons, Inc.)*, 18(7), 509-533.
- Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal (John Wiley & Sons, Inc.)*, 28(13), 1319-1350.
- Tseng, S-M., & Pei-Shan, L. (2014). The effect of knowledge management capability and dynamic capability on organizational performance. *Journal of Enterprise Information Management*, 27(2), 158-179.
- Tushman, M. L. & O'Reilly, C.A. (1997). *Winning through Innovation: A practical guide to leading organizational Change and Renewal*. Boston Mass. Harvard Business School Press.
- United States Government Accountability Office, Report to Congressional requesters. Drug Industry: Profits, research and development spending, a merger and acquisitions deals. GAO-18-40: Published: Nov 17, 2017. Publicly released Dec 19, 2017. Accessed 27th September 2019 from Government Accountability Website: <https://www/gao.gov/products/GAO-18-40>
- Vance, D. E., Talley, M., Azuero, A., Pearce, P. F, & Christian, B. J. (2013). Conducting an article critique for a quantitative research study: perspectives for doctoral students and other novice readers. *Nursing: Research and Reviews, default* [online] 67-75.
- Van Looy, B., Debackere, K., & Martens, T. (2005). Organizing for Continuous Innovation: On the Sustainability of Ambidextrous Organizations. *Creativity and Innovation Management*, 14(3), 208-221.
- Visscher, K., & De Weerd-Nederhof, P. C. (2006). Rise and Fall of an Innovative Organisation: The Innovation Journey of Ericsson Enschede. *International Journal of Innovation Management*, 10(3), 217-235.
- Vorraber, W., Neubacher, D., Moesl, B., Brugger, J., Stadlmeier, S., & Voessner, S. (2019). UCTM—An Ambidextrous Service Innovation Framework—A Bottom-Up Approach to Combine Human- and Technology-Centered Service Design. *Systems*, 7(2), 23.
- Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews*, 9(1), 31-51.
- Wang, C., Rodan, S., Fruin, M., & Xu., X. (2014). Knowledge Networks, Collaboration Networks, and Exploratory Innovation. *Academy of Management Journal*, 57(2), 454-514.
- Wang, C. L., & Rafiq, M. (2014). Ambidextrous Organizational Culture, Contextual Ambidex-

- terity and New Product Innovation: A Comparative Study of UK and Chinese High-tech Firms. *British Journal of Management*, 25(1), 58–76.
- Wang, Y.-S., & Hsu, T.-H. (2018). Dynamic capabilities of biologics firms in the emerging business market: Perspective of dynamic capabilities evident. *Industrial Marketing Management*, 71, 5–18.
- Xiang, J., Archer, N., & Detlor, B. (2014). Business process redesign project success: the role of socio-technical theory. *Business Process Management Journal*, (5), 773.
- Yi, L., Mao, H. & Wang, Z. (2019). How paradoxical leadership affects ambidextrous innovation: The role of knowledge sharing. *Social Behavior & Personality: An International Journal*, 47(4), 1–15.
- Yin, X., Chen, J. & Chuang Zhao., C. (2019). Double Screen Innovation: Building Sustainable Core Competence through Knowledge Management. *Sustainability*, 16, 4266.
- Yu, C., Yu, T.-F., & Yu, C.-C. (2013). Knowledge sharing, organizational climate, and innovative behavior: a cross-level analysis of effects. *Social Behavior and Personality: An International Journal*, 1, 143.
- Zacher, H., Robinson, A. J., & Rosing, K. (2016). Ambidextrous Leadership and Employees' Self-reported Innovative Performance: The Role of Exploration and Exploitation Behaviors. *Journal of Creative Behavior*, 50(1), 24–46.
- Zhou, K. Z., & Li, C. B. (2012). How knowledge affects radical innovation: Knowledge base, market knowledge acquisition, and internal knowledge sharing. *Strategic Management Journal (John Wiley & Sons, Inc.)*, 33(9), 1090–1102.

Appendix A

Table A.1. Cluster of radical innovation articles

| | Author | Year of publication | Type of research | Scopus citations | Code |
|---|----------------------|----------------------------|---|-------------------------|-------------|
| 1 | Slayton and Spinardi | 2016 | Case study | 24 | A |
| 2 | Cheng et al. | 2016 | Survey; empirical study | 17 | A |
| 3 | Carlo et al. | 2012 | Survey; longitudinal study | 77 | A |
| 4 | Fores and Camison | 2016 | Questionnaires; mixed studies method | 102 | A2 |
| 5 | Zhou and Li | 2012 | Survey; Cross sectional – high technology companies | 308 | A30 |
| 6 | Norman and Verganti | 2014 | Conceptual framework paper | 186 | A2 |
| 7 | Lassen et al. | 2006 | 5 case studies | 43 | A |

| | | | | | |
|---|---------------|------|---|----|---|
| 8 | Kelley et al. | 2011 | Interviews across 12 different organizations. Good longitudinal study | 41 | A |
|---|---------------|------|---|----|---|

Table A.2. Cluster of incremental innovation articles

| | Author | Year of publication | Type of research | Scopus citations | Code |
|---|---------------------|----------------------------|---|-------------------------|-------------|
| 1 | Doran and Ryan | 2014 | Survey. Longitudinal data | 7 | B |
| 2 | Beck et al. | 2016 | Survey. Longitudinal data; Swiss firms | 21 | B |
| 3 | Sheng and Chien | 2016 | Questionnaires; 1000 firms; Empirical study | 31 | B |
| 4 | Chen et al. | 2014 | Research framework; new constructs | 30 | B |
| 5 | Fores and Camison | 2016 | Questionnaires; mixed studies method | 102 | B2; A2; |
| 6 | Norman and Verganti | 2014 | Conceptual framework paper | 186 | B2; A2 |
| 7 | Mei et al. | 2013 | Conference paper | 4 | B |

Table A.3. Cluster of *teams* articles

| | Author | Year of publication | Type of research | Scopus citations | Code |
|---|-------------------------------|----------------------------|---|-------------------------|-------------|
| 1 | Nissen et al. | 2014 | Two (2) case studies | 57 | C |
| 2 | Heavey and Simsek | 2014 | Surveys, CEOs firms in the USA | 47 | C |
| 3 | Patanakul et al. | 2012 | Theoretical conceptual frameworks. Technology companies in NE USA | 38 | C |
| 4 | Alexander and van Knippenberg | 2014 | Theoretical framework, large mature firms | 65 | C |

Table A.4. Cluster of dynamic capabilities articles

| | Author | Year of publication | Type of research | Scopus citations | Code |
|---|-------------------|----------------------------|---------------------------------|-------------------------|-------------|
| 1 | Cetindamar et al. | 2009 | Theoretical framework | 115 | D2 |
| 2 | Hung et al. | 2010 | Survey data high tech | 81 | D1 |
| 3 | Gao and Tian | 2014 | Survey; Manufacturing companies | 8 | D |

| | Author | Year of publication | Type of research | Scopus citations | Code |
|----|----------------------|----------------------------|--|-------------------------|-------------|
| 4 | Arfin and Frmanzah | 2015 | Conceptual framework; Survey across firms | 2 | D |
| 5 | Hasegan et al. | 2018 | Case study manufacturing plant | 0 | D |
| 6 | Tseng and Pei-Shan | 2014 | Questionnaire and statistical analysis | 74 | D1 |
| 7 | Shin et al. | 2016 | Empirical study of Korean biotechnology firms | 16 | D |
| 8 | Wang and Hsu | 2018 | Theoretical conceptual framework. Asia Pacific region biologics firms | 1 | D |
| 9 | Teece | 2007 | Conceptual Framework | 3537 | D350 |
| 10 | O'Reilly and Tushman | 2008 | Conceptual paper | 187 | D2 |
| 11 | Dangelico | 2017 | Structural modeling 189 Italian manufacturing firms | 88 | D1 |
| 12 | Shan | 2018 | Conceptual modeling | 2 | D |
| 13 | Lessard et al. | 2016 | Multinational enterprises analysis using dynamic capabilities model | 19 | D |
| 14 | Prescott | 2016 | case-study global information/media analytics company using RBV and dynamic capability framework | 2 | D |
| 15 | Ambrosini | 2009 | Conceptual paper | 306 | D30 |

Table A.5. Cluster of open innovation articles

| | Author | Year of publication | Type of research | Scopus citations | Code |
|---|--------------------|----------------------------|---|-------------------------|-------------|
| 1 | Cheng et al. | 2016 | Survey; empirical study | 17 | E |
| 2 | Ferrary | 2011 | Longitudinal study high tech companies USA | 54 | E |
| 3 | Ardito et al. | 2018 | Longitudinal study of Italian firms | 5 | E |
| 4 | Peris-Ortiz et al. | 2018 | Comparative analysis 29 companies in Spain, France and Portugal | 4 | E |
| 5 | Shi and Zhang | 2018 | Longitudinal study | 3 | E |
| 6 | Kang and Hwang | 2019 | Innovation survey Korean companies | 0 | E |
| 7 | Bianchi et al. | 2016 | R & D units 841 Spanish manufacturing firms | 34 | E |

| | | | | | |
|---|--------------------|------|---|---|---|
| 8 | Amponsah and Adams | 2017 | Global companies with patents including PBI | 1 | E |
|---|--------------------|------|---|---|---|

Table A.6. Cluster of knowledge management articles

| | Author | Year of publication | Type of research | Scopus citations | Code |
|---|-----------------------------|----------------------------|---|-------------------------|-------------|
| 1 | Garcia- Sanchez et al. | 2017 | Theoretical paper | 0 | F |
| 2 | Grundstein | 2013 | Conceptual and theoretical paper | 2 | F |
| 3 | Basnayaka & Jayakody | 2018 | Survey 100 teams | 0 | F |
| 4 | Yin et al. | 2019 | Conceptual paper | 0 | F |
| 5 | Schneckenberg et al. 2019 | 2015 | Case study of global industrial corporation | 19 | F |
| 6 | Nielsen | 2006 | Literature review | 103 | F2 |
| 7 | Campos and Sanchez | 2003 | Conceptual paper | 0 | F |
| 8 | Donate and Sanchez de Pablo | 2015 | Empirical data from technological firms | 152 | F2 |
| 9 | Hannachi | 2016 | French biotechnology firms | Not available | |

Table A.7. Cluster of exploratory and exploitative innovation articles

| | Author | Year of publication | Type of research | Scopus citations | Code |
|---|------------------------|----------------------------|--|-------------------------|-------------|
| 1 | Hoang and Rothaermel | 2010 | 412 R&D projects in PBI; longitudinal study | 224 | G2 |
| 2 | Soosay and Hyland | 2008 | Case study; Australian firm | 43 | G |
| 3 | Wang and Rafiq | 2014 | Data from 150 UK and 242 Chinese high-tech firms; conceptual framework | 105 | G1 |
| 4 | Andriopoulos and Lewis | 2009 | Case study five ambidextrous firms | 751 | G7 |
| 5 | Wang et al. | 2014 | US manufacturing firms | 135 | G1 |
| 6 | Martini et al. | 2013 | Theoretical framework | 49 | G |
| 7 | Gilsing and Nootboom | 2006 | Case study pharmaceutical biotechnology; theoretical framework | 188 | G1 |
| 8 | Dunlap et al. | 2016 | Business unit level of emerging firms in Brazil | 5 | G |

Table A.8. Cluster of ambidextrous innovation articles

| | Author | Year of publication | Type of research | Scopus citations | Code |
|---|----------------------|----------------------------|--|-------------------------|-------------|
| 1 | Yi et al. | 2019 | 306 senior or intermediate leaders in high technology companies in China | Not available | |
| 2 | Martini et al. | 2013 | Theoretical framework | 49 | H |
| 3 | O'Reilly and Tushman | 2008 | Theoretical conceptual | 778 | H70 |
| 4 | Lee et al. | 2019 | Biopharmaceutical patent data – negative binomial regression | 2 | H |
| 5 | Vorraber et al. | 2019 | Case study | 1 | H |
| 6 | Dunlap et al. | 2016 | Business level units in Brazil | 5 | H |
| 7 | Jansen et al. | 2012 | 285 organizational units across 88 autonomous branches | 125 | H2 |

Biographies



Heather A. Johnson. Heather Audrene Johnson is currently a doctoral candidate pursuing a degree in Management/Business Administration from the University of Maryland Global Campus, Maryland, (2020). Heather was born in Jamaica and migrated to the USA in 1980. Heather received the A.S. degree from Broward College, Florida in Medical Laboratory Technology (Clinical Lab Science) 1986. Heather received the B.S. in applied science and technology from Thomas Edison University, New Jersey (2012). Heather Johnson received the M.S. in quality management from Eastern Michigan University, Michigan (2016). The focus of her dissertation is "Radical Innovation and Strategic Management in a Volatile, Uncertain, Complex and Ambiguous (VUCA) world". She is conducting research in several areas: Ambidextrous (Radical and Incremental) Innovation organizations and Big Data and data analytics. She is an entrepreneur owner, President, CEO of MontRose Consulting Inc and has over 35 years of experience as scientist, engineer and practitioner in the pharmaceutical biotechnology industry. Ms. Johnson is a member of Project Management Institute and American Society of Quality. She authored an article "Meaningful Mentoring" [Women in Quality] in Quality Progress magazine (2019).