BUILDING NEW INNOVATION CAPABILITIES THROUGH KNOWLEDGE SHARING AND STRATEGIC ALLIANCES IN HEALTHCARE RESEARCH AND DEVELOPMENT

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ABSTRACT

The knowledge base of an academic medical center is elaborate and far-reaching as the sources of expertise can be found in multiple networks of learning and management within the organization. Therefore, it is incumbent for professionals within a healthcare ecosystem to utilize external collaboration. This research explored open innovation processes between different academic medical centers with biomedical and genomic research institutions and biopharmaceutical companies with the intention to develop new insights that would maximize the probability of successful collaborative academic-industry knowledge creation. Through exploratory research consisting of a literature review and semi-structured interviews of senior-level managers and top-of-field researchers, it became evident that both individuals and organizations employed critical success strategies for open innovation orchestration by fostering trust, identifying motivating factors, continuously developing collaborative knowledge sharing with top-management support and lowering barriers to collaboration through project-level processes and procedures, but not without experiencing scientist-manager tension in the process. This study provided a relatively rare series of insights into the senior-level collaboration views and issues between those scientists and managers within several major academic-industry strategic alliances.

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Foremost, I would like to express my sincere gratitude and appreciation to my mentor Dr. Anthony Di Benedetto for his patience, understanding and instruction throughout this entire research process. I would also like to thank the other members of my committee, Dr. Susan Mudambi and Dr. Guntram Werther, for their guidance in overcoming numerous obstacles I have been facing through my research. No one has been more important to me during this undertaking than the members of my family. I would like to thank my parents and my sister whose love and support have been unending throughout this process and in whatever I pursue. Most importantly, I would like to express thanks to my loving wife, Becky, and my two stepchildren, Kyla and Karyn, who have been unconditionally understanding and considerate of the time it took to complete this project.

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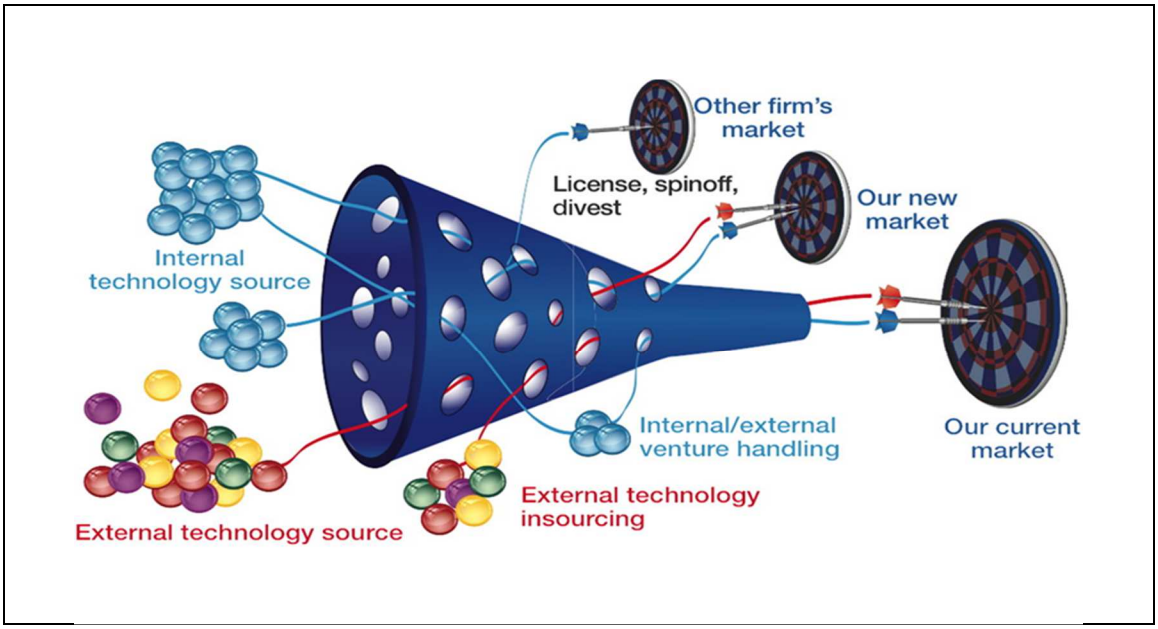
INTRODUCTION

Companies in an increasingly competitive business environment face a common challenge: How to use knowledge more effectively than their competitors do. Additionally, knowledge sharing is becoming an increasingly valuable competitive resource specifically in the healthcare industry in which academic medical centers are collaborating with genomic research centers and biopharmaceutical companies. Examining how new knowledge can be created through knowledge sharing to increase the performance of these collaborations is critical to strategy, sustaining a competitive advantage and developing new innovations.

How do knowledge and innovation relate? Innovation is the transformation of knowledge from research to development to application. Sharing knowledge to enable innovation is a mainstay of firm development. Open innovation is a relatively new way of sharing knowledge across traditionally closed firm boundaries in the hopes of generating both new knowledge and collective innovation.

Open Innovation (OI) as seen in Figure 1.1, can be defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough et al., 2006, p.213). "OI is a more profitable way to innovate and facilitate learning as it reduces cost, reduces ties to market, increases differentiation in a market and creates new revenue streams for the firm" (Chesbrough, 2010).

Figure 1.1 Open Innovation



Life science companies have traditionally created knowledge by collaboration through mergers and acquisitions, however challenges such as the patent cliff, shorter product lifecycles, increasing pricing pressure, increasing global competition and regulatory changes have led to an anticipated drop in sales revenue (Jones and Clifford, 2005). In response, life science companies have cut costs and staff, expanded into emerging markets, and adjusted business model and research objectives. Strategic alliances are one way to implement open innovation and have emerged as a common alternative to mergers and acquisitions as a way to share costs, risks and rewards across separate entities (Strategic Alliances in the Life Sciences, 2014).

An example of open innovation processes can be found in the pharmaceutical and biotechnology companies. From 1993 to 2004, companies increased research and development spending by 147%, but new drug applications submitted to the US Food and Drug Administration only increased by 38% (Jones and Clifford, 2005). Faced with less

than ideal research output, pharmaceutical and biotechnology companies began to look outside of their walls for innovation. "The idea that the next new approach might not come from internal research has led many companies to shift their R&D expenditures externally through collaborations with small biotechnology companies, other companies and academia." (Melese et. al, 2009 p. 502). "In the collaborative innovation model, companies look outside their boundaries for ideas and intellectual property, leading to new revenues generated through licensing, spin-offs or sales and divestitures." (Melese et. al, 2009 p. 502).

While these collaborations have spread, it is not yet clear how successful they have been. Further, there is little research on how scientists in academia and managers in industry have worked together within such collaborations. Scientists in academia have different priorities than managers in industry. The scientist's role is to engage in scientific discovery, whereas the manager's role is to develop commercial products (Connell, 1987). Typically, scientific knowledge from a biotechnology company is not shared because this would diminish a firm's ability to commercialize a product which is in direct contrast to the scientist's desire to publish new information (Morrison, 2017). The objective of this research is to examine scientist-manager knowledge creation through the process of open innovation in academic-industry strategic alliances and uncover factors that would increase the probability of success.

The following research consists of two studies. The first study explores two academic medical center-genomic research institution innovation-oriented strategic alliances to identify factors that contribute to knowledge creation through scientist-manager collaboration. This study provides uncommon detail about the factors that shape

the scientist-manager collaboration and also reveals persistent, deeply rooted tensions between scientists and managers. The second study focuses on one academic medical center and several of its strategic alliances with the biopharmaceutical industry to explore more deeply the scientist-manager tension identified in study one. The second study suggests a number of success factors that might improve the probability of knowledge creation through an open innovation process in academic-industry strategic alliances and provides managerial insight into ways to mitigate the tension between scientists and managers, thus improving the effectiveness of collaborative knowledge creation.

CHAPTER 1

STUDY ONE: BRIDGING THE SCIENTIST FINDINGS AND MANAGER PRACTICES OF OPEN INNOVATION IN CANCER RESEARCH

Abstract

Studies on open innovation have proliferated over the last several years, yet there are barriers to intellectual trade between scientific theory and manager practices of this paradigm. Bridging the scientific and manager worlds to increase knowledge creation and engage the open innovation processes will lead to a more effective outcome. The objective of study one was, first, to review the literature of critical success factors that lead to effective knowledge creation through open innovation and summarize the terminology and definitional differences between scientist and manager studies on open innovation. Secondly, this study examined two separate industry-leading institutions that have successfully implemented open innovation practices through scientist-manager collaborations in academic-industry strategic alliances and assessed the attributes that lead to effective knowledge creation. The main finding was top-of-field scientists and senior-level managers that have access to physical resources and specialized equipment developing high quality science who engage in transparent bilateral communication, garner financial resources and promote collaborative cohesiveness that moves publishable research and technology forward, possess top-management leadership that establishes a strategic agenda and governance structure, and contain a culture consisting of trainable professionals that lower barriers to collaboration and enable risk-taking will increase knowledge creation in a strategic alliance, but not without knowledge flow tension between the two professions.

Introduction

Biotechnology academic-industry collaborations have become increasingly important for both universities and industries in the United States (Blumenthal et al., 1986). These relationships can benefit or enhance the sum-total performance by working together. These collaborative efforts seem to strengthen the commercial as well as academic productivity of the firm (Blumenthal et al., 1986). In addition to the evident objectives of the academic-industry research relationships, motivations for collaborations stretch beyond the financial and new technology acquisitions and lead towards the development of tacit knowledge (Senker and Sharp, 1997). Within academic medical center knowledge networks, firm-level competencies specific to healthcare and biopharmaceutical professionals are required for success (Dogramatzis, 2012).

The changing landscape of the life sciences industry, due in no small part to cost management, innovative partnerships, customer engagement and changing regulatory environment, has led to a stronger need for collaboration and strategic alliances to mitigate the challenges that each of these pressures present within a healthcare ecosystem (Strategic Alliances in the Life Sciences, 2014). Collaborative knowledge creation has been a cornerstone of medical research. Nationwide Children's Hospital (NCH), The Ohio State University (OSU) and The Ohio State University Medical Center (OSUMC) have long-standing collaborative academic relationships to address child health challenges worldwide (We appreciate that many minds are better than one., 2017). ViiV Healthcare, a global specialist HIV company, developed from the collaboration's efforts of GlaxoSmithKline and Pfizer Inc., has recently completed transactions to acquire Bristol-Meyers Squibb's R&D HIV assets leading to a more robust portfolio which will

further development of new medicines and treatment needs of those living with HIV (About Us., 2016). Most recently, drug maker AstraZeneca has collaborated with Circassia, a biopharmaceutical company, to develop drugs Tudorza and Duaklir which treat chronic obstructive pulmonary disease (Boland, 2017). It is collaborative examples such as these that help to reduce inefficiencies, mitigate risk and lower costs all while improving the quality of medical research and patient care. Examples of academic-industry collaborations, more specifically related to this study, include the historical alliance of Centocor with the Wistar Institute (1979) for monoclonal antibody targets, birthing an entirely new treatment area and becoming a global leader in biomedical research with an expertise in cancer, immunology, infectious diseases and vaccine development ("Our Story", 2017). It was this collaboration that led to the Philadelphia region's first profitable biotech company, which was sold to Johnson and Johnson for $4.9 billion in 1999 (Linda Lloyd, 2007). More recently in 2016, Biogen, a biotech company based in Cambridge MA, has formed an alliance with University of Pennsylvania gene therapy pioneer Jim Wilson, with the hopes of sending genetic instructions to the body to treat various diseases, in a deal that could potentially be worth $2 billion (Fidler, 2016). Jim Wilson has also collaborated with Spark Therapeutics to deliver gene therapy into the eye. At the beginning of 2018, Spark Therapeutics licensed this FDA approved gene therapy treatment, Luxturna, to biopharmaceutical company as a one-time treatment for a type of inherited retinal disorder that causes blindness (George, 2018).

Academic-industry strategic alliances are designed to bring together scientists and managers in a collaborative way to create new knowledge, however these collaborations

have a propensity for failure because of the cultural and communication divides that exist within the partnership. Several factors shape the effective flow of knowledge in academic-industry strategic alliances. Factors including interpersonal trust, motivations of participants within a collaboration, top management support and project level processes and procedures influence the quantity and quality of new knowledge created.

While academic-industry strategic alliances and the challenges they face are not new developments, it is vital to examine collaborative themes and optimize processes that improve the probability of collaborative success. The following research examined critical success factors of open innovation within scientist-manager collaborations in academic-industry strategic alliances. Successful open innovation, in the context of this research, was defined as knowledge creation in a scientist-manager collaboration. Several critical factors contribute to successful open innovation. Factors including interpersonal trust, motivations of participants within a collaboration, top-management support and project-level processes and procedures were analyzed to determine the impact each had on knowledge creation in a scientist-manager collaboration. Following a literature review and conceptual model review, top-of-field scientists and senior-level managers were interviewed to refine these critical success factors and identify processes that increased the probability of successful open innovation.

Literature Review

Traditionally, competitive advantage has been built, developed and sustained from R&D inside an organization. It is within these walls that innovation was pursued creating economies of scale. The idea of a central research lab and internal product development was the main component to the rise of the industrial corporation, thus, ignoring outside

connection to universities, industry and government affiliation (Chesbrough, 2003). A shifting knowledge sharing landscape however, changed the way that internal R&D was operationalized. Within these R&D departments, a unique collaboration between academics and industry began to occur with public universities as private universities remained fixed on their research agendas. Furthermore, The GI Bill of Rights catalyzed the role of universities in the U.S. innovation system as more individuals took advantage of higher education. Still, the knowledge landscape of R&D was heavily internalized as vertical integration was considered paramount to firm growth. Even within this closed model, tension developed between the research (scientist) and development (manager) side of the innovation process. To remedy this problem, organizations created a buffer between the two sides of innovation so development was not tightly coupled to research (Chesbrough, 2003). This created a problem because ideas that didn't fit a current need of an organization were shelved for later use and the projects would stop receiving funding. This practice was the beginning of the end for closed innovation processes. Factors such as external options for ideas not being used by the firm, the mobility and availability of skilled workers, the venture capital market and the increasing capability of external suppliers have led to the attrition of the closed business model (Chesbrough, 2003).

As the walls of innovation within a firm have broken down, a new paradigm for innovation has developed. "Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology" (Chesbrough, 2003, p.24). Open innovation uses a different knowledge sharing landscape than closed innovation in that it

places the same level of importance on outside use of ideas as closed innovation does internal ideas (Chesbrough, 2003). This idea paired with the abundance of knowledge flow derived from the development of technology breaks down the notion of a centralized R&D center. Public and private universities full of professors and graduate students with an immense knowledge base are eager to collaborate with industry hoping to garner research funding. The knowledge base and the knowledge creation opportunities have now become exponentially larger between scientist and manager, which in turn mitigates knowledge monopolies. The "do-it-yourself" approach now only makes sense in a world that has no channel to external knowledge Chesbrough, 2003). Based on these points, the way to innovate and advance technology is to find a great deal of knowledge outside the walls of the organization.

Although Chesbrough's publications on open innovation have been described as revolutionary, there have been several authors of published papers that define and conceptualize openness and open innovation differently (Huizingh, 2011). Different forms of open innovation have been studied: Outbound open innovation which is disclosing resources to the external environment by selling (pecuniary) or revealing (non-pecuniary) and Inbound open innovation which is using external resources for innovation by acquiring (pecuniary) or sourcing (non-pecuniary) (Huizingh, 2011).

Examples of non-pecuniary outbound open innovation include the work of (West, 2003) who discusses proprietary platform vendors consisting of Apple, IBM and Sun Microsystems and defines openness as open source systems traditionally proprietary in platform, now experimenting with hybrid strategies that use open source software. The key results of this study show "Proprietary platform firms support open source

technologies as part of their platform strategies by balancing the tension between appropriation and appropriability" (Dahlander and Gann, 2010, p. 703). A paper by Henkel, (2006) describes openness from the open source software perspective of Linux as sharing of their developments, which are traditionally held close to the firm, back to the public embedded Linux code thus receiving informal development support from other firms. The findings of this study showed "Firms selectively reveal some technologies to the public as the attach different values to it" (Dahlander and Gann, 2010, p. 703).

Lichtenthaler and Ernst (2007) examine the structures, strategies and processes for managing pecuniary outbound open innovation in 154 medium-sized and large European firms spanning multiple industries. The study showed that most firms do not fully exploit pecuniary outbound open innovation, thus not fully leveraging opportunities for external technology commercialization.

Fey and Birkinshaw (2005, p.600) discuss non-pecuniary inbound open innovation from the perspective of open systems "to conceptualize the organizational boundary of the firm as a semipermeable membrane through which knowledge passes at different rates and to different degrees." The empirical setting of this research is based on the R&D activities of many large firms based in the UK and Sweden accessing knowledge outside of the firm through alliances, university partnerships and contracting. The results of this study examine "how the choice of governance mode for external R&D, along with openness to new ideas and codifiability of knowledge, affects R&D performance (Dahlander and Gann, 2010, p. 703). Larsen and Salter, (2006) examine pecuniary inbound open innovation in manufacturing firms in the UK by exploring the openness of firms' external search strategies for sourcing information and their innovative

performance. The central component towards open innovation is how firms go about the searching strategy for new ideas (Larsen and Salter, 2006). The findings show that "firm external strategy (breadth and depth) is curvilinearly related to innovative performance" (Dhalander and Gann, 2010, p. 703).

Clayton Christensen looks at pecuniary inbound open innovation in his paper on the industrial dynamics of open innovation where he examines the consumer electronics industry." The main proposition of the paper is that the specific modes in which different companies manage open innovation with regard to an emerging technology reflect their differential position within the innovation system in question, the nature and stage of maturity of the technological regime, and the particular value proposition pursued by companies" (Christensen et al. 2005, p. 1533). Christensen addressed the theoretical and intellectual tradition associated with industrial dynamics and applied evolutionary economics in case study form. These forms of open innovation can be visually represented in Table 1.1

Table 1.1: Studies On Open Innovation

Study	Industry	Definition	Results	Focus
Christensen et al. (2005)	Consumer Electronics	The study of industrial and strategic dynamics associated with development of new technological regime	Different use of open innovation practices is contingent upon the position in the innovation system and technological regime	Inbound-acquiring
Laursen & Salter (2006)	Manufacturing firms in UK	How firms go about the search strategy for sourcing information and their innovative performance	Firm external strategy is curvilinearly related to innovative performance	Inbound-sourcing

Table 1.1 (continued)

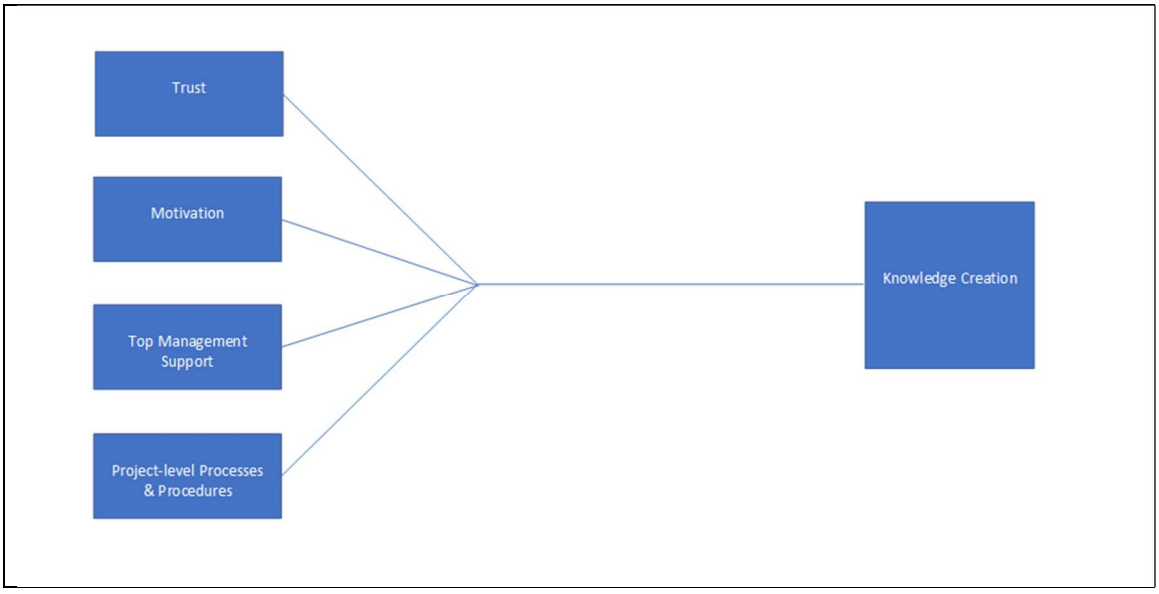
Fey & Birkenshaw (2005)	Firms with R&D activities in UK and Sweden	Conceptualizing the organizational boundary of the firm as a semipermeable membrane through which knowledge passes at different rates to different degrees	How the choice of governance mode for external R&D, along with openness to new ideas and codifiability of knowledge, affects performance	Inbound-sourcing
Henkel (2006)	Embedded Linux	Sharing of own developments back to the publicly imbedded Linus code.	Firms selectively reveal some technologies to the public as they attach different values to it	Outbound-revealing
West (2003)	Proprietary Platform Vendors	Open source systems traditionally proprietary in platform using hybrid strategies that use open source software	Proprietary platform firms support open source technologies as part of their platform strategies by balancing tension between appropriation and appropriability	Outbound-revealing
Lichtenthaler & Earnst (2009)	Multiple Industries	Licensing of technological knowledge outside the organization	The strategy process and characteristics jointly shape the performance of out-licensing	Outbound-licensing
Lichtenthaler & Earnst (2007)	Multiple Industries	The commercialization of technical knowledge	External technology commercialization is not fully leveraged, but have great potential if successfully implemented	Outbound-licensing

Knowledge creation has been given a great deal of attention due to the value of organizational learning and innovation (van den Hooff and de Ridder, 2004) and (Donate and Guadamillas, 2011). The most successful knowledge creating firms are the ones that have effective knowledge sharing processes (Casmir, Lee and Loon 2012). Knowledge harbored by individuals can help sustain a competitive advantage if shared within a network, as this knowledge is valuable, rare, inimitable, and non-substitutable (Afiouni, 2007). The challenge is to effectively promote this knowledge creating process as these collaborations are becoming a mainstay in business model development. When knowledge becomes more complex, the need to develop collaborative relationships with different professionals across different industries and universities becomes an essential driver for firm growth and sustainability.

Open innovation can be managed within a strategic alliance by determining the strategic direction of the firm and finding suitable partners to collaborate with (Segers, 2015). Open innovation within academic-industry strategic alliances in the biotechnology industry requires sophisticated management skills to be developed in order garner new knowledge (Fisken and Rutherford, 2002). Therefore, it is important to examine open innovation processes that make academic-industry strategic alliances more cohesive and effectively managed. The following research explored critical success factors of open innovation in between two academic medical center-genomic research institution strategic alliances where open innovation success was defined as knowledge creation. The objective of this research was to examine factors that contributed to knowledge creation within scientist-manager collaborations in strategic alliances and increase the chances of open innovation success.

Open innovation is becoming increasingly important as it is closely linked to knowledge creation (Eservel, 2014). However, open innovation is not an automatic process. No single factor can ensure that groups collaborate effectively. Past research suggests four clusters of factors that affect knowledge creation in strategic alliance settings. These factors are summarized in Figure 1.2 and described more fully below.

Figure 1.2 Factors That Affect Knowledge Creation



Trust

Trust is an important factor in the implementation of knowledge creation as "trust leads to increased overall knowledge exchange, makes knowledge exchanges less costly and increases the likelihood that knowledge acquired from a colleague is sufficiently understood and absorbed that a person can put it to use" (O'Reilly and Roberts, 1974; Currall and Judge, 1995; Argyris, 1982; Abrams et al., 2003 p.65). When individuals are able to trust each other, they become much more willing to exchange information (Abrams et al., 2003). There are three components of trust: trust in another person which refers to the expectation that the other party will act in an altruistic manner, the

willingness to be vulnerable in that, the other party will not live up to expectations and thirdly, dependency meaning that the person is influenced by the actions of others (Mayer et al., 1995). Consequently, knowledge-creating participants feel more positive about managers and peers when they believe the managers and peers to be trustworthy (Matzler and Renzl, 2006). Trust in a collaborative environment can stimulate communication (Newell et al., 2007), moral obligation to share knowledge gained from collaboration (Ardichvili et al., 2003) and access to individuals of particular interest or specialty in a certain field (Wasko and Faraj, 2000). There are two ways that culture can positively affect knowledge creation. First, creating an environment in which knowledge creation is considered a social norm. Second, creating an environment that is conducive to caring and trust (Cabrera and Cabrera, 2005). Creating an environment of trust is essential to develop a culture of knowledge creation. Moreover, it is the development of a more profound trust in these knowledge networks that acts as a fulcrum for successful and useful knowledge creation.

Traditional business models have long been reluctant to share technological advances and intellectual property. For collaboration to occur in an open innovation setting, an environment favorable to the sharing of new ideas must be nurtured. Trust leads to higher levels of loyalty and more bargaining power from boundary spanners of the open innovation networks.

Motivation

Formal organizational structure and incentive systems make up an organizations knowledge management structure, which supports the open sharing of valuable knowledge (Gold et al., 2001). As such, the success of knowledge creation in an open

innovation network is contingent upon the motivating factors of the participants involved. Individuals can either be intrinsically motivated or extrinsically motivated. An intrinsically motivated person is one who will engage in the process because it is interesting and enjoyable whereas a person that is extrinsically motivated will employ a process driven by an end goal (Deci and Ryan, 2001). Intrinsically speaking, alongside an individual's rational thoughts of self-concern, altruistic tendencies may exist which is a form of unconditional kindness where a person expects nothing in return and gets personal satisfaction out of the process simply by helping (Kollock, 1999). Conversely, in extrinsic fashion, financial gain is the most apparent form of motivation (Hall and Graham, 2004). Organizational environment factors can also motivate individuals in a collaborative creation process (Correia and Mesquita, 2010). The organizational culture conditions participants in a collaborative environment to create knowledge by presenting payoffs such as bonuses, job security or promotions (Davenport et al., 1998) which are all examples of motivations in collaborative groups (Correia and Mesquita, 2010). The more an individual is motivated, the more knowledge creation will occur.

Compensation systems designed to encourage knowledge creation behaviors send a clear message to employees that knowledge creation is an important aspect of the organization (Cabrera and Cabrera, 2005). An effective strategy to develop a knowledge creation atmosphere within an organization is to make it vital for success (Cabrera and Cabrera, 2005). For instance, an employee that develops a reputation for sharing what they know can be on the fast track to a leadership position. Performance evaluations can be another strategy. However, the way the evaluations are carried out can have a direct effect on the success of employee participation in knowledge creation. A performance

review consisting of developmental evaluations will encourage an individual to unlock their creative ideas whereas a critical review will have the opposite effect (Cabrera and Cabrera, 2005). Financial rewards have also been shown to have a negative impact as they can be interpreted as a controlling or manipulative tactic. It is important to note that whatever compensation strategy organizations use, recognition should be rewarded for group performance and not on an individual level as this creates competition from within the collaborative group – thus making the whole process counterproductive.

Top-Management Support

Organizational vision and strategic intent lead to generating a clear purpose for an organization which enables goal achievement and knowledge sharing capabilities (Kim and Lee, 2006) as top-management support in collaborative knowledge sharing organizations play a central role in managing knowledge (Bryant, 2003). Knowledge sharing can take place at the organizational and individual level (Lin, 2007). This study addresses knowledge sharing at the individual level and the impact top-management has a scientist-manager collaboration.

Top management has the responsibility of enabling open innovation by demonstrating commitment and support as they help to overcome any resistance by the organizations participating in the knowledge collaboration. Top management must work to make open innovation a function of the company just like any other function in normal daily operation. A successful top-manager will work to make open innovation as "business as usual" within a company.

Project-Level Processes and Procedures

Proper management practices in open innovation knowledge sharing include work design, communication and technology (Cabrera and Cabrera 2005).

Work design is fundamental to knowledge creation activity in that it defines the job structure of an organization by identifying relevant tasks and activities that are then allocated amongst employees. These allocations then establish interdependencies, the frequency of interactions and information flow requirements between the different jobs (Cabrera and Cabrera 2005). Teams also present an ideal opportunity for individuals to work together and collaborate sharing the same objectives of completing the tasks in which they are all equally responsible for.

Firms must communicate and break down barriers that make knowledge sharing a challenge. To do this, face to face communication can be effective in that direct communication helps to reduce tension by breaking down barriers and providing ideal conditions for information exchange (Cabrera and Cabrera, 2005). (Riege, 2005) has asserted that culture, through some of its dimensions serves as a barrier to the knowledge sharing capabilities within an organization. "Some of the components of culture that have been identified as being influential towards the impeding of a knowledge sharing behavior include manager's commitment, emotional intelligence, fear, the presence of hierarchy in the organizational structure, lack of social network, age differences, gender differences, shortage of resources, conflict of motives, uncertainty, underestimation of lower levels, conflict avoidance and the general environment at work, among others" (Kathiravelu et. al, 2013).

"To the extent that structure follows and implements strategy, the objectives of joint R&D alliances have implications for alliance structure" (Tang and Das, 2008, p. 728). "With joint R&D alliances, the key lies in the transfer of a critical resource – technological knowledge" (Tang and Das, 2008, p. 728). Both knowledge transfer and learning affect the choice of alliance structure (Tang and Das, 2008). Moreover, the challenge is to expedite learning while deterring opportunistic learning to protect one's core competencies (Das and Kumar, 2007). "Strong governance is desirable for effective joint R&D activities since legitimate knowledge transfer and learning are essential for success" (Tang and Das, 2008, p. 728).

The use of technology in knowledge creation can help minimize the cost and time of collaboration; however, the technology itself must be properly applied and managed by individuals, for it is the individuals that pose the bigger threat of technology failure (Cabrera and Cabrera, 2005). It is important to understand that technology must enhance an already stable business model. If technology is applied in a scenario that disrupts the information flow of an already established organization, knowledge creation may slow even more. It is important that hiring managers pay close attention to any new technology implemented in an organization as they can be a strong asset in the selection of new technology initiatives (Cabrera and Cabrera, 2005).

Research Methodology

Data Collection Method

The objective of this qualitative exploratory research was to refine the independent variables of the conceptual model. For study one, two genomic research centers affiliated with academic medical centers were used to determine if trust,

motivation, top management support and project-level processes and procedures affected knowledge creation. IRB authorization was obtained prior to data collection. For this study, the data collection engaged in semi-structured recorded thirty-minute telephone interviews of top-of-field scientists and senior-level managers from each of these institutions.

For all those interviewed, a qualifying question was first asked regarding open innovation success in a collaborative setting to set the tone for the interview and develop a rapport with the interviewees. This question enabled further probing and adjustments to questions for the duration of the interview.

Separate questions were developed for each factor impacting knowledge creation. The question asked of top-of-field scientists and senior-level managers with regards to trust was: "How important is trust when developing or executing open innovation processes?" The question asked of top-of-field scientists and senior-level managers with regards to motivation was: "There has been much said about intellectual property and ownership thereof in the open innovation paradigm. What do you think the motivations of collaborators are during these processes of open innovation?" The question asked of top-of-field scientists and senior-level managers with regards to top-management support was: "Open innovation becomes most effective when processes and objectives are well defined. How much do you think management support determines the success of open innovation processes?" The questions asked of top-of-field scientists and senior-level managers with regards to project-level processes and procedures were: "Is there a specific process to activate or facilitate collaboration? How do you determine who the players are in cross-fertilization of information?"

Data Source

During the exploratory period, two top-of-field scientists and two senior-level managers were initially interviewed from two separate genomic research institutions affiliated with academic medical centers (AMC) regarding successful open innovation factors. The purpose was to discover topics relevant to these two open innovation efforts that were used for more in-depth exploration during the study two interviews. There has been significant experience from both research centers that could be leveraged for this study as both centers are comprised of interdisciplinary researchers that collaborate with multiple academic medical centers to bring insight and momentum to cutting-edge cancer research. Additionally, the participants from the genomic research centers come from both a scientist and manager background. Respondents can be visually represented in Table 1.2.

Table 1.2 Interview Respondents Study One

Interview	Top-of-field Scientist/Senior-level Manager	Academic Medical Center-Industry Alliance Number
A	Top-of-field Scientist 1	1
B	Senior-level Manager 1	1
C	Top-of-field Scientist 2	2
D	Senior-level Manager 2	2

Data Analysis Method

Upon completion of the recorded phone interviews, data was converted into written transcripts using Rev transcription software. The transcribed interview data was loaded into ATLAS.ti for qualitative analysis by manually coding all relevant words, phrases and sentences with regards to factors impacting knowledge creation. The manually coded categorized data was converted to an excel spreadsheet output organizing

all quoted interview statements by the factors impacting knowledge creation: trust, motivation, top-level management and project level processes and procedures factors. Themes and general issues were then developed based on the categorized quotes.

Results

Analysis of the data from the semi-structured interviews revealed several themes with regards to the factors that impact knowledge creation in scientist-manager collaborations. These factors included interpersonal trust, motivation, top-management support and project-level processes and procedures.

The following summarizes the results in four topical areas: Within trust, the direction of knowledge flow between the scientist and manager must be clearly understood and there must be belief in the ability of each side of the strategic alliance to work together and accomplish objectives. Within motivation, managers tend to be financially driven whereas scientists are driven by forwarding science. Within top-management support, top-of-field scientists and senior-level managers agreed that recognizing, supporting and nurturing knowledge output from a collaborative knowledge network as well as the development of joint steering committees on each side of the alliance are important responsibilities for collaboration success. Within project-level processes and procedures, there must not be an indoctrinated way of thinking as scientists and managers that join a collaboration without a predetermined set of beliefs are more likely to successfully collaborate.

A qualifying question was first asked regarding open innovation success in a collaborative setting to set the tone for the interview and develop a rapport with the

interviewees. This question enabled further probing and adjustments to questions for the duration of the interview.

Open Innovation Success

Open innovation success was defined as knowledge creation within a scientist-manager collaboration. The question asked of top-of-field scientists and senior-level managers regarding open innovation success uncovered several themes specific to factors that contributed to knowledge creation in scientist-manager collaborations within academic medical center-industry strategic alliances. Resources such as specialized equipment and financial capital are needed as well as access to complementary knowledge form both the scientist and manager side of the collaboration. There must also be a sense of privacy or boundaries within the collaborative eco-system so scientists and managers are comfortable sharing knowledge. Quality knowledge creation will drive innovations forward.

Theme 1

A top-of-field scientist said open innovation is a knowledge creating process whereby all intellectual property is created across a knowledge network. However, after speaking to the participants in this interview, it is evident that top-of-field scientists and senior-level managers need resources for open innovation to be successful. Resources such as specialized equipment and capital as well as access to experienced, intelligent people are at the forefront.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

I think from a broad point of view the first big thing is resources. All right, so in a life science space in most of academia and most sciences, access to people, smart people and access to both physical resources, specialized equipment and cash is very important.

Theme 2

A top-of-field scientist said for successful open innovation to occur, participants must have access to complementary knowledge, that is, the knowledge the scientist and the manager collaboratively produce will increase the probability of new and innovative knowledge. As new knowledge is produced, more top-of-field scientists and senior-level managers will contribute to collaborative knowledge creation.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

You need to think of a complementarity in assets, in people and knowledge that are critical. What we're able to achieve is actually find resources and so forth, to weigh the concentration of equipment, technologies, people, to really make a big difference. That by itself has externality, the more good people you have, the more other good people show up and it starts to grow from there.

Theme 3

A senior level manager said in relation, to the "sandbox analogy" – there must be an environment created where the participants feel some privacy in information exchange; otherwise maximum firm innovation will not be realized. Initial observations bring to the forefront that the quality of the science is what will determine the quality of the collaborative output however if resources are not being shared within the organization it becomes harder to achieve stated objectives or drive the program forward. Supplying the proper resources to be shared and advancing the newly created collaborative knowledge then becomes the objective of the senior-level manager.

Interview B. Senior-level Manager 1 AMC-Industry Alliance *1*

The sandbox needs to be big enough to have enough opportunity for innovation and advancement, yet not totally open because then you lose trust. Then you lose camaraderie. Then You must have, like any sandbox, it's not the beach. It's actually got some boundaries to it. People feel like they're within the sandbox they can play, but yet it's not open, fully open.

Then what you do is you couple that with toys. You got to bring the right toys. In our case it could be technology. It could be instrumentation. It could be retreats, but there's got to be toys in the sandbox so that those people who are in it, they feel as if they're getting access to things that otherwise they might not have access to. Yet those toys are somewhat. They're not arbitrary. You bring in the kind of toys that you want people to do certain things. You give them the toys to do that. In a way, it's managing it, but it's not directed. Then you let people start playing in the sandbox. Then they get to play with each other. They get to play with the toys. They get to innovate and you keep your eye on it because it's a relatively constrained area compared to the whole world of science so you can exploit it. My job is when something happens in that sandbox, then I'm there to help them not necessarily create the IP, but to advance it.

Theme 4

A senior-level manager said to achieve a quality output in collaborative alliances it is essential to have quality science being produced. It is the quality of the science that will advance the program and further develop the scientist-manager collaborative knowledge creation. Key scientist-manager objectives are discussed and worked through in the beginning stages of the alliance to ensure collaborative success and the development of quality science.

Interview D. Senior-level Manager 2 AMC-Industry Alliance 2

I think one of the main things that is always key is obviously the science drives the partnership forward. Basically, the thing that, again, gets these alliances going is the quality of the science, the caliber of the science that ultimately leads to the product development program that we structure. That's one thing, again, to get the ball rolling that's critical. Again, that's what I do here. We work through many of those key issues with our partners on the other side to ensure, again there's a smooth runway there so that, again, the success can continue driving the program forward.

Table 1.3 examines open innovation key themes from top-of-field scientist/senior-level manager interviews that will improve the probability of knowledge creation in open innovation processes.

Table 1.3 Open Innovation Success Key Themes Study One

Top-of-field Scientist	Senior-level Manager
I think from a broad point of view the first big thing is resources. All right, so in a life science space in most of academia and most sciences, access to people, smart people and access to both physical resources, specialized equipment and cash is very important (top-of-field scientist 1).	*I think one of the main things that is always key is obviously the science drives the partnership forward. Basically, the thing that, again, gets these alliances going is the quality of the science, the caliber of the science that ultimately leads to the product development program that we structure (senior-level manager 2).*

Insights from top-of-field scientists and senior-level managers related to open innovation success key themes found that access to physical resources and specialized equipment that develops high-quality science in a scientist-manager strategic alliance will increase the probability of knowledge creation. That is, the higher the caliber of knowledge produced, the higher the probability that science and innovation will move forward.

Trust

Trust in a scientist-manager collaboration is defined as the belief in the ability of the scientists and managers to work together reciprocally within a strategic alliance to create knowledge. Trust is an important factor in the implementation of knowledge creation as "trust leads to increased overall knowledge exchange, makes knowledge exchanges less costly and increases the likelihood that knowledge acquired from a colleague is sufficiently understood and absorbed that a person can put it to use" (O'Reilly and Roberts, 1974; Currall and Judge, 1995; Argyris, 1982; Abrams et al., 2003 p.65). The question asked of top-of-field scientists and senior-level managers regarding trust uncovered several themes specific to factors that contributed to knowledge creation in scientist-manager collaborations within academic medical center-industry strategic

alliances. Contracts must be developed at the beginning of the collaboration that clearly states the direction of knowledge flow between the scientist and manager as this will increase the probability of a trusting relationship. If there is no clear direction in the flow of knowledge, scientist-manager tensions will develop. Participant credentials and career milestones aid in the development of trusting relationships as scientists and managers are drawn to other scientists and managers that have experience in their field of expertise. Tensions develop when established groups become dismantled because of participant turnover which happens much more frequently on the manager side. Scientists and managers must trust in the ability of each side of the strategic alliance to work together and accomplish objectives.

Theme 1

A top-of-field scientist said for successful collaboration between scientist and manager to succeed; trust becomes a key factor. Contracts that are developed at the beginning of a collaboration will dictate the knowledge flow. Depending on the contract, knowledge can flow one way from scientist to a manager or both ways where both sides are exchanging knowledge. It is when knowledge flow has enacted both ways, tensions and distrust may occur as top-of-field scientists and senior-level managers don't necessarily possess the same phenotype for knowledge sharing.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 2

I think that it's very important, and essential to the success. I think that the contract as a collaboration agreement will define how that information is supposed to flow, so in some cases it's one way and in other cases it's two ways. But, when it's two ways there's hesitation on both sides to share because it's not necessarily their phenotype to share. So, for example, an academic institution shares everything. It's their phenotype. It's the way that they publish, they put all their information out there, because they want to share it to the general public. When an academic institution has a strategic alliance with a biotech or a pharma company they have a very different perspective on that.

Although they publish all their clinical trial data openly anything prior to that is top secret.

Theme 2

A senior-level manager said for successful knowledge sharing ecosystems to exist; there must be trust on an administrative level as well as a measured valuation of each participants assurance that the collaboration will be successful, in that, the environment is conducive to knowledge creation and products will go to market quickly and effectively. The credentials of the participants involved in the collaboration must show past career milestones, achievements or successes, thereby proving reliability and feasibility of the project. Communicative transparency between the participants involved will also bolster trust.

Interview D. Senior-level Manager 2 AMC-Industry Alliance 2

I think there's an administrative level of trust for structuring of these programs at one level. Then there's also the operational level of trust with, again, all the scientists involved, the project management teams on both sides. There needs to be trust in the partner being the right partner, obviously, to get to that end goal. At an institutional level, we need to feel that, we've partnered the assets with the right team on the other side to really move the needle and to do it effectively. Trust to get a product to market the quickest and, again, ultimately creating the highest value. Fluid communication between the parties and, again, the track record that obviously they've established before but also on understanding really the people on the other side.

Theme 3

A senior-level manager said there is a breakdown of trust between the scientist and manager because the manager side of the alliance has higher turnover than the scientist side. Scientists tend to stay in the same career for longer periods than the managers and tensions arise as it becomes difficult for these cultural differences to be understood by each party. The breakdown of trust or development of tensions could be lessened if the cultures were better understood from the beginning phases of the alliance.

Interview D. Senior-level Manager 2 AMC-Industry Alliance 2

On the university side, there's definitely constancy; much more so than there is on the other side. I think that can often lead to fraying of this trust at many levels. I think that's where communication is critical. Both between administration at a university and the faculty involved in the program. Then, also, really between the scientists and an understanding that they need to understand the culture of the other side and be able to adapt to, again, a very different culture.

Theme 4

A senior-level manager said trust is the most important factor for collaborative knowledge creation as there must be trust between colleagues in the ability of their capacity for a particular task, so they succeed in working together. Trust is also an assessment in the ability of a collaborative participant to get the job done and "deliver".

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

Yeah, my latest mantra to everybody has been that that's the single most important variable [trust] for success. In fact, I just finished reading this book by Stephen Covey. I don't know if you've heard of this book called The Speed of Trust.

It's a good book. It basically talks about the critical importance of trust in moving things across faster. We've been trying to create within the institute that kind of level of trust. Anyway, yeah, so I would argue that trust is the single most important thing.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

I think we have to operationalize trust. Trust is a combination of your assessment of somebody's competence, in a particular task. Your assessment of their capacity to deliver. So, I think, yeah, I agree with you, trust is too much of a broad catch-all term.

Table 1.4 examines trust key themes from top-of-field scientist-senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 1.4 Trust Key Themes Study One

Top-of-field Scientists	Senior-level Managers
I think that it's very important, and essential to the success. I think that the contract as a collaboration agreement will define how that information is supposed to flow, so in some cases it's one way and in other cases it's two ways. But, when it's two ways there's hesitation on both sides to share because it's not necessarily their phenotype to share (top-of-field scientist 2).	*I think there's an administrative level of trust for structuring of these programs at one level. Then there's also the operational level of trust with, again, all the scientists involved, the project management teams on both sides. There needs to be trust in the partner being the right partner, obviously, to get to that end goal. At an institutional level, we need to feel that, we've partnered the assets with the right team on the other side to really move the needle and to do it in an effective way (senior-level manager 2).*
I think we have to operationalize trust. Trust is a combination of your assessment of somebody's competence, in a particular task. Your assessment of their capacity to deliver. So, I think, yeah, I agree with you, trust is too much of a broad catch-all term (top-of-field scientist 1).	*On the university side, there's definitely constancy. Much more so than there is on the other side. I think that can often lead to fraying of this trust at many levels (senior-level manager 2).*

Insights from top-of-field scientists and senior-level managers related to trust key themes found that competent professionals who engage in transparent bilateral communication in a scientist-manager strategic alliance will increase the probability of knowledge creation. Trust is commonly an overused term when discussing knowledge creation in scientist-manager strategic alliances and must be operationalized. Trust is an assessment of confidence in yourself and that of your colleagues to complete a task. When knowledge flow becomes unclear confidence of the scientist and manager break down and tensions develop. There was a general tension discovered between the scientist and manager in terms of knowledge flow and turnover on the manager side of the strategic alliance. When there is knowledge flow on both sides there is hesitance to share

as managers and scientists are “not from the same phenotype” according to top-of-field scientist 2. Managers also have a much higher turnover rate than scientists which leads to fractured relationships over the life of the collaboration.

Motivation

Motivation in a scientist-manager collaboration is defined as the reasoning why scientists and managers work together within a strategic alliance to create knowledge. The question asked of top-of-field scientists and senior-level managers regarding motivation uncovered several themes specific to factors that contributed to knowledge creation in scientist-manager collaborations within academic medical center-industry strategic alliances. Motivational factors can be broken down into three categories: Extrinsic motivators (done for the payoff at the end), Intrinsic motivators (done for the joy of the task itself) and prosocial motivators (done for the identity or because of one's responsibility or duty). According to managers, financial drivers concerning garnering research funds are more prevalent than altruistic motivations for scientists while managers wish to move science forward in a cost-effective way. Additionally, the ego can play a part in why scientists collaborate because of the recognition they receive.

Theme 1

While altruism is not a major driver it can be a supplemental factor, in that, forwarding science will bring drugs to market quicker for people in need. A major financial driver would be related to the research and development capital needed to fund these projects and continue to forward the science.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

I don't want to be cynical about this, but I don’t think altruism is the major driver. I think it may be the major sort of vocalized reason and I think for some people ...

Altruism for me is a, it's too non-selfish, but I think there's certainly for some people motivation that they believe that working together will speed discovery and treatments for people with this terrible disease. I do believe that that's on the list for many people, but I don't think it's actually a major driver. I think that the major drivers are financial, but not necessarily financial money in the pocket, in their pocket, although to some extent I think that that is true, but I think that it's much more financial in terms of being able to garner the resources that they believe they need to effectuate their own research agenda.

Theme 2

Managers seek relationships that are cohesive that can develop collaborative knowledge and move innovations forward in the most cost-effective way.

Interview D. Senior-level Manager 2 AMC-Industry Alliance 2

I'd say, from the academic side, we simply want to find that party that we can work closely within a collaborative way and that we feel is going to give this technology the best chance to move to the next level. What motivates that, I think, on the industry side actually, again, a real understanding at some level that this is critical for them and is going to be, again, a cost-effective and critical way to move a key program forward.

Theme 3

Ego ranks very high in the list for scientists because they want recognition, accolades and respect. Helping forward individual's personal research by learning something that may have otherwise not been known is another motivator.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

Equally high is ego. Because we don't get, historically, although I think now that's changed a little bit, historically we don't get the kind of financial rewards personally that ego becomes a pretty strong motivator, being recognized for your discoveries and your advances of medicine. Those are pretty high, I think on the list of why people do what they do in our field. I'd rank that really high.

Theme 4

Knowledge creation motivational factors can be broken down into separate categories: Extrinsic motivators which are activities one does for the payoff at the end, whether it be monetary, fame or industry respect for example. Intrinsic motivators -

which are the joy of the task itself. Prosocial motivators - done for the identity or because of one's responsibility or duty.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

One is broadly speaking, we think about motivators in three categories, there's what we call extrinsic, intrinsic, and pro-social. Extrinsic are activity you do for the outcome at the end. It could be the cash you get at the end. It could be the reward. It could be the fame you get at the end, the recognition you get at the end and so forth. People do things to get extrinsic rewards. Economics spends a lot of time talking about that. Then there's a set of rewards that are intrinsic which is like the joy of the task itself. People do it because they enjoy the task. Like what they're doing. It's fun. There's a learning element to it. There's a scale development on which those things are the benefits of doing the task itself instead of the outcome you're getting from the task. And the third set of things are what we call pro-social, which are things that you do for your identity, for your sense of belonging, your sense of responsibility and duty and so forth. So those are the three broad buckets. Economics focuses on extrinsic. Psychology on intrinsic, Sociology focuses on pro-social and of course, it can also be mixed, across the board and all.

Theme 5

Timetables for distribution of new knowledge leads to tension because the scientist may want to present or publish new information openly and managers want a longer time to review the knowledge collaboratively created before it is shared.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

When an academic institution has a strategic alliance with a biotech or a pharma company they have a very different perspective on that. Although they publish all their clinical trial data openly anything prior to that is top secret. So, the two institutions or the cultures of the two institutions have a very hard time coming to terms with that. I think that they don't have a hard time sitting around the table sharing information with each other, but I think it becomes more difficult when, say, a researcher at an academic institution wants to publish or wants to do a presentation at a conference and the pharma company wants 60 to 90 days to review all the slides. These men and women are usually doing their slides on an airplane on their way to the conference.

Table 1.5 examines motivation key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 1.5 Motivation Key Themes Study One

Top-of-field Scientists	Senior-level Managers
When an academic institution has a strategic alliance with a biotech or a pharma company they have a very different perspective on that. Although they publish all their clinical trial data openly anything prior to that is top secret. So, the two institutions or the cultures of the two institutions have a very hard time coming to terms with that (top-of-field scientist 1).	*I think that the major drivers are financial, but not necessarily financial money in the pocket, in their pocket, although to some extent I think that that is true, but I think that it's much more financial in terms of being able to garner the resources that they believe they need to effectuate their own research agenda (senior-level manager 1).*
One is broadly speaking, we think about motivators in three categories, there's what we call extrinsic, intrinsic, and pro-social (top-of-field scientist 1).	*I'd say, from the academic side, we simply want to find that party that we can work closely within a collaborative way and that we feel is going to give this technology the best chance to move to the next level (senior-level manager 2).*

Insights from top-of-field scientists and senior-level managers related to motivation key themes found that garnering financial resources and promoting collaborative cohesiveness that moves publishable research and technology forward in a scientist-manager strategic collaboration will increase the probability of knowledge creation. There was a general tension observed between the scientist and manager regarding alignment of objectives and motivations. While the goal in a strategic alliance is to align scientist and manager motivations, at its foundation, scientists want to publish and managers want to keep new innovations in the organization's pipeline. This leads to a strain on information sharing between the two professionals.

Top-Management Support

Top-management support in a scientist-manager collaboration is defined as leadership that provides organizational vision and strategic intent that leading to a generation of clear purpose for an organization which enables goal achievement and

knowledge sharing capabilities (Kim and Lee, 2006). The question asked of top-of-field scientists and senior-level managers regarding top-management support uncovered several themes specific to factors that contributed to knowledge creation in scientist-manager collaborations within academic medical center-industry strategic alliances. Top-of-field scientists and senior-level managers agree that recognizing, supporting and nurturing knowledge output from a collaborative knowledge network as well as the development of joint steering committees on each side of the alliance are important responsibilities of top-management. According to a manager interviewed scientists do not know how to properly structure large partnerships and make them successful.

Theme 1

According to the manager interviewed, the most challenging aspect of a collaborative knowledge network is nurturing output which is better identified as "meta-leadership" - "being able to support bottom-up, innovation and entrepreneurship while giving it a structure and a set of resources that allow people to be successful and doing that in a way that drives a strategic agenda, a common strategic agenda, without forcing that agenda".

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

I'm not sure that I would use the word management. It's more meta-leadership than it is direct management and oversight is I think a good manager in this environment is somebody who is able to balance a legitimate ability to support bubbling up, bottom up, innovation and entrepreneurship while giving it a structure and a set of resources that allow people to be successful and doing that in a way that drives a strategic agenda, a common strategic agenda, without forcing that agenda.

Theme 2

Scientists said the role that top-managers play in collaborative knowledge sharing is greatly undervalued and understated in the life sciences.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

I think it's super important. I think this in many ways is like the most understudied topic in life sciences, which I think we undervalue the role management can play in enabling great science, great open innovations are supremely undervalued. I would certainly agree with your assessment that this is very important.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 2

My opinion is that management and leadership are absolutely essential in the success.

It's actually a great question. Yes, they know what they're doing in that when we launched the alliance we implemented a governance system for the entire alliance and it was composed of multiple subcommittees

Theme 3

A top-of-field scientist said there are multiple joint steering committees each with their own deliverables and each joint steering committee has their own subcommittee. Everything is very highly defined in terms of goals and objectives.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 2

Each one of those committees had their own charter, their own deliverables that they had to provide up to what the governance of the overall alliance such as a joint steering committee. So, each time we had a joint steering committee meeting each team was responsible to submit updates on their goals and objectives, and then any new requests, for let's say new science or new relationships, so on and so forth, would have to go up to the joint steering committee. So, all things management usually will come to the alliance manager and interestingly, in the contract, that was a role that was defined. In the contract it defines that there will be a joint steering committee as the overall governance. There will be an alliance manager, and then there was one other committee that was defined in the contract that needed to be in place for the commercialization. Then once we launched it we had a bunch of other subcommittees. They met regularly. They had subcommittees within the subcommittee. So, it was very, very well defined

Theme 4

A senior-level manager said the scientist does not know how to structure a large partnership to make it successful. The manager must try and bridge the gap in

management styles, provide solutions to communication problems and keep the collaboration moving forward.

Interview D. Senior-level Manager 2 AMC-Industry Alliance 2

You need obviously the science to, again, spawn and interest from the other side. Then, again, scientists really have no idea how to structure a large partnership like this to make it successful. Really, you need experienced managers and individuals who understand how to bridge the gap here and pull the two pieces together. Both to structure the program and then to keep it on the rails as things go forward. The scientists, again, will come in, they'll fly off the handle, "Well, this isn't working. These people aren't listening to us." Well, again, we talk with them, calm them down, and then go back to the other side. Try to bridge that gap and figure out a solution to an issue that otherwise could cause the whole program to derail. I really think it's an intimate partnership there between management and science that really makes these programs successful.

Table 1.6 examines top-management support key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 1.6 Top-management Support Key Themes Study One

Top-of-field Scientist	Senior-level Manager
My opinion is that management and leadership are absolutely essential in the success. *It's actually a great question. Yes, they know what they're doing in that when we launched the alliance we implemented a governance system for the entire alliance and it was composed of multiple subcommittees (top-of-field scientist 2).*	*It's more meta-leadership than it is direct management and oversight is I think a good manager in this environment is somebody who is able to balance a legitimate ability to support bubbling up, bottom up, innovation and entrepreneurship while giving it a structure and a set of resources that allow people to be successful and doing that in a way that drives a strategic agenda, a common strategic agenda, without forcing that agenda (senior-level manager 1).*

Insights from top-of-field scientists and senior-level managers related to top-management key themes found that top-management leadership which establishes a strategic agenda and governance structure in a scientist-manager collaboration will

increase the probability knowledge creation. There was a general tension observed between the scientist and manager when a senior-level manager stated that scientists did not know how to successfully structure collaborative partnerships. Scientists can have a difficult time communicating effectively with managers and this can cause strain within the collaboration.

Project-level Processes and Procedures

Project-level processes and procedures in a scientist-manager collaboration are defined as work design that defines the job structure of an organization by identifying relevant tasks and activities which are then allocated amongst employees. These allocations then establish interdependencies, the frequency of interactions and information flow requirements between the different jobs (Cabrera and Cabrera 2005). The question asked of top-of-field scientists and senior-level managers regarding project-level processes and procedures uncovered several themes specific to factors that contributed to knowledge creation in scientist-manager collaborations within academic medical center-industry strategic alliances. There are times when the most capable professionals are not necessarily the best participants for a collaborative environment. A manager said it is important to find professionals that are not tied to a specific set of beliefs or a certain way of thinking because collaborative groups are most effective when there isn't a pre-existing mindset. Academia management styles are much different than industry management styles in terms of the hierarchical structure which can have a negative impact on collaborative knowledge creation. High turnover was mentioned by scientists as a leading reason for the failure of a collaboration within a scientist-manager strategic alliance.

Theme 1

A senior-level manager said there are times when the "best" professionals are not necessarily the most ideal participants in a collaborative knowledge sharing ecosystem. These professionals that come together collaboratively, have been at times rewarded in their careers for not working well with others. It is important to find people that aren't "indoctrinated" into a certain way of thinking as groups that are built from the ground up with no pre-existing mindsets of objectives for the collaborative group are more effective.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

Being the best people in the field doesn't necessarily mean they play in the sandbox together. To some extent they've been rewarded most of their careers for not. I think the other part of it is you need your own people. You need to find, in our case, younger people, people who haven't yet been indoctrinated into a certain type of behavior, perhaps some other people from the outside who have the phenotype. I've worked with groups before which were built from scratch based on that phenotype being critical. That's turned out to be the most successful way to do it. If you inherit people, you just need to demonstrate over time, and it takes time, the value of working together far exceeds the value of not and that they shouldn't feel threatened.

Theme 2

A top-of-field scientist said that project-level processes and procedures isn't necessarily about who works well with whom. Academia doesn't have management styles like industry does, in that, you cannot force people to work together in academia. Successful project-level processes and procedures means creating an environment conducive to learning for the participants involved by lowering any barriers mitigating collaborative success.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

I think culture is often, again, like trust, this big word which has sort of lost meaning. What I was going to say is, it's not so much knowing who works well with whom because in academia there is no management. My dean doesn't tell me who I should work with.

My department chair doesn't tell me who to work with. In your company you can, but in most settings, that's not the case. So, what's going on is instead is that we want to have a setting that allows us to create opportunities for people to learn. We lower barriers to collaboration - where you enable people to take risks and experiment, and those are the hallmarks of the culture that needs to be innovative, right? Not just the culture be composed into what is the task that we need to do, and how to do that.

Theme 3

A top-of-field scientist said that one of the determining factors the leads to failure of project-level processes and procedures with alliances is the high turnover on the manager side of the alliance. When joint subcommittees and governance processes are enacted and managers leave the alliance, the processes put in place need to be revised or restarted to onboard new participants. This creates tension on the scientist side of the alliance because of the length of time and money it takes to bring everyone up to speed.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 2

One of the issues, and I don't want to get into another topic that you're not necessarily looking for, but I will say that ... and this is one of my own little hypotheses that I have but ... I frequently on the success of alliances, and one of the determining factors I think is the very high turnover of people on the pharma side.

Yeah. And you're onboarding new people, have different directives. They have different styles. Just trying to establish a new relationship, new trusts. And then they're in place for three or four months and then somebody else comes in. And it makes it very hard for that trust, for that motivation, kind of those elements we were talking about being in place. It makes it hard to maintain the same momentum and the same level of success when you're having a lot of turnover.

I don't know that every alliance does this, but because of its importance and how broad the collaboration agreement was, we put a lot of time and energy into a thorough launch, the definition of all the different subcommittees and the governance and process ... we have a ton of processes we've put in place. All of these things were implemented in order to ensure success.

What happens is, is when you start getting these new people that come in, especially on the pharma side, we have a process for onboarding new people. Whoever's side it was on you go through this ... I would meet with someone for maybe two hours, kind of going over all the different elements of the alliance, getting them up to date. But there's a lot of decisions, and a lot of situations that were negotiated, and there were reasons behind all of that, and that's a very different topic to articulate to someone, because they don't have the historical knowledge, right?

So, then you bring in these new people who have a very different culture. So, we spent a lot of time on understanding each other's cultures at the launch of the alliance.

And, this person doesn't like me, and it wasn't about that. So, we spent so much time and money making these things a possibility for us, and we kind of got into this nice groove. It wasn't perfect. People can still be people, but then you start having turnover and you're like, oh, my goodness, here we go

Theme 4

A senior-level manager said a collaborative culture that supports empowerment, risk-taking, social harmony and mutual support is more apt for successful innovation knowledge transfer.

*Interview D. S*enior-level Manager 2 AMC-Industry Alliance 2

We understand there is going to be this challenge and what I probably do, and my team does, coach the individuals early in the process here and have an open conversation with our scientists about these cultural differences that, again, they will experience stepping into this new type of environment as well as what the expectations are on the industry side if they haven't done this before.

I think it's always an issue and then at the same time, like I say, as we're structuring the deal, these are things that I put on the table first. Look, these are key must-haves for an academic medical center in any alliance program - things like publication rights. The scientists must be able to publish their work. Well, the people on the company side they say, "Well, we're not going to publish anything here. This is all going to be secretive until we're in the clinic." Well, for the academic medical center and for most other academic institutions, it would simply be a no-go.

There is a matter of understanding that, but then finding a solution there. A middle ground that we both can live with. It's a balanced understanding what the company can do and is willing to do to make this work. Then, also, getting some concessions out of faculty. You will be able to publish it, but you're going to have to wait some time. The company's going to have to review this work, we're going to have to file intellectual property to the extent we must, and we're going to have to just put a delay period around your ability to get this technology out.

You can't just say, "Well, tomorrow I'm going to go to a meeting and present." No, it needs to go through this review process first. Issues like that, if you get ahead of them, if you get people on the same page, you must keep reiterating this. It's culture, as you know, is so ingrained in certain people who have lived in a certain situation for so long. You need to keep going back and reminding people on our side. Well, this is what we signed up for, it's manageable, we'll help you manage it, but, again, you need to work with us and really, we need to follow what's in our outline in the contract.

It's important to, again, be upfront about it, but then also to stay with it through the process. Then, also at times, we do need to adapt it. That you find we thought this would work, but it just isn't working. We've got to go back and work with our partner to

find a better solution. All these things, I think, help. Again, if you're listening to the wants and needs of your side, you're in a better position to bridge the gap. Also, work with them and counsel them on the reasons why we need to, again, also work with our partner to help find a middle ground here in bridging this cultural divide.

Table 1.7 examines project-level processes and procedures support key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 1.7 Project-level Processes and Procedures Key Themes Study One

Top-of-field Scientist	Senior-level Manager
We want to have a setting that allows us to create opportunities for people to learn. We lower barriers to collaboration where you enable people to take risks and experiment, and those are the hallmarks of the culture that needs to be innovative (top-of-field scientist 1).	*I think the other part of it is you need your own people. You need to find, in our case, younger people, people who haven't yet been indoctrinated into a certain type of behavior, perhaps some other people from the outside who have the phenotype (senior-level manager 1).*

Insights from top-of-field scientists and senior-level managers related to project-level processes and procedures key themes found that a culture consisting of trainable professionals that lowers barriers to collaboration and enables risk-taking in a scientist-manager strategic collaboration will increase the probability of knowledge creation. There was a general tension observed between the scientist and manager with regards to the setting in which they are familiar and comfortable working in. Scientists generally work in an environment where they do not report directly to a superior and are not specifically told with whom to work. Conversely, the manager culture is much more hierarchical in structure. The high turnover on the manager side of a collaboration also creates tension within the collaboration.

Discussion

As the quality of knowledge created increases, so too will the level of innovation that drives science forward. For quality science to occur, collaborative scientist-manager participants must feel as though there are boundaries in which intellectual property will remain. Information cannot be shared freely outside of the boundaries of the strategic alliance as this will negatively impact the amount of knowledge created. Therefore, access to physical resources and specialized equipment that develops high-quality science in a scientist-manager strategic alliance will increase the probability of knowledge creation.

Contracts in scientist-manager collaborations are an important aspect of the development of trust as reciprocal knowledge flow must be established from the very beginning. Without a clear and concise understanding from both sides of the collaboration, trust will begin to break down as the belief in the ability of each member to complete tasks and objectives will weaken and negatively impact the amount of knowledge created. Therefore, competent professionals who engage in transparent bilateral communication in a scientist-manager strategic alliance will increase the probability of knowledge creation.

Motivations for scientists include garnering research funding and gaining recognition for scientific discoveries whereas managers wish to move science forward in a cost-effective way and sustain competitive advantage. Sustaining this competitive advantage means keeping new knowledge within the company pipeline for as long as possible. Scientists, on the other hand, want to publish new knowledge as quickly as possible. Tension develops between the scientist and manager because of these objective

timetable differences which will negatively impact knowledge creation. Therefore, garnering financial resources and promoting collaborative cohesiveness that moves publishable research and technology forward in a scientist-manager collaboration will increase the probability of knowledge creation.

Top-management support in scientist-manager collaborations provides a vision and purpose, guiding participants towards clear objectives. Recognizing and supporting knowledge development as well as implementing joint steering committees on each side of the alliance are important responsibilities of top-management, however managers noted that scientists lack the proper skill set to structure large partnerships. This leads to the development of tension between the scientist and manager decreasing the probability of knowledge creation. Therefore, top-management leadership which establishes a strategic agenda and governance structure in a scientist-manager collaboration will increase the probability of knowledge creation.

Project-level processes and procedures in a scientist-manager collaboration are defined as work design that defines the job structure of an organization by identifying relevant tasks and activities which are then allocated to employees. There are times in a scientist-manager collaboration when the most capable professionals are not necessarily the best participants for a collaborative environment. It is important to find professionals that do not have a specific set of embedded beliefs as collaborative groups are most efficient without a pre-existing mindset. Management styles in academia are much different than industry management styles in regarding hierarchical structure. Cultural difference in management styles, as well as high turnover on the manager side of the collaboration, can decrease the probability of knowledge creation. Therefore, a culture

consisting of trainable professionals that lower barriers to collaboration and enables risk-taking in a scientist manager collaboration will increase the probability of knowledge creation.

Although the study one suggested several factors that directly impact knowledge creation, this is not an exhaustive list of possible factors contributing to the success of knowledge creation in open innovation activities. This study might have uncovered more critical success factors if the sample size had been larger, but it's difficult to get access to senior level scientist's and manager's in general or to their time. Future studies can explore whether more critical success factors, in fact, exist beyond those mentioned by these interviewees. The time constraints of each interview didn't allow for a more in-depth examination as further interviewing could have led to more insight on the scientist-manager tension in open innovation relationships. Characteristics may also vary across different medical institutions, but it would not be possible to cross-reference as there were only two genomic research institute/academic medical center alliances examined in this study.

There was an expressed aspect and general tone of the interviews which uncovered a tension between the scientist and manager side of collaborative knowledge creation in healthcare. If knowledge flow isn't reciprocated both ways in a collaboration, there is a breakdown of trust as it becomes difficult to have clear strategies and objectives that both sides clearly understand. Moreover, the motivations of scientists differ from managers in that scientist's primary objective is to publish research and move science forward whereas managers are attracted the potential of minimizing research and development costs and getting treatments into the clinic. Top management in scientist-

manager collaborations is responsible for keeping both sides focused and working towards the same shared goals as strategic vision can become blurry if both sides aren't in constant communication. While top management acts as the boundary spanner bridging the communication and knowledge gap between the scientist and manager, project level management is comprised of a joint steering committee that is made up of both top-of-field scientists and senior-level managers that take care of the day to day operations. Scientist careers are much more constant and long-term whereas managers tend to cycle more quickly. This creates tension as scientists then must spend time bringing new entrants to the collaboration up to speed.

Study one has uncovered a root problem. How can we ensure collaborative information creation processes succeed within an organization when there is tension between the two professional guilds? With knowledge creation extending deeply into various organizations and institutions in healthcare, are there specific factors that lead to the more successful collaborative strategic alliances? The proposal for new research will include a successful academic collaborator with industry. The new research will address the scientist-manager tension and seek to answer the question: What are the organizational factors that lead to a successful academic-industry alliance.

CHAPTER 2

STRATEGIC ALLIANCES IN HEALTHCARE, TENSIONS IN COLLABORATIVE KNOWLEDGE CREATION

Abstract

The healthcare industry harbors an environment that is fast-paced and ever-changing. To increase adaptability, competitiveness and efficiency, academic institutions, genomic research centers and biopharmaceutical companies have developed a network-oriented business model by creating strategic alliances. While the end goal is to increase capabilities for success, the initiative can be met with challenges and tensions between the firm participants. Through exploratory research consisting of semi-structured interviews of a larger pool of top-of-field scientists and senior-level managers, this study addressed the scientist-manager tension and identified organizational factors that increased the probability of knowledge creation in academic-industry alliances. The main finding was clearly defined participative roles that enable risk-taking with collaborative focus and aligned incentives, scientists and managers that maintain transparency and possess a strong belief in the reliability of collaborative research and development relationships, alignment of motivations with shared mandates, top-managers that foster communication and facilitate organizational structure and project-level processes and procedures that is well defined and operationally structured to minimize turnover in a scientist-manager strategic alliance will increase knowledge creation.

Introduction

With a strong commitment towards translational research, the academic medical center examined in this study has formed multiple strategic alliances with the

biopharmaceutical industry. While these strategic alliances share the same objectives, the characteristics of each remain different. Academic medical center-industry alliances have proven to be effective and provide continuing promise for future research and discoveries, however studies have shown that strategic alliances have a propensity for failure. Also, despite literature on strategic alliance management, challenges in execution remain. An objective of this study is to uncover the organizational factors that lead to a successful academic-industry alliance in hopes to provoke more thought on what the ideal strategic alliance may look like in the life science industry.

The following study examined critical success factors and scientist-manager tension that exists within two successful academic medical center-industry alliances by interviewing senior-level managers and top-of-field researchers from each collaboration through semi-structured interviews. The interview responses uncovered underlying themes that increased the probability of knowledge creation within the collaboration. Tension can put a strain on scientist-manager collaborations. Therefore, specific critical success factors including interpersonal trust, motivation, top-level management, project-level processes and procedures and boundary spanning activities were examined with regards to how tension negatively impacted these factors.

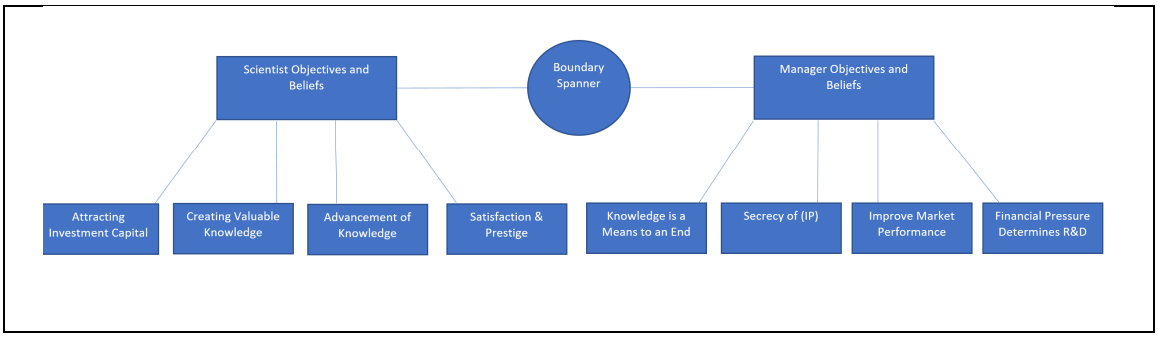
Study one examined critical success factors of open innovation within scientist-manager collaborations in academic-industry strategic alliances. Two separate institutions that successfully implemented open innovation processes were used for the study. The main finding was top-of-field scientists and senior-level managers that have access to physical resources and specialized equipment developing high quality science who engage in transparent bilateral communication, garner financial resources and

promote collaborative cohesiveness that moves publishable research and technology forward, possess top-management leadership that establishes a strategic agenda and governance structure, and contain a culture consisting of trainable professionals that lower barriers to collaboration and enable risk-taking will increase knowledge creation in a strategic alliance, but not without knowledge flow tension between the two professions. The objective of this study was to address the scientist-manager tension discovered in study one and identify the organizational factors that increased the probability of knowledge creation in scientist-manager collaborations within academic-industry strategic alliances.

It cannot be considered a given that a network's knowledge creation processes and interactions are cohesive, as open innovation activities require a broad level of collaborative and creative efforts along with effective management practices. The inter-organizational relationships that develop as a byproduct of open innovation require disruptive thinking along with the development of critical success factors to effectively promote knowledge sharing (Sakakibara, 2002). Furthermore, inter-organizational relationships comprised of top-of-field scientists and senior-level managers generate tension because of their conflicting beliefs and success measure differences (Mudambi and Swift, 2009). Scientists identify with creating knowledge, disseminating knowledge for knowledge sake, attracting investment capital to continue their research and the satisfaction or prestige in scientific discovery as their main objectives and beliefs (Mudambi and Swift, 2009). Managers, on the other hand, believe that knowledge and R&D are simply a means to an end and is primarily driven by financial pressures; they ascertain that secrecy of intellectual property and improved market performance are

amongst the most important objectives (Mudambi and Swift, 2009). Both top-of-field scientists and senior-level managers objectives can overlap, potentially making boundary spanning the job of any player within these inter-organizational relationships. These relationships can be visually represented in Figure 2.1.

Figure 2.1 Scientist and Manager Beliefs and Objectives



The tension between scientists and managers has been examined previously and is not considered a new development. "Management is frustrated by its inability to determine whether progress on a project is as good as could be expected; the research staff is frustrated by managements inability to understand the nature of the technical problem" (Shephard, 1956, p. 299). "Members of the same professional guild form similar personal and business judgments on the basis of their shared professional values" (Mudambi and Swift, 2009, p.737). It is these "personal and organizational relationships which increase the perceived or recognized incompatibility of organization and scientific goals tend to heighten tension and strain between scientists and managers" (La Porte, 1965, p. 25). It is important to examine how to bridge the scientist-manager gap between both guilds as increasing economic pressures, global competition and the need for interdisciplinary approaches to complex problems continuously increases (Mudambi and Swift, 2009). Additionally, with the tendency of scientist-manager collaborations in

academic-industry strategic alliances to be problematic, it is important to address the existing processes and characteristics to determine if they are helping or hindering large-scale public-private consortia (Morrison, 2017). These tensions have a direct impact on the critical success factors examined in study one. To properly address increasing the probability of knowledge creation within scientist-manager collaborations, tensions that negatively influenced interpersonal trust, motivations, top-management support, project-level processes and procedures and boundary spanning were examined. This paper began with a literature review of critical success factors of academic-industry alliances and developed research questions related to tensions specific to the aforementioned factors. Through semi-structured interviews of a larger pool of top-of-field scientists and senior-level managers, themes were developed and examined to provide insight on increasing the probability of knowledge creation.

Literature Review

The following literature review consisted of a brief overview of factors impacting knowledge creation within a scientist-manager collaboration in an academic medical center-industry alliance. Tensions were addressed by posing research questions that garnered further insight into the probability of knowledge creation despite the tension that exists between the scientist and manager. A larger pool of top-of-field scientists and senior-level managers who participate in academic medical center-industry strategic alliances were then interviewed with these research questions in mind. The responses to these interview questions uncovered themes that impacted the probability of success in academic medical center-industry strategic alliances.

Trust

The socio-psychological barriers that exist between academia and industry have a direct effect on the level of innovation output produced by collaborative efforts. Relationship capital in strategic alliances involves the actors investing time and effort toward building positive feelings and interaction patterns within the collaboration (Cullen et al., 2000). Without trust and commitment, which are considered major forms of relationship capital, the strategic alliance will not perform optimally. Strategic alliance strength and success can be gauged by the level of cohesive partnerships participating in the alliance. Contribution by each partner is a success factor that takes precedent. The relationship orientation of the individuals involved will act as a determinant of contribution by each partner (Bastida et al., 2017). One of the challenges of successful strategic alliance knowledge creation is balancing significant contribution of all participants involved. At inter-firm level trust is a key element in collaborative relationships (Das et al., 2001). Research question one: How does scientist-manager tension reduce the positive relationship between interpersonal trust and knowledge creation in open innovation processes?

Motivation

Firms engage in alliances with universities for several different reasons – leveraging R&D as strategic alliances are more cost-effective than mergers and acquisitions, gaining insight into scientific knowledge and emerging technologies which will enhance knowledge base, improving problem-solving skills and broadening perspectives and strategic objectives which would otherwise be narrowly focused (Perkman et al., 2001). Firms working with universities can also bolster reputation which

increases the attractiveness of firms to employers (Hicks, 1995). Scientists, on the other hand, look to industry for funding of research as support for academic research continues to erode and corporate engagement becomes critical for universities to continue cutting-edge work (McCluskey, 2017). The proprietary strategies that firms pursue to increase competitiveness and performance are characteristically different from universities, whereby publishing innovative research is the motivation and objective (Perkman et al., 2001). This is in direct contrast to the protection of intellectual property managers seek. While the manager wants to keep information out of the hands of competitors, scientists are looking to disseminate information to other scientists and forward the research. Additionally, scientists are more inclined towards long-term goals driven by curiosity just for science sake whereas managers want short-term results to improve firm value. These fundamental differences can lead to challenges and tensions within the collaborative relationship. Research question two: How does scientist-manager tension reduce the positive relationship between motivation and knowledge creation in open innovation processes?

Top-Management Support

The best performing collaborations have top managers employing strategies whereby the participants are properly aligned as complementary skills make an important contribution to collaborative success (Brouthers et al., 1995). A sense of knowing where one is at and a direction for which to go helps maintain structure within an organization. Organizational governance and leadership are developed by a setting strategic vision and building self-confidence through which others can become inspired and follow that vision (Jasper and Jumma, 2008). Strategic fit is the process by which a firm aligns the

resources of an organization with the capabilities of the participants involved. The participants must be matched correctly with the resources for strategic fit and alliance knowledge creation to be successful (Murray and Kotabe, 2005). "Researchers suggest that it is best to use contingency theory to examine environment-strategy co-alignment" (Murray and Kotabe, 2005 p.1526). Contingency theory explains that there is no exact process by which organize or lead a firm as the actions are dependent on the internal and external environments (Hambrick and Lei, 1985). However, cooperation and sharing offer advantages for alliances lacking competencies (Todeva and Kenoke, 2005). If the relationships between the top-of-field scientists and senior-level managers in a collaboration are misaligned or mismanaged, the knowledge creation output will fail to realize maximum potential. The business alliance tends to be an open-ended relationship that ends when the business model ceases to be economically viable. The challenge is to maintain focus on the potential of the alliance but also have a plan to get out (Koza and Lewin, 2000). Research question three: How does scientist-manager tension reduce the positive relationship between top-management support and knowledge creation?

Project-level Processes and Procedures

Organizational governance of a strategic alliance is the ability of a firm to delegate processes and strategies to individuals within the collaboration and set the overall direction for objective completion. However, university-industry collaborations are frequently operated in a decentralized manner and projects are complex with different objectives, time horizons and size from a scientist and manager perspective (Perkman et al., 2001). Management controls in healthcare alliances are mechanisms that manage relational risk and performance risk. A relational risk is related to lack of cooperation

between the partners of an alliance whereas performance risk is the risk of failure even with full cooperation (Anderson et al., 2015). Management controls align interests and coordinate actions across the boundaries of a collaboration. However, a university-industry alliance is conducive to frequently changing directions with a more fluid scheduling system for success. Change in the strategy of one alliance partner without express communication to the other can catalyze the breakdown of the alliance altogether (Koza and Lewin, 2000). While scientists and managers possess different objectives, it is imperative for project-level processes and procedures to facilitate a combined picture of participants interests (Perkman et al., 2001). Research question four: How does scientist-manager tension reduce the positive relationship between project-level processes and procedures and knowledge creation?

Boundary Spanner

For value to be created and extracted in an innovation network, certain deliberate and purposeful actions must occur (Kogut, 1988). The value in the context of academic-industry collaboration is knowledge creation and the boundary spanner is tasked with the extraction of this knowledge. The first objective of the boundary spanner is to ensure knowledge mobility. Knowledge mobility is defined as "the ease with which knowledge is shared, acquired, and deployed within the network (Dhanaraj and Parkhe, 2006 p. 660). If knowledge cannot be exchanged in a collaborative knowledge network, information will stay held within the individual boundaries of the scientist and manager. The second objective of the boundary spanner is managing innovation appropriability. Appropriability is an environmental property that "governs an innovator's ability to capture the profits generated by an innovation" (Teece, 1986 p. 610). It is the

responsibility of the boundary spanner to create the proper appropriability regime to foster innovative knowledge creation (Dhanaraj and Parkhe, 2006). Fostering network stability is the third objective of a boundary spanner (Dhanaraj and Parkhe, 2006) as certain networks may face a breakdown of communication and knowledge sharing because they are too loosely coupled. Dynamic stability in this context allows for "non-negative growth rate while allowing for the entry and exit of network members" (Dhanaraj and Parkhe, 2006 p. 661). The boundary spanner is one who is "respectful, reliable, tolerant, diplomatic, caring and committed" (Williams, 2002 p. 112). It is these characteristics that are needed to control tensions between the scientist and manager and maximize knowledge creation. Research question five: How does scientist-manager tension reduce the positive relationship between boundary spanning and knowledge creation?

In the following study, these academic industry strategic alliances relationships are examined to determine organizational factors required for increased probability of knowledge creation.

Research Methodology

Data Collection Method

This study is based on twelve interviews with two top-of-field scientists and two senior-level managers from each of the three academic-industry strategic alliances. The data was collected through semi-structured telephone interviews, each of which was about thirty minutes long and was recorded for later analysis.

At the beginning of each call, a qualifying question was first asked regarding open innovation success in a collaborative setting to set the tone for the interview and develop

a rapport with the interviewees. This question enabled further probing and adjustments to questions for the duration of the interview. The question was: "What are some of the key factors that make this institution successful?"

The remainder of each call followed a semi-structured script based around the following questions.

The question asked of top-of-field scientists and senior-level managers with regards to trust was: "How important is trust when developing or executing open innovation processes?" The question asked of top-of-field scientists and senior-level managers with regards to motivation was: "What do you think the core motivations of collaborators are during open innovation processes?" The question asked of top-of-field scientists and senior-level managers with regards to top-management support was: "How much do you think top-management support determines the success of open innovation?" The questions asked of top-of-field scientists and senior-level managers with regards to project level processes and procedures were: "Is there a specific process to activate or facilitate collaboration on the project level? How do you determine who the players are in the cross-fertilization of information?" The question asked of top-of-field scientists and senior-level managers with regards to boundary spanning was: "Who do you consider to be boundary spanners in open innovation processes?"

Data Source

For study number two, strategic alliance relationships between an academic medical center and three separate industry partners was examined by interviewing top-of-field scientists and senior-level managers within these strategic alliances. Specifically, two academic medical center-biopharmaceutical strategic alliances and one academic

medical center/genomic research institute strategic alliance. Respondents can be visually represented in table 2.2.

Table 2.1 Interview Respondents Study Two

Interview	Top-of-field Scientist/Senior-level Manager	Academic Medical Center-Industry Alliance Number
A	Top-of-field Scientist 1	1
B	Senior-level Manager 1	1
C	Top-of-field Scientist 2	1
D	Top-of-field Scientist 3	2
E	Top-of-field Scientist 4	3
F	Top-of-field Scientist 5	3
G	Senior-level Manager 4	3
G	Senior-level Manager 5	3
H	Senior-level Manager 3	2
I	Senior-level Manager 2	1
J	Top-of-field Scientist 6	2
K	Senior-level Manager 6	2

Data Analysis Method

A qualitative analysis of top-of-field scientist and senior-level manager data was transcribed the transcribed using ATLAS.ti software upon completion of the recorded thirty-minute telephone interviews. The data was manually coded into categories based on the factors impacting knowledge creation in scientist-manager collaborations. The factors were: open innovation success, trust, motivations, top-management, project-level processes and procedures and boundary spanners. Data from the top-of-field scientists and senior-level managers was labeled to distinguish any differences in responses for further analysis of collaborative tensions. Themes and general tones were developed based on the categorized quotes.

Results

Analysis of the data from the semi-structured interviews revealed several themes with regards to the factors that impact knowledge creation in scientist-manager collaborations. These themes were categorized by each factor which included interpersonal trust, motivation, project-level governance and project-level processes and procedures. Tensions between top-of-field scientists and senior-level managers were observed during the interview process and addressed through analysis and insight development of the interviewee responses for all interview questions.

The following summarizes the results in four topical areas: Within trust, managerial culture of the collaboration has a significant impact. Scientists and managers come from different backgrounds in terms of hierarchical structure. These cultures need to be aligned and mutually conducive to all participants involved in the collaboration. A key to successful knowledge creation between scientists and managers is recognizing the cultural differences and finding a way to succeed despite them by focusing on shared objectives by developing trusting relationships. Within motivation, it is important for both sides of the alliance to look beyond interests that lie solely within their traditional belief system, for it is shared motivations that will increase the quality of knowledge creation. Within top-management support, maintaining a high-level focus on keeping both sides of the alliance on track to complete shared objectives is critical. The hierarchical structure on the scientist side is much more convoluted in that, and there are no specific superiors for which to report to. Top-management on the scientist side can help to bring structure this environment through the development of a more cohesive bond from an organizational standpoint. Within project-level processes and procedures,

the capacity in which each side of the alliance operates should be clearly defined. Managers experience high turnover which can disrupt already established scientist-manager relationships. It is the responsibility of managers to minimize the impact of misalignment when these circumstances occur.

A closing question was asked with regards to boundary-spanning to determine what individual bridges the gap in a scientist-manager collaboration. The boundary spanner is a key point of contact for both sides of the alliance and serves an integral part of knowledge creation within a scientist-manager collaboration. A successful boundary spanner takes a unique skill set and is not easily identifiable as there is no one specific role or qualification.

Open Innovation Success

Open Innovation success was defined as knowledge creation within a scientist-manager collaboration. The question asked regarding open innovation success uncovered several themes specific to factors that contributed to knowledge creation within scientist-manager collaborations in an academic medical center-industry strategic alliance. Proper strategic alignment with joint steering committees and sub comities on both sides of the alliance is a critical as well open-mindedness with regards to viewing aspects of the collaboration in a different way than the scientist and manager are accustomed to. Launching the collaboration with clear objectives and participative roles that enable risk-taking on each side of the collaboration was another significant aspect of success.

Theme 1

One of the most critical factors of success was proper strategic alignment between the scientist and manager side of the alliance. It is critical that both sides share the same

objectives. It is essential that both the top-of-field scientists and senior-level managers keep an open mind on what these objectives could and should be, looking at aspects perhaps differently than they are used to. This open-mindedness is a skill set that cannot easily be taught as it is more of a tacit knowledge development. Both top-of-field researchers and senior-level managers agreed it is vital to develop an explicit strategic alignment agreement in the early stages of the collaboration regarding objectives and incentives.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

I think that the most critical factor is that they have strategic alignment. It's fundamental. So that's the first thing, get the agreement right in the strategic alignment.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

The commitment by the health system and the medical school to look at things in a very different way and again, I think traditionally a big research university has taken a conservative viewpoint, they're risk-averse, not willing to take a chance. With a technology like this, again groundbreaking technology, obviously great potential but also significant risk. I think the institution itself needs to be willing to take on that risk and push the envelope. Again, without that willingness to commit to a resource that's necessary to move this forward, even if again the funding comes in from the outside party to do this, the university needs to be willing to take that step forward and go out on a limb a bit.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 1

I think the critical thing is making sure that the parties are aligned in what their goals are from the outset and, you know, try to keep that consistent and that alignment consistent throughout the whole term of the relationship and the agreement.

Interview E. Top-of-field Scientist 4 AMC-Industry Alliance 3

Well, in general, I can tell you that the factors that are important for successful interaction and progression of any process is the people that are involved, whether they have an open mind, are driven they can relate to the external from the industry standpoint. You have to be able to interact properly to be able to understand what the science is about and also to be able to relate and to establish good communication with the investigator.

Interview F. Top-of-field Scientist 5 AMC-Industry Alliance 3

I think, is the leader, who that person is, what their motivations are, what their style is and what their priorities are. For us, very much, it's a trickle-down effect. I personally am the way I am because of knowing the manager's motivations and how they think and operates and leads us. Who the leader is and their personality style and all that, I think, is huge and the message that they send down.

Interview H. Senior-level Manager 3 AMC-Industry Alliance 2

So, the words that I use are alignment, and that's what I always think about. How can we move towards alignment? And I think, like the second law of thermodynamics, which is everything devolves into chaos, that unless you are purposeful about how you design this from the beginning, and then you work at it, that we come misaligned. That's just the way it's naturally going to happen - and at some point, it's going to happen. Every relationship has its life cycle. And the misalignment is incredibly destructive. It's not productive. It's destructive, we'll say.

Interview I. Senior-level Manager 2 AMC-Industry Alliance 1

Yeah, I think the biggest issue in failure is non-alignment of goals. I've been in many different academic industries, collaborations both from the academic side and from the industry side.

Theme 2

Both top-of-field scientists and senior-level managers agreed it is critical to launching a mission correctly, with regards to the spectrum in which each side of the alliance will operate. For example, there may be times where scientists in the research and development phase may be able to work freely without much formal instruction or guidance from the manager side. If this is not the case and the managerial side of the alliance wants to develop a hands-on approach, then there must be procedures developed to facilitate this process. Execution of these procedures then becomes the highest priority - governance, a steering committee and sub committee's help to ensure this success. Throughout the entire process, it is important to analyze feedback from both sides of the

alliance and work to bridge the gap between the scientist and manager on a continuous basis. The more defined the procedures are, the higher chances of alliance success.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

It's I think always a challenge to, in these larger partnerships, to bridge the gap between what our investigators expect and have done throughout their careers which is essentially built on trust. Building large collaborations with other academic admissions, building these partnerships again have worked throughout their career which really are based on trust and collaboration, and again bridging that, moving that into a totally new or them into a new arena where we certainly do need to, I think you always need to trust your partners and believe in what they're doing and have that level of alignment.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 1

Keeping everybody focused on what the objectives are of the original agreement is a challenge. So, something like that I think it needs to have flexibility through a steering committee to be able to change very fundamental things in the contract.

Interview E. Top-of-field Scientist 4 AMC-Industry Alliance 3

In that sense, it's important to have some bouncing ball, or wall if you like, internally. That is a sign that may be connected to some degree to what externally you are investigator is doing because then the people have a better understanding of what's being done outside because they are working on similar problems. Maybe less advanced perhaps, or more conventional, internally. But obviously have to speak the same language, just to be clear. Also, you know, you must be able to stay in touch and establish good communication lines with the external part.

I'm involved in a project with the academic medical center, so we have considered ... we try to have communication through the meetings so that people can update each other. You can tell what's going on. And perhaps intervene as soon as possible to correct anything that needs to be revised because it's going in the wrong direction like. So, I think that open-mindedness, communication, understanding of what the science is about and being able to also realize that the people that you're dealing with do not have necessarily the same frame of mind the type of drug discovery process to take care of. And their academic investigation, their priorities may be somewhat different of course than one from a typical company.

Interview G. Senior-level Manager 5 AMC-Industry Alliance 3

If you get the business structure right at the front end and you take care of the legalities and the business structure, then it's in everybody's interest for a product to come out the other end. That's going to advance the science. That's going to get it to patients, and that's going to generate the returns that everybody's going to share it. The

only thing that's left is to focus on working together to advance that project, and the way we do that is by having these joint steering committees.

Interview H. Senior-level Manager 3 AMC-Industry Alliance 2

Something that the Academy does not understand and that is that whatever the alliance is, it must be based on what is going to create the most successful business. It has to start with that. That rarely starts with that, because what the Academy wants, do I want to fund my lab, I want stock or whatever else. What I've learned, and I've experienced and been very successful, etc., that you can't shoehorn it, because then there's structural misalignment, this alignment thing. So that I must figure out a way in which I can participate, me and the 250 people that work with me, participate in this venture in a way in which the number one goal is to develop a successful business. Read my lips. Successful business, successful business and help patients in the process.

Interview J. Top-of-field Scientist 6 AMC-Industry Alliance 2

So I think one of the important factors that make our alliance successful is that we have implemented a governance in the alliance, and so there's a Joint Steering Committee, which is led by leadership from both institutions, and kind of a sub piece of information to that, the Joint Steering Committee is composed of key leaders from both institutions, so they're people of influence and people who are really driving the success of the alliance, and I think without something like that and without those types of people, it wouldn't have been as successful, and then the other component. I think the subcommittees relate to the size of the alliance. Since ours is quite large, we have multiple subcommittees, which I think also helped make it a success. So, we had committees that applied to the different areas of expertise throughout the alliance so whether... Maybe expertise is the wrong word. Discipline is probably the better word, but there's a finance group, and there's a clinical group, and there's a manufacturing group, and there's an intellectual property group, and there are public relations, and so representatives from each institution also met jointly on all these different disciplines, and that also I think is a key to its success, the alliance success.

Theme 3

Top-of-field scientists and senior-level managers both agreed that the willingness for both sides of the alliance to take risks holds precedent. Traditionally, universities have a conservative viewpoint; they're risk adverse and not willing to take a chance. Additionally, if the funding comes from the outside, without the willingness to commit a resource or drive innovation forward, the objectives of the alliance may become impossible to complete. It's been a mission of the university in years to consciously

make itself more receptive to industrial collaborations and sponsored research and partnerships and alliances. This mission of doing a better job of open partnering with the private sector is in stark contrast to the historical perspective of the university business model.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

We've seen the same vision by the university, wanting to be at the forefront of medicine, wanting to push the envelope in terms of driving this innovation forward. There are very few institutions that bring together the group of eminent scientists and physicians like you would see at this organization. There are only a handful of these centers around the country. Being there puts us in a great place to capitalize on opportunities, simply because these are the scientists that are leading the way, leading the charge in terms of generating these new innovations and generating cutting-edge science.

Interview G. Senior-level Manager 4 AMC-Industry Alliance 3

We made an institutional decision that the university was going to make itself more receptive to industrial collaborations and sponsored research and partnerships and alliances. A big part of Innovation and Impact was universities do a better job of being open to partnering with the private sector, and if that means that we must adjust some of our practices, or adjust our expectations in order to meet our partners midway, that's what we're going to do. That was a stark, sharp contrast from the historical perspective, at least how the private sector viewed university, as being the stodgy, Ivy League institution with the ivory towers. You're not going to taint us with your dirty industry money, or if you want to work with us, you must work with us on our terms. That's not the way the private sector does business. It's not going to be attractive to industrial partners, so we've got to change the way we look at how we participate in those sorts of activities. It's partly intellectual property. I would say certainly we had to get comfortable with the idea that sponsors who were willing to spend a lot of money and spend a lot of years working with us weren't going to want a lot of uncertainty in terms of who was going to have commercial rights to the fruits of that work. We had to convince ourselves that we were going to be comfortable agreeing to terms on the front end that could extend out five, ten years into the future, and we had to stick to those. Sometimes, it would cause conflicts, and we'd have to be willing to accept and manage those conflicts.

Table 2.2 examines open innovation success key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 2.2 Open Innovation Key Themes Study Two

Top-of-field Scientists	Senior-level Managers
I think that the most important factor is that they have strategic alignment. It's fundamental, but I think it's critical that the two sides are aiming for the same objective. You can imagine from an academic perspective, very often they might be focused on research, which might not result in an end product, which is where industry would normally be focused (top-of-field scientist 1).	*The commitment by the health system and the medical school to look at things in a very different way and again, I think traditionally a big research university has taken a conservative viewpoint, they're risk-averse, not willing to take a chance. With a technology like this, again groundbreaking technology, obviously great potential but also great risk. I think the institution itself needs to be willing to take on that risk and push the envelope (senior-level manager 1).*
Well, in general, I can tell you that the factors that are important for successful interaction and progression of any process are the people that are involved, whether they have an open mind, are driven they can relate to the external from the industry standpoint. You have to be able to interact properly to be able to understand what the science is about and also to be able to relate and to establish good communication with the investigator (top-of-field scientist 4).	*If you get the business structure right at the front end and you take care of the legalities and the business structure, then it's in everybody's interest for a product to come out the other end. That's going to advance the science (senior-level manager 5).*
Keeping everybody focused on what the objectives are of the original agreement is a challenge. So, something like that I think it needs to have flexibility through a steering committee to be able to change very fundamental things in the contract (top-of-field scientist 2).	*Something that the academy does not understand and that is that whatever the alliance is, it must be based on what is going to create the most successful business. It has to start with that (senior-level manager 3).*

Insights from top-of-field scientists and senior-level managers related to open innovation success key themes found that strategic alignment and open-mindedness along with a willingness to take risks on both the scientist and manager side of the collaboration impacted knowledge creation in a positive manner.

Therefore, P1: *Clearly defined participative roles that enable risk-taking with collaborative alignment of objectives in a scientist manager strategic alliance will increase knowledge creation.*

Trust

Trust within a scientist-manager collaboration is considered a major form of relationship capital which without, a strategic alliance would not be successful. The question asked regarding interpersonal trust uncovered several themes that contributed to knowledge creation within scientist-manager collaborations in academic medical center-industry strategic alliances. Trust is dependent on the managerial culture of the collaboration. Scientists and managers come from different backgrounds in terms of hierarchical structure. However, these cultures need to be aligned and mutually conducive to all participants involved in the collaboration. A key to successful knowledge creation between scientists and managers is recognizing the cultural differences and finding a way to succeed despite them by focusing on shared objectives by developing trusting relationships.

Theme 1

A top-of-field scientist said trust depends on the culture within the company in that, if you have companies and institutions that are essentially dictatorships and similarly have a hierarchical structure, they may be able to work efficiently. Most of the time, however, academia encourages free thinking which is very different than industry that has procedures for everything. The key to increasing or sustaining trust in a scientist-manager collaborative relationship is recognizing that there are in fact differences. The compromise should not be focused on the differences as much as figuring out how to

work best together. Stereotypically, academics would be driven by their pure research whereas industry would be driven profits but when reality sets in there are more than one goal and people are driven by more than one factor. People that work in these alliances also work towards the development of life-saving medicines that improve society and help humanity. Unfortunately, while there is a tendency to overestimate these stereotypes, the differences between the scientist and manager hold true.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

I think that it depends on the culture within the company that you work and the institution that you work in as well as the individual. So, if you had two companies or two institutions that were essentially dictatorships and very hierarchical and they ended up working together, maybe they can work very efficiently in the same way. I think that in academia, you try to encourage a lot freer thinking. It is very different to say, a Swiss company that has set procedures for everything, including approvals and you have to recognize that going in. I think it's important to look for the differences. It shouldn't be a compromise between the differences; you should eventually between the two groups, work out. "How can we work best together?"

It's very individual. The stereotypes, of course, would be that academic may be driven by their pure research goals to serve the science. And industry could be characterized as essentially trying to increase their profitability in the stock. But when the reality kicks in, you're not looking at an institution that's just driven by one factor. In industry, people go and work there, not because they're going to increase their stock price, but because they can develop lifesaving medicines that improve society and help humanity.

So, I think there is the tendency to overestimate the stereotypes, but I would say that some of the differences usually hold true, because, within a company, you'll have a clearly defined hierarchy, clearly defined way of getting things done. Get and focus on efficiency, and they'll have meetings. Let's just take that one small part rather than the big picture. I think that if you look at industry, every day most people will have several meetings which are highly structured. They'll have invitations ahead of time, they'll have predefined agendas, there'll be pre-reads, people know what the objective at the meeting is, and you come out with documented evidence of what the decisions were, who's going to implement them and by when.

Theme 2

Top-of-field scientists and senior-level managers said it is important to find a mutual way to achieve objectives. However, there is a trust breakdown in this process –

the highly structured meetings of the managers do not fall in line with the less structured conversational approaches to achieving objectives for the scientists. When reality sets in during a long-term contract, relationships can start to get start to break down, and sacrifices may be made to reach the agreed-upon objectives thus leading to less than the desired scientific outcome. Also, when company managers change strategy in the middle of the relationship the trust that has been previously built up may dissolve.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

With the academic environment, that may exist in some parts of the institutions, but at the research level and the operational level, the way they have meetings is, they meet in the corridor and say, "I'm going to do this, are you going to do that? Can you send me that?" And at the research level, it works for them. You've got to meet at the kickoff and decide well, how are we going to work together? Are the people just going to come along, walk down the corridors, see who they need? Then if you don't discuss it and have open communication, what can happen is, the people in academia will then just say, "Well gosh, we can't get any work done, we're spending all our time in meetings." And you must find a mutual way forward so that you can achieve the objectives. Shifting the culture of both parties. In our collaboration, we do have regular meetings that are highly structured, and the way that became acceptable from the academic perspective is that they were able to see that they got things done. And they would initially question, "Why'd you need so many slides, why'd you need time to prepare the powerpoint." The managers said, "Well within our company that's how you get stuff done. An extra $5 million for this research and you put these slides together. You'll get it. If you send them a memo saying, "Can you send me the money, then you won't get it." "Okay, so we get funding for the next year, if we do these slides, that's great, let's do them." You can't just impose it. It has to be a joint decision about how you're going to work together.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

We've learned this building many of these programs. You go in and the first one, I don't think there was as much up-front disclosure to the investigators, and again there wasn't as much experience on our side and pulling these together and seeing how things would evolve through the course of a partnership. I think in the new ones we go in with our eyes wide open, we talk with the investigators in the beginning about what this is going to be like and how this will differ from your standard academic collaboration. Or even sponsored research or a small project with industry where it might run a year or two years but these are very long-term engaged partnerships, and again, there are many things that are going to accept that are different than standard collaboration and I think that's key to making these successful is talking to the faculty, making sure they're on board with how this is going to run before we sign on the dotted line.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 1

Making sure both parties continue to focus on what the objective is for the relationship, right? So, I think often times you start to get into the reality of things and things start to get a little unsavory but you still are interested in that original goal, and so you might be willing to make certain sacrifices or swallow a bitter pill to get that done.
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Interview D. Top-of-field Scientist 3 AMC-Industry Alliance 2

Companies change strategies in the middle of a relationship, and then they may put even more emphasis on your programs, so you're even more instrumental to their success or less, either way. They can go from jeopardizing your program, but they have a contract that commits them to execute and fund the project to like, you guys can't fail, you need to go faster and let's put more resources. So, things can go ramp up or ramp down depending on the case.

Yes, what I wanted to comment on something on trust and on these relationships, is that, it is key, at least for us, that they trust from the point of that we can provide the best input on gene therapy, and the best know how.

You have to particularly prove to them that they were not right and that we've seen that in multiple projects before. It's not that you have to take our word, of course, we can do the experiment and show it to them, but basically, we expect that when we work with a partner that it has to be an open relationship between both that the end is expert results. Cause we've done this over and over and over again.

Theme 3

For success, trust must remain at the forefront of the culture participating in the alliance. There is not genuine collaboration occurring unless there's trust. There's an inherent bias when you truly collaborate, but part of a successful strategy is recognizing differences and succeeding despite them. The more transparent both sides of the alliance are, the higher the probability for strategic alliance success. Additionally, there must be belief in alliance participants capability of getting objectives accomplished.

Interview F. Top-of-field Scientist 5 AMC-Industry Alliance 3

Yeah, because it comes down to the trust and then the transparency that's occurring in that organization as well. Yeah, we're all going to keep plugging away and doing what we're supposed to, and they are as well because they have their end goal and we have our end goal, and usually it's the same. It's to get to the end. But, along the way, yeah, you might not trust them because they're not transparent.

Interview G. Senior-level Manager 4 AMC-Industry Alliance 3

You're entering into a contract. The contract is a trust of sorts, but you're expecting ... The other party has to live up to certain obligations. If they don't live up to those obligations, then it destroys the trust but also the potential for the relationship. What I think happens over time is you have this "trust but verify" start. You give good intentions to the other party. You work together as partners, and you advance the program. When your partner has a problem, you figure out how to help him, or her solve it and vice versa. Over time, you build trust between the parties. The defect in that, as we're learning, is on the academic side, people hang around for a long time, especially tenured professors.

Interview I. Senior-level Manager 2 AMC-Industry Alliance 1

Well, I don't think there's ever trust unless you're a real collaborator. There's a chance that on the industry side, there are academicians who cut corners. They're arrogant, and they don't understand the dictates of the FDA, and how important it is to have accuracy and fidelity and so forth. And on the academic side, they fear attack of the industry people and them bashing them. And so, there is that inherent bias that when you collaborate, truly collaborate, and you develop trust. And it may be possible, and there are many examples in which people who don't trust each other still had successful... out the door. But it definitely improves the output and outcome if there is trust.

Table 2.3 examines trust key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 2.3 Trust Key Themes Study Two

Top-of-field Scientists	Senior-level Managers
I think that it depends on the culture within the company that you work and the institution that you work in as well as the individual. I think that in academia, you try to encourage a lot freer thinking. It is very different to say, a Swiss company that has set procedures for everything, including approvals and you have to recognize that going in. It shouldn't be a compromise between the differences. You should eventually between the two groups, work out. "How can we work best together?" (top-of-field scientist 1).	*You go in and the first one, I don't think there was as much up-front disclosure to the investigators, and again there wasn't as much experience on our side and pulling these together and seeing how things would evolve through the course of a partnership. I think in the new ones we go in with our eyes wide open, we talk with the investigators in the beginning about what this is going to be like and how this will differ from your standard academic collaboration (senior-level manager 1).*

Table 2.3 (continued)

So, I think often times you start to get into the reality of things and things start to get a little unsavory but you still are interested in that original goal, and so you might be willing to make certain sacrifices or swallow a bitter pill to get that done (top-of-field scientist 2).	*You're entering into a contract. The contract is a trust of sorts, but you're expecting the other party has to live up to certain obligations. If they don't live up to those obligations, then it destroys the trust but also the potential for the relationship. What I think happens over time is you have this "trust but verify" start. You assume good intentions. Then you work together as partners, and you advance the program. When your partner has a problem, you figure out how to help him, or her solve it and vice versa. Over time, you build trust between the parties. The defect in that, as we're learning, is on the academic side, people hang around for a long time, especially tenured professors (senior-level manager 4).*

Insights from top-of-field scientists and senior-level managers related to trust key themes found that trusting relationships are developed when there are clear mutually shared objectives by both scientists and managers. Trust begins with the belief that your collaborative partner can fulfill the obligations and objectives that were agreed upon. Obligations of each side of the alliance must be understood and communicated at the beginning of the contract because if these obligations are not adhered to, there is a breakdown of trust and tension develops.

Therefore, P2: *Scientists and managers that maintain transparency and possess a strong belief in the reliability of collaborative research and development relationships in a scientist-manager strategic alliance will increase knowledge sharing.*

Motivation

Scientists and managers participate in alliances for different reasons. Managers, for example, look for cost-effective research and development initiatives. This is done aligning with academia instead of traditional mergers and acquisitions. Managers try to keep new knowledge within the boundaries of the firm for as long as possible building competitive advantage. Scientists look to industry to garner finances for research capabilities that will continue to forward publishable science. The question asked regarding motivations uncovered several themes that contributed to knowledge creation within scientist-manager collaborations in academic medical center-industry strategic alliances. Scientists and managers have conflicting views on motivation because scientists want to publish new knowledge as quickly as possible which falls in direct contrast to managers who prefer to keep new knowledge within the firm pipeline. There is never a perfect overlap in terms of motivations however a savvy company is going to align interests with scientists because without scientist support the collaboration is not viable. It is important for both sides of the alliance to look beyond interests that lie solely within their traditional belief system, for it is shared motivations that will increase the quality of knowledge creation.

Theme 1

Top-of-field scientists and senior-level managers had conflicting views on motivation. Typically, during onboarding of a new alliance scientists try and stress the ability to maintain their academic freedom. It can be challenging to get managers to accept the fact that when scientists develop a new technology, they need to be able to publish, as they want to get the knowledge out to the world. This falls in direct contrast

to the managers who want to keep the knowledge within their pipeline and secretive if possible. The core of academic faculty is to publish or perish which is parallel with career development, however, in a capitalist society business need to be profitable for investor and venture capital financing. For an alliance to be successful, the scientist and manager must come together for a collective mandate, despite individual motives.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

I think it's critical that the two sides are aiming for the same objective. You can imagine from an academic perspective, very often they might be focused on research, which might not result in an end product, which is where industry would normally be focused. So, it's important that each's intent is captured by the agreement and the agreement is understood by all those who will be impacted by it.

Interview B. Senior-level manager 1 AMC-Industry Alliance 1

I think what we try to stress in any of these partnerships is the ability for our admissions to maintain their academic freedom, and I think that helps to buffer this out. At the end of the day, this is something our partners also need to accept that when we develop a new technology we need to be able to publish, the admissions need to be able to go out to meetings, present these data and be the first ones to disclose it. So, they want to get knowledge out to the outside world, and I think sometimes this runs counter to what a company would typically do, certainly with their internal pipeline, they want to keep this secretive as long as possible and maybe not disclose it. Academics want to publish, and I think that's one of the pieces that we've held firm to and I think it's really helped in terms of being able to bridge this divide at times if you want to work with a university.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 1

This is a critical aspect of any contracting that we do with industry. We always have the ability to publish, and we always put a timeline, we'll let a company delay publication so if there's intellectual property that needs to be filed on there's time to do that. We also give the companies the ability to take certain information out of publication if it's their confidential information. It goes to the core of our mission, and its faculty need to publish or perish, and it goes to their career development, so we work hard to protect that. I can't think of an instance where we've given up that right to publish first and make sure the other party can't delay that forever.

Interview D. Top-of-field Scientist 3 AMC-Industry Alliance 2

It's a very interesting mix here because a lot of the people here are academics at heart, and I would say that that defines between ours and the companies that work on, particularly when it's a rare disease that has no treatment, is that their mandate is so high that finding a treatment really, really makes a difference. You can say that for many pharma people usually when talking about heart failure or diabetes. When we're talking about things with a large mandate with devastating disease, pediatric diseases, in two years a baby will die from, type of diseases, right? That concept taken to an extreme, the mandate to help patients. However, we live in a capitalist society, and you cannot just let always the philanthropy and ... In an ideal world it would be a nice, companies were the way they're supposed to be and resources would be instead of spent for the army and the military they would be used for health care. That's not the case. Now you need, it's a for-profit business, companies need to be profitable, investors, venture capital when they create a company around this they must be profitable. Otherwise, there is no investment. You always need to keep that in mind. The challenges of motivation, academics have a stereotype of, oh, well, they just want their publications, and they just want their personal glory. Motivation is important. What is the leader looking to get out of it? Is it the next deal? Is the next big milestone, or not even milestone, upfront payment?

Interview E. Top-of-field Scientist 4 AMC-Industry Alliance 3

Well, I think that there are commonalities in what pharmaceutical companies want to do and what a scientist wants to accomplish. In the sense that we are talking about innovation, discovering new things that can be meaningful, have an impact on our lives. And there are economic returns that can come back to who invents something and obviously the company who develops a product that ultimately is sold and becomes very important. So, I think there is motivation ... and you know, if there are similar drivers binding you ... new approaches new imperatives are something that drives each of us to do our best. I think if you are in the field of discovery, of scientific innovation, I think it's all there. Obviously, the returns for a pharmaceutical company in terms of what they do is not the short-term, right? Because in order to get to a product, it's going to take you five, ten years. Whereas for a Clinician you probably should sell major science, so you go to major conferences, and your name is spoken with high regard luckily that's much shorter term. But those investigators that are high level are also playing the long-term game as well because they want to establish themselves in the field and therefore that requires a continuous investment. Both mental and physical in resources in what they do and therefore, in some ways, it's not that dissimilar for what pharmaceutical companies must do in order to create a new drug. Pharma is a for-profit type of organization, right? So, they have to sell products because if they don't make the money from the products, they cannot maintain their research, that they have to do to achieve and generate new products. You have billions of dollars that have put into research in order to come up with something. So, to stay up close in a condition like that you've got to make money.

Interview I. Senior-level Manager 2 AMC-Industry Alliance 1

If you look in the R&D organization in a pharma company, I don't know a single one where the commitment isn't improving the lives of human beings. If a company succeeds with the medicine, everybody does well, but that's not the guiding force in the pharma company, and I've been head of R&D in two of them, so I know that that isn't the case. I also know, that at the investigative level, by and large, it might be different in other places where there's entrepreneurs who are really into making money. I've been on both sides and the true academic, ones really committed to making new medicine and wanting to do something to improve society ... I think that puts them very tightly aligned with the industry counterpart. The industry people really want to make new medicine. Now, if you asked the president of the university, there might not be any alignment at all.

Theme 2

Managers said motivation comes back to the question of alignment. There's no question there is not always a perfect overlap in terms of expectations of both parties, however, on the commercial side a savvy company isn't going to be so blunt as to say it's only about shareholder value so, in this instance it would be prudent to help the scientists advance products to the point where they would get commercialized. In other words, it's worth the managers time to support the scientists need because it's ultimately going to serve the needs of the managers and company. Professors don't have bosses in the sense a company would, but one must deal with the reality - to work in such alliances things will have to be different. Relationships will have to morph and evolve into something much different than the scientists or managers are used to. Without collaborator transparency between the top-of-field scientists and senior-level managers in terms of purpose, tension will develop as a common goal cannot be clearly disseminated.

Interview H. Senior-level Manager 3 AMC-Industry Alliance 2

See, it's all about alignment, and I have changed my whole approach to how we consider developing this organization, based on where I can maximize alignment with successful businesses, and still have fun doing what we're doing. I had to change. You've got to deal with the reality. It sounds like this is what we're going to do, and you find the business, and so that requires judgment. I don't want to become something that we shouldn't be, but we do have to evolve and morph into something that is consistent with our relationship with the successful businesses but still meets our goals of changing,

impacting on patients and all that sort of thing. So, many academics don't want to do that. You know, I'm a professor, I don't have a boss. That's part of the problem. But there's a new generation that's coming up, that's thinking about this very, very differently.

Interview G. Senior-level Manager 5 AMC-Industry Alliance 3

That's a very insightful question because there's no doubt that there is not always a perfect overlap in terms of the expectations of both the parties. On the academic side, it's almost always advancing science or reaching patients, at least in the biopharmaceutical or pharmaceutical stuff. I've been in the private sector, commercial side, too. I know darn well, at least for the company that I was with, that there really is only one objective, and that's shareholder value. It's easy, but a smart company isn't going to be so blunt about that. What the smart company is going to say is, "The way I get to increase shareholder value is by creating an environment where my partner wants to help me advance these products to the point where they get commercialized, and the motivator for them is the science, is moving these things into the clinic. It's worth my while to support their need because ultimately, it's going to serve mine."

Interview I. Senior-level Manager 2 AMC-Industry Alliance 1

What I've learned is that often the academic side simply wants money. They want money, and often, on the academic side, the interest of the investigator is not necessarily aligned in the interest of the industry but sometimes, the academic institution, and often the investigators are only looking for money, and they want to use the money for their own personal initiatives. They used to get NIH money and when they asked ... when they put in an application, then they'd take your money, and they'd do something completely different. And that's completely allowed, at the NIH. But when the industry gives the money, it's usually for a very specific purpose, and they don't want that money to go to other activities. So, the idea is that the investigators and the institution only want money. On the other side, industry is only interested in intellectual property. I know what I'm saying is extreme and what they don't necessarily want to give up is the intellectual property or the control of the intellectual property. So, there's misalignment.

Interview K. Senior-level Manager 6 AMC-Industry Alliance 2

So I think one of the important factors that make our alliance successful is that we have implemented a governance in the alliance, and so there's a Joint Steering Committee, which is led by leadership from both institutions, and kind of a sub piece of information to that, the Joint Steering Committee is composed of key leaders from both institutions, so they're people of influence and people who are really driving the success of the alliance, and I think without something like that and without those types of people, it wouldn't have been as successful, and then the other component. I think the subcommittees really relate to the size of the alliance. Since ours is quite large, we have multiple subcommittees, which I think also helped make it a success. So, we had committees that applied to the different areas of expertise throughout the alliance so whether. Maybe expertise is the wrong word. Discipline is probably the better word, but

there's a finance group, and there's a clinical group, and there's a manufacturing group, and there's an intellectual property group, and there are public relations, and so representatives from each institution also met jointly on all these different disciplines, and that also I think is a key to its success, the alliance success.

Table 2.4 examines motivation key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 2.4 Motivation Key Themes Study Two

Top-of-field Scientists	Senior-level Managers
This is a critical aspect of any contracting that we do with industry. We always have the ability to publish, and we always put a timeline, we'll let a company delay publication so if there's intellectual property that needs to be filed on there's time to do that. We also give the companies the ability to take certain information out of publication if it's their confidential information. It goes to the core of our mission, and its faculty needs to publish or perish, and it goes to their career development, so we work hard to protect that. I can't think of an instance where we've given up that right to publish first and make sure the other party can't delay that forever (top-of-field scientist 2).	*On the academic side, it's almost always advancing science or reaching patients. I've been in the private sector, commercial side, too. I know darn well, at least for the company that I was with, that there really is only one objective, and that's shareholder value. It's easy, but a smart company isn't going to be so blunt about that. What the smart company is going to say is, "The way I get to increase shareholder value is by creating an environment where my partner wants to help me advance these products to the point where they get commercialized, and the motivator for them is the science, is moving these things into the clinic. It's worth my while to support their need because ultimately, it's going to serve mine." (senior-level manager 5).*

Table 2.4 (continued)

Well, I think that there are commonalities in what pharmaceutical companies want to do and what a scientist wants to accomplish. In the sense that we are talking about innovation, discovering new things that can be meaningful, have an impact on our lives. And there are economic returns that can come back to who invents something and obviously the company who develops a product that ultimately is sold and becomes very important.So, I think there is motivation ... and you know, if there are similar drivers binding you ... new approaches ... new imperatives are something that drives each of us to do our best (top-of-field scientist 4).	*I've been on both sides and the true academic, ones really committed to making new medicine and wanting to do something to improve society ... I think that puts them very tightly aligned with the industry counterpart. The industry people really want to make new medicine. Now, if you asked the president of the university, there might not be any alignment at all (senior-level manager 2).*
I think it's critical that the two sides are aiming for the same objective. You can imagine from an academic perspective, very often they might be focused on research, which might not result in an end product, which is where industry would normally be focused (top-of-field scientist 1).	*To make open innovation work, first and foremost, you must align the incentives. I would also state that it probably works best in complex areas, where it's clear that any one person on their own is unlikely to be as successful, as any one person alongside a series of other experts (senior-level manager 6).*

Insights from top-of-field scientists and senior-level managers related to motivation key themes found that motivation is a critical aspect of successful collaboration. While the scientist and manager have individual motivations, it is critical that the two sides are aligned mutually from a collaborative standpoint for knowledge creation to occur. If communication is not clear and then incentives are not aligned tension can develop.

Therefore, P3: *Alignment of motivations with shared mandates in a scientist-manager strategic alliance will increase knowledge creation.*

Top-Management Support

Collaborations that have top-management support employing strategies whereby the participants are properly aligned with complimentary skillsets make an important contribution to collaborative success (Brouthers et al., 1995). The question asked regarding motivations uncovered several themes that contributed to knowledge creation within scientist-manager collaborations in academic medical center-industry alliances. Top-management support is responsible for maintaining vision and applying leadership influence driving innovations forward. Strategic alliance contracts can run for multiple years making it difficult to stay on track. Top-management support maintains a high-level focus on keeping both sides of the alliance on track to complete shared objectives. Additionally, the hierarchical structure on the scientist side is much more convoluted in that, and there are no specific superiors for which to report to. Top-management on the scientist side can help to bring structure this environment through the development of a more cohesive bond from an organizational standpoint. Developing a hybrid business model that more closely resembles managers and industry can perpetuate a closer scientist-manager relationship.

Theme 1

Top-of-field scientists and senior-level managers said there needs to be leadership influence driving the people who are on the ground reminding them that this is something the institution or company stands for. Many times, in five or ten-year contracts it becomes quite easy to "lose your way" as a scientist or manager. The longevity of an alliance agreement can impact the alliance negatively if not properly managed. Top management support is responsible for driving purpose and maintaining focus from a

high level within the alliance. Top management in industry is a lot more dynamic than in academia. It's not only people leaving but people getting promoted and moving to different positions within the company. To some degree, this is the responsibility of industry top management support to reduce the probability of high turnover. There are also times when there can be CEO shift which then deprioritizes the entire project.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

I'd say very, very soft touch in terms of the faculty on this side. I think more of an impact on trying to drive some of the pieces on the other side, just making the partnership work better for university, taking feedback from the faculty, things that are working, aren't working, build this into the programs and push the other side when something isn't working. I'd say that's more of the role that we play here. Obviously, we structure the contracts, and then we oversee the active day to day management of things, when they aren't' working, when the faculty are upset about something, when they need something else, and we need to be heavy and push the partner or work with the partner to make sure that there's a smooth path forward.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 1

So, our superior then expanded the sphere with people he was working with, brought them into the relationship. There was certainly more people at the academic medical institution who wanted to get involved, but there just wasn't resources or the ability or maybe even industry interest in doing that. Certainly, several labs brought projects and asked us on a regular basis, "Can we put this in the industry alliance?" and industry just didn't have the bandwidth or the interest to do some of those things. There are a few academic medical center hubs for sure. But yeah, the companies know typically who the thought leaders are in an area, and they'll come looking for those people. Or, they'll, I think in the case of our academic medical center recently they know we have a critical mass of expertise in a particular area. So cellular therapy, gene therapy, other areas, robotics with the engineering school and so some companies will want to tap into that regardless of who the investigators are. Mainly driven by the fact they are in that area, and they want to tap into that expertise, and so they'll come and essentially, they might come with a blank slate and say, they may not have an agenda or something they want to get done. But if they just want to tap into that expertise, they'll come and say, "What do you want to do? What can we fund and seed?" And something will come out of that.

Interview D. Top-of-field Scientist 3 AMC-Industry Alliance 2

I would say that our superior, if he can, well if he will not get into it today, I mean, it's not needed. But whenever we get to a crossroads on a very important decision, then

he will weigh in. He attends the different joint decision-making committees, the different ones. He wants to be up to date, and he's hands-off as long as things are running smoothly. There can be hiccups where he doesn't need to intervene because we can find ... One of the roles of the project manager has been to put a lot of processes in place, that you can sort of call on these processes whenever there's a deviation. Sometimes it gets to a point it's actually a philosophical difference, or they want to start a new project, or they want to cancel a project, or they want to change the running of the administration. When it's something that is large, then our superior will intervene.
You could have a CEO shift, and the CEO deprioritizes the project or the CSO of the organization no longer wants to support gene therapy anymore. Okay. We do have a wind-down procedure. Are we really going down that, because the company still has champions that want to do it? Now they're fighting with the C-suite. It can get complicated.

Interview J. Top-of-field Scientist 6 AMC-Industry Alliance 2

There has to be leadership influence, kind of driving those people who are on the ground, reminding them that this is something the institution stands behind. This is something the institution wants to see happen. I don't think. I think if it doesn't have that, then it's left to, let's say, the principal investigator or whoever that one individual is then to drive that. It needs leadership. It needs someone who's going to be able to do that.

Theme 2

Top-of-field scientists said top-management hierarchy is somewhat more convoluted for scientists in that the principal investigator isn't necessarily the boss of everyone in the organization. The PI may sit on the joint steering committee (JSC), and this person may be the entry point for industry and managers however there are other leaders of science also on the JSC that have influence but don't necessarily report to the primary investigator. There are heavily administrative and scientific participants in top management that make up the academic side of the alliance.

Interview F. Top-of-field Scientist 5 AMC-Industry Alliance 3

I have interacted with a lot of other PIs, clinician scientists as well. He's MD-PhD. He doesn't see patients, but we know a lot of different varieties of this, that some of them actually do see patients and run a lab, and that's got to be an even crazier world than we live in because they've got two assistants to manage the two calendars. Yeah. But I've seen how other people manage and, okay, I'm glad that we work with our superior and he's the way he is. There's complete transparency here, in that everything's an open

book. There are no secrets with what we're doing. Now, of course, things get managed on different levels. There's certain stuff like, okay, down at the PM level, they don't need to know that right now, but it's not in a secretive way. It's on a what's business appropriate way. Pretty much everything is open in these lab meetings and whatever, and then people have information. I think that helps a lot with the leader, transparency because, on the other side, that what we've seen in some of our partners is ... I'm in a lot of the more senior leadership meetings, and things get discussed, and then we go to our next meeting, and we share it with our team. On the other side, it is not trickling down. This is a problem because now I have my alliance manager and my project managers who have information that I've told them we need to implement this. And then I can't have my people breaking the news to their people, their counterpart. This has been problematic, but you can't control the style of leadership at your partner institution, so that's been a big one. Other people say oh, my gosh, there's so much clutter and chatter, and he gets everybody focused again. To me, that's a huge thing with the leadership because there's a lot of things going on in a day, in my day and your day and their day. He keeps that going, yes. And it's probably because these different teams meet so frequently and the communication is there. Every organization has communication challenges, and we work through that, especially with growth. But I think that's key because he is always with either ... And so, I guess, I don't know what we call, the portfolio management level, that team is huge too. They're the ones who are then out to their teams getting it all done. Yeah, but the problem is if the CEO of industry changes, that's a two-year turnaround of the trickle-down through the whole company, and then it's like, oh, well, then all their head of R&D changed.

Interview J. Top-of-field Scientist 6 AMC-Industry Alliance 2

There is an ultimate executive who's at the head, who's keeping an eye on these things which we're submitting reports. Our superior is P.I. in that in which industry wanted to do work with. They wanted our superior's intellectual property. They wanted access to his lab. They wanted access to his brain and anybody else who's affiliated or does work with him. And So, that was their primary entry point. So, our superior sits on the JSC, but there are other leaders of influence who sit on the JSC besides him that don't report to him, that he does not have authority over. So, for example, other high-level executives sit on the JSC for the industry alliance. We have the chief scientific officer who sits on the alliance. We also have the head of the cancer center which sits on the alliance, and these are, these are friends, colleagues. These are in some part people senior to our superior, or people who are just in very different positions.

Theme 3

Top-level scientists and senior-level managers said the key to making these alliances successful is talking with faculty and managers making sure everyone is on board with how things are going to run before the contract is signed. You can't just

impose goals. It must be a joint decision about how the alliance is going to work. Tension develops if there isn't clear communication from both top management on the scientific and manager sides of the alliance from birth. If communication breaks down, focus and strategic intent tend to become obscure which decreases the chances of success. A large part of top management is recognizing differences and learning to work towards a common goal but not forcing anything.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

It's across all levels of the collaboration. At the top level with the senior executives, they're going to be on the joint steering committee. It would be their responsibility to set the right environment amongst all of their teams so that issues are readily raised, and you have a collaborative mindset. You can imagine if you set your team going and you have your alignment meeting before you get to the kickoff, and you say, "Hey, this stuff's confidential here, try not to tell them this, don't do that, don't spend any money, this isn't really priority for us, but we're not telling them that." If you have that sort of mindset, you're destined for failure right from the start. A large part of it is recognizing differences and learning to work with that and what you're actually doing to make an alliance work is figuring out how to get stuff done in the midst of all that difference. So that's the challenge of it, that's why it's such an interesting job.

Interview E. Top-of-field Scientist 4 AMC-Industry Alliance 3

Be it with any university or even other companies. You must have the blessing of leadership. Therefore, top managers must say, "Yes, go ahead," because it implies ... it has financial implications for some research to be done. We involve people that should perhaps be doing something else, and they are diverted to that particular collaboration, and therefore, every action that we take has a cost. And because of that, just thinking financially there needs to be an okay from those who have the power to decide whether funds should be deployed one way or another.

Also, in terms of science, we do have strategies, which we think their actions are made from. I mean, yeah, we obviously try to make sure that what we do externally has a value for what we are doing internally and that goes back to the original concept that if you have people that are working on similar problems, they may have a better understanding of the science that is entailed in that particular external operation. At the same time, the data that comes from the collaboration is going to be of value for whatever internal program you are trying to foster. So there has to be a marriage between the external approaches that we are trying to pursue and the internal strategy that would be defined. And to achieve that we have to get the okay of our management.

Because again, one of the issues of interaction with external is that if there is no support from the management, maybe, it may be viewed from something outside of your

responsibility. You may have a person of importance that you have to meet, and those do not include whatever interaction with the external group then, that particular interaction becomes secondary and perhaps it gets penalized because it's not as intense, if you like, as it should be. That's I think, a really important element because, whatever interaction we take in to feed, okay, it's because we have the blessing or at least the approval of the management that supports such missions.

Interview H. Senior-level Manager 3 AMC-Industry Alliance 2

There are concerns over conflicts of interest and other things. University is represented on the board and invests in the company. I mean, this is out there. You've got to understand, this not the way it usually happens in an Ivy League school. But if we're investors and we're directors and we, and the investors and the founders, agree that this is a plan that's going to create a good business. What this mitigates is companies losing their way, and companies lose their way more than you care to know about it. Wait a minute, guys, I thought this was the plan, and we had alignment in this? So that it's not only set the stage, and you know, being open about it, that with great investors and good directors, this is good business. But we need to be part of it, to make sure they don't lose their way. They lose their way for all kinds of reasons.

Interview I. Senior-level Manager 2 AMC-Industry Alliance 1

I actually think the top management at the university often gets in the way.

Interview K. Senior-level manager 6 AMC-Industry Alliance 2

It's really, like a conductor over an orchestra. You have a lot of very brilliant people. You have to give them the right goals and the right resources and the right structure to have them play beautiful music. If things aren't going well, it's the organization's job to try and figure out how to redirect and restructure what's below it. I think the goal would be to assume that the broader crowd in the network is where you want the group genius to emerge, and that you're not the one dictating what's supposed to happen. The management team has to make sure that the groups are being productive because they're responsible for the resources and to make sure that the collaborative incentives aren't backfiring. It's much more about treating the network as this thing with infinite potential, and your job is to empower it to do its best work. That requires a mix of structure, incentives, and resources.

Table 2.5 examines top-management support key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 2.5 Top-management Support Key Themes Study Two

Top-of-field Scientists	Senior-level Managers
I would say that our superior, if he can, well if he will not get into it today, I mean, it's not needed. But whenever we get to a crossroads on a very important decision, then he will weigh in. You could have a CEO shift, and the CEO deprioritizes the project or the CSO of the organization no longer wants to support gene therapy anymore. Okay. We do have a wind-down procedure. Are we really going down that, because the company still has champions that want to do it? Now they're fighting with the C-suite. It can get complicated (top-of-field scientist 3).	*I think more of an impact on trying to drive some of the pieces on the other side, just making the partnership work better for university, taking feedback from the faculty, things that are working, aren't working, build this into the programs and push the other side when something isn't working. I'd say that's more of the role that we play here. Obviously, we structure the contracts, and then we oversee the active day to day management of things, when they aren't' working, when the faculty are upset about something, when they need something else, and we need to be heavy and push the partner or work with the partner to make sure that there's a smooth path forward (senior-level manager 1).*
There has to be leadership influence, kind of driving those people who are on the ground, reminding them that this is something the institution stands behind. This is something the institution wants to see happen (top-of-field scientist 6).	*It's really, like a conductor over an orchestra. You have a lot of very brilliant people. You have to give them the right goals and the right resources and the right structure to have them play beautiful music. If things aren't going well, it's the organization's job to try and figure out how to redirect and restructure what's below it. I think the goal would be to assume that the broader crowd in the network is where you want the group genius to emerge, and that you're not the one dictating what's supposed to happen (senior-level manager 6).*

Insights from top-of-field scientists and senior-level managers related to top-management support key themes found that maintaining an overall vision that drives participants towards a common goal and alleviates tensions that may build because of

differences in organizational governing structures will optimize scientist-manager collaborations.

Therefore, P4: *Top-managers that that foster communication and facilitate organizational structure in a scientist-manager strategic alliance will increase knowledge creation.*

Project-level Processes and Procedures

Project-level processes and procedures delegate strategies to individuals within collaboration and set the overall direction for completion of objectives. While scientists and managers have different objectives, it is imperative for project-level processes and procedures to align, facilitating a shared strategy (Perkman et al., 2001). The question asked regarding project-level processes and procedures uncovered several themes that contributed to knowledge creation within scientist-manager collaborations in academic medical center-industry alliances. The capacity in which each side of the alliance operates should be clearly defined, however, managers experience high turnover which can disrupt already established scientist-manager relationships. It is the responsibility of managers to minimize the impact of misalignment when these circumstances occur. Additionally, collaborative relationships can also be impacted by the pace of projects which can change dramatically depending upon on the amount of financial capital available. When projects slow down timelines for the completion of objectives changes and tensions arise.

Theme 1

Top-of-field scientists and senior-level managers said large contracts formed for a strategic alliance have joint steering committees with membership from both the scientist

and manager side. In some cases, the capacity in which everyone will operate is clearly defined, but in other cases, it's much more open-ended particularly on the manager side as positions are filled when they see fit. Situations then arise where individuals sitting on the JSC are comprised of more scientists than managers and governance isn't successfully implemented. This can lead to complications, miscommunications and incorrect interpretation of the contract as the JSC sets the environment for the project level teams. The project management teams take care of the day to day activities of the alliance by monitoring and communicating all the contractual obligations. Moreover, there are a lot of other aspects that go into management besides the scientific component such as financial and intellectual property negotiations or management of licensing contracts. Companies have management turnover, and scientists have turnover but not usually at the same rate. From a project level, high turnover on the manager side can have a negative effect and threaten the viability of a project. Also, when working with industry, projects can speed up or slow down depending on how much money is available to contribute to the project. These factors create tension and frustration for the scientists for two reasons. First, high turnover means that the onboarding processes must start over from the beginning by bringing new members up to speed. This happens frequently, and the scientists will say, "Why bother onboarding somebody, they'll be gone before we start working with them." Scientists believe they should not spend the time getting up to speed if new managers are only going to be working with them for a month or put their careers on hold from a research standpoint at the expense of keeping one or two people happy on the manager side of a collaboration.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

I think that once the agreement is signed, it's critical to kick off or launch the collaboration in the correct manner. Now this will depend on the extent of the collaboration. Sometimes it might just be free to operate at one end of the spectrum versus a full research development collaboration at the other end of the spectrum. Freedom to operate probably shouldn't be a big deal. So, let's focus on the other end of the spectrum where you've got considerable collaboration on both sides.

I think in that case, you must have a defined procedure to make sure the alliance is started correctly. We used to incorporate a day launch person. So, execution is on day one of the agreement, and then you would spend the next thirty days preparing for a kickoff meeting. And that would include ensuring that the governance met the needs of both parties and was further developed beyond that necessary as described in the agreement. With staff up on both sides making sure you have equality between the groups. Governance, a steering committee, subcommittees are set up, and then you would start the chartering process. Where the coaches of each of the committees would take on board to prepare in advance things like the logistics meeting frequency on the one end, but on the more important end, identify key milestones that they may have over the next six to twelve months and identify the key challenges that would prevent them meeting those milestones. And the overall objective of that committee is part of realizing what's in agreement.

The parties would also work together to set up the agenda for the kickoff. Usually, it's something like the vision of the highest executives at the meeting, followed by a review of each party's culture and how they get things done. Then it would be a review of the agreement by legal to make sure everybody knows mainly and what it's all about and what are the roles and responsibilities. You'd have an update based online units, and then you would follow that with probably breakouts for each of the subcommittees and probably the joint steering committee. So that they can finalize their charters, agree on what all the milestones and challenges are. And then you'd have a feedback session after that, and then an important part of both parties is the best practices in terms of alliance management.

Interview B. Senior-level Manager 1 AMC-Industry Alliance 1

All these large contracts have a joint steering committee with membership from both sides. On some, it's well defined from which office still sits, again what capacity each individual will be, who sits on the JSC. Other cases we leave that open-ended and each party fills the JSC as they feel fit. But again I think that's important to get that right, and we've seen where it hasn't worked well for instance where one example would be where all individuals sitting on the JSC either work in the laboratory that is part of the partnership or ends up reporting into the PI who heads up these partnerships, and it's just like that doesn't work well because the university's governance piece isn't represented as the JSC level and often times that can lead to complications, miscommunications, and just improper interpretation of the contract at times when that's necessary.

Typically, there's a good mix of the project lead on the scientific side, some business development executives, maybe the president of oncology if it's an oncology collaboration on the partner side. On our side we might have a health system administration representative, the key scientist is almost always on it. Then often someone from this office, me, someone on my team would be on the JSC. So that's typically how they're structured, but at times it tends to get tilted heavily in one direction. It may be, and it's usually towards the academic scientist and his or her lab, that they'll staff or they'll fill the JSC with just the scientist and some of his key scientists.
Sitting on the other side are typically the same people, head of research, head of business development and maybe even legal in some cases, sometimes. It's nice to have the proper balance on each side, and if you have an imbalance where it can create issues. I think those are two important people to have represented, and sometimes a scientist is business savvy, understands the details of the contract or thinks they understand the details and again can work in that capacity. I think having both the business development and the scientific representation on the JSC is crucial.

Interview J. Top-of-field Scientist 6 AMC-Industry Alliance 2

So I think one of the important factors that make our alliance successful is that we have implemented a governance in the alliance, and so there's a Joint Steering Committee, which is led by leadership from both institutions, and kind of a sub piece of information to that, the Joint Steering Committee is composed of key leaders from both institutions, so they're people of influence and people who are really driving the success of the alliance, and I think without something like that and without those types of people, it wouldn't have been as successful.
I think that's part of the mission of these subcommittees is to maintain that getting guidance and directive from the Joint Steering Committee, which is very much strategic in nature, and then passing that message down to the subcommittees that can then take that into their respective groups at their respective institutions to execute based on whatever the directives are, so I think that's very important.
I guess in part it depends on the size of the alliance or what the alliance is about that defines who those leaders are. That really drives the ship, if you will, in terms of being that positive force that stands behind everyone saying this is how we're going to do it. It also, it also is very helpful when things go awry in an alliance because you have people at the Joint Steering Committee who have decision making authority. It doesn't work well if you have people who are at the sort of the Joint Steering Committee level that isn't, don't have influence within their own institutions for change. So, it needs to have, it needs to have influential people at the table, but there's a lot of other pieces that go into management of an alliance that is beyond the scientific component. You know, we have like financial things we have to talk about, or we have to talk about the negotiation of intellectual property, or we have to talk about are we going to license this or say to industry "What did you do here?" So, it requires expertise from a lot of different types of individuals at the table.

Interview K. Senior-level Manager 6 AMC-Industry Alliance 2

There are numerous structures. There's a scientific steering committee at the highest level, well, at the highest level, there's a board of directors that make big financial allocation decisions and strategic decisions. Then there's a scientific hierarchy where each of the centers, there's a center director and co-directors, and they all sit on a panel that meets quarterly, or more often, as often as once a month to discuss things that are happening and help identify opportunities, collaborate across the centers.
Then, below that, there are teams. Within each team, you have, senior scientists, that are themselves trying to make decisions about how that project should be financed and who should lead what. Then, within that network, it's really good to create interesting ways to have unforeseen innovation and ideas bubble up. That's where within that network you create contests. You create incentives. You create grants. You create retreats. You create brainstorming sessions. You create prompts that you challenge people too.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

Longevity has an impact on collaborations. It's very difficult to control in an industry environment. It's not just people leaving and going to another company, it's people getting promoted, moving to different projects. It's a lot more dynamic in industry than it is in academia and there's only so much you can do to compensate for that. You can introduce onboarding processes but if your turnover is so high that before people have even gotten to work with the person, the next person moves in, then you end up in a situation where the academics will say, "Well why bother onboarding somebody, they'll be gone before we start working with them."

Interview I. Senior-level Manager 2 AMC-Industry Alliance 1

You must have a joint steering committee. That's the only way you can get an alignment on a daily basis. Everybody needs to be on the same page.

Theme 2

Top-of-field scientists and senior-level managers said clearly defined the principles, policies, and procedures with regards to project management in terms of facilitating these interactions without overly managing are key to successful operations. If this is not set up correctly or if there is high turnover on the manager side of the alliance there is misalignment and relationships can get very unrewarding very quickly.

Interview F. Top-of-field Scientist 5 AMC-Industry Alliance 3

Yeah. We have an alliance and program management team, which reports into me. We have this structure in place. Alliance manager is an outward-facing position, whereby

this person is the contact for each of the corporate sponsors. That's not to say that other people in our organization don't talk to this person.

This person is we call the contract, or the compliance cop to make sure, "Okay, we signed this big SRA. We have this sponsored research agreement, the work plan in the budget," this person is the one that's responsible what IP is obligated to them through this, to look at those details to make sure we're compliant with it. Our project managers all have PhDs in these different science areas. They keep all the timelines going. They can help write the work plans with the primary scientists who are in the lab and so with that structure, they're just really in the nitty-gritty of the science, making sure the timelines are moving according to plan or are we changing the timeline. If we're adding a study, how does that impact the timeline and the budget? The day that you sign the contract, it's outdated because the science is going to send you in a different direction. Then if it gets determined at some lab meeting, like the scientist shows data and they say, "Oh, that's fascinating," and everyone's in the room and this is how we operate here. At our lab meetings, Our boss/superior meets with the scientists every week. They present their new data every week. It's not just the primary scientists in the room. The animal models team is there. The vector team is there, the immunology team and the cell morphology team. It all gets decided in that room.

Interview H. Senior-level Manager 3 AMC-Industry Alliance 2

On the pharma side, just have control through Phase I, and make sure that they view it, not only because you forced them to, but because that's what's best for them. Yeah, we're going to have a light touch on this one, as we learn.

Let me give you an example, and I've known industry for a long time. They're a local company, and you know ... They said "We want you to be in charge through Phase I so that the program progresses. If we brought this internal, it would be mired in every committee that you can imagine, and it wouldn't go." This is what they're telling me. So, I know that they mean it, that they really want us to have control, not because I want to have control.

We've set up relationships where we didn't have this alignment, and then where we didn't ... We weren't part of the Board or whatever, and it was a mess. It's been ... Let me tell you, it just hasn't been fun, but we have enough experience that we know how to proceed. Just once you're in the relationship, how you manage ... That whole issue around alliance management, project management, in terms of facilitating these interactions and whatever else. It's an operational thing, but you must do that well and understand how to do it. And we've learned how to do that very well. We are not overly managing interactions. That's more of an operational thing, that is necessary but not sufficient. Because if you don't set it up right, no matter how you manage that, there's misalignment. And then it gets really ugly, and it gets very unrewarding, and you don't make the kind of progress that you want to make. So, I think you're onto something really, really important here. I really do.

Interview J. Top-of-field Scientist 6 AMC-Industry Alliance 2

Now, one of the things that we, that I personally have noticed as something that affects alliances is that the academic alliance Joint Steering Committee members, for the most part, has been there since the day we signed the contract. The industry Joint Steering Committee members have turned over 300%.

Interview E. Top-of-field Scientist 4 AMC-Industry Alliance 3

And they are difficult to deal with. But sometimes you don't get into a collaboration with many people like that because in the end, who wants to be with somebody who is not very present. You want a positive interaction, not a complex one. The world of academics sometimes different from the world of Pharma and there are some things that Pharma does on the day in and the day out that academics don't and that's where sometimes you run into some issues.

Interview G. Senior-level Manager 4 AMC-Industry Alliance 3

We have project managers on the science side, and they're generally guided by the scientific ... the PIs, the top scientists, and they're reporting to the JSC. We also have alliance managers who are taking care of the business needs of the alliance, so intellectual property, some of the contracting needs, some of the reporting. There's an overlap between the scientific project managers and the alliance managers in terms of publication review and that sort of thing, so there are generally two types in the big ones. My group generally handles more of the alliance management side of things, and then someone on the academic medical center side will generally handle the scientific project management needs. I'd say, by the two-year mark in almost any of our alliances, and we're dealing with a whole new set of people.

Interview D. Top-of-field Scientist 3 AMC-Industry Alliance 2

Yes, so we do have an alliance manager and a project management team that reports to the alliance manager. They are the ones that take care of the day to day monitoring and also the communication, and sort of following all of the contractual obligations. Some relationships are older, so the contracts look different than the new contracts, so there's a little bit of, I would say, diversity with the contracts. I would say, companies have turn over, we also have turn over, but mostly we have growth. The structure of alliance management is not that old, in a way. I started a year ago, before that there was my supervisor who brought me over who was doing business a lot online.

He also brought the alliance manager, so he's been here for a year and a half. We are also growing a structure that helps support these types of relationships in a more structured way, right, before the idea was a little bit looser. It was all done through the academic medical center, which they are good at what they do, but they deal with the whole university not only us. When you're working with biopharma, they can slow down or speed up the pace depending upon on how much money that they have to contribute to the project?

In our relationships that are multiple, there are two committees there's a committee and a general research and development committee that meet regularly, but it is true that with large companies they sort of ... Even though they check on it very often, they give a bit more control, and they let us live more. When you work with small biotech, since that's everything they pretty much are running all the pipeline, they want to have much more control. The way that we structure the group, so we have, I think five now, five research directors. Each research director has a team, and their team of two to three senior research investigators and each senior investigator has a team of technicians or Ph.D. students. So, it's like a pyramidal type of structure. Then, it depends on the interest of the partner, right? If the partner wants to run a pediatric epilepsy program, it would fall under that research director, and then if they need more staff, we will have to build up the staff. Now if the partner wants a totally different action that we don't have the structure yet, then we can build it. If we think that it's a project that is feasible and the funding is, we have funding for it, then we build a structure around that new area.

Table 2.6 examines project-level processes and procedures key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 2.6 Project-level Processes and Procedures Key Themes Study Two

Top-of-field Scientists	Senior-level Managers
Longevity has an impact on collaborations. It's very difficult to control in an industry environment. It's not just people leaving and going to another company, it's people getting promoted, moving to different projects. It's a lot more dynamic in industry than it is in academia and there's only so much you can do to compensate for that (top-of-field scientist 1).	*All these large contracts have a joint steering committee with membership from both sides. On some, it's well defined from which office still sits, again what capacity each individual will be, who sits on the JSC. Other cases we leave that open-ended and each party fills the JSC as they feel fit. But again, I think that's important to get that right (senior-level manager 1).*
Now, one of the things that we, that I personally have noticed as something that affects alliances is that the academic alliance Joint Steering Committee members, for the most part, has been there since the day we signed the contract. The industry Joint Steering Committee members have turned over 300% (top-of-field scientist 6).	*My group generally handles more of the alliance management side of things, and then someone on the academic medical center side will generally handle the scientific project management needs. I'd say, by the two-year mark in almost any of our alliances, and we're dealing with a new set of people (s*enior-level manager 4).

Table 2.6 (continued)

The world of academics sometimes different from the world of Pharma and there are some things that Pharma does on the day in and the day out that academics don't and that'. S where sometimes you run into some issues (top-of-field scientist 4).	*That's more of an operational thing, that is necessary but not sufficient. Because if you don't set it up right, no matter how you manage that, there's misalignment. And then it gets really ugly, and it gets very unrewarding, and you don't make the kind of progress that you want to make (senior-level manager 3).*
I think that once the agreement is signed, it's critical to kick off or launch the collaboration in the correct manner. Now this will depend on the extent of the collaboration. Sometimes it might just be free to operate at one end of the spectrum versus a full research development collaboration at the other end of the spectrum (top-field-scientist 1).	

Insights from top-of-field scientists and senior level managers related to project-level process and procedures key themes found that high manager turnover and delays in project timelines cause tensions to develop. The hierarchical structure of manager organizations contrasts the convoluted chain of command in an academic setting. This can to tension with regards to strategy development.

Therefore, P5: *Project-level processes and procedures that are well defined and operationally structured to minimize turnover in a scientist-manager strategic alliance will increase knowledge creation.*

Boundary Spanner

During the interviews of top-of-field scientists and senior-level managers referred to boundary spanners to describe a professional who bridges the gap between the scientist and manager in academic medical center-industry alliances. A wide gap exists between scientist research and managerial practice and is not limited to academic medical center-

industry alliances (Rynes et al., 2001). The boundary spanner is a key point of contact for both sides of the alliance and serves an integral part of knowledge creation within a scientist-manager collaboration. A successful boundary spanner is not necessarily the most highly trained and educated individual as it takes a unique skill set required to occupy this role successfully.

Theme 1

Top-of-field scientists and senior-level managers said the boundary spanner acts a key point of contact for a researcher who may, for example, have an inquiry about the clinical trial or regulatory aspects and needs guidance with regards of whom to speak to on the manager side of the alliance. While there are tech transfer offices and alliance managers, the boundary spanner possesses important insight and tacit knowledge therefore successfully facilitating information transfer. It is also important for the boundary spanner to engage with doctors to understand what the clinical could look like as well as support the scientific visionary throughout the alliance with the correct business people and administrators. Boundary spanning serves as a unique and integral part of making a strategic alliance successful. Perhaps the most important job within an alliance is that of a boundary spanner as this responsibility is the cohesive link that brings both sides together. It's important to have a boundary spanner on each side of the alliance possessing the skillset necessary to see the broader spectrum of processes from the scientific, financial, clinical trial and regulatory aspects. It's difficult for the boundary spanner to measure success in terms of trust or productivity as these variables change throughout the lifecycle of an alliance with personnel changes. The individuals in charge and the strategic intent they employ can make or break the cultural feasibility of a project.

Interview C. Top-of-field Scientist 2 AMC-Industry Alliance 1

The academic medical center is large organization typically the people we would partner with are large organizations so it definitely helps to have point people who see the broader spectrum of everything that's going on because we get an inquiry from a researcher who doesn't know much about the clinical trial aspects or maybe the regulatory aspects and they'll say, "I need to get this done. Who do I talk to?"

Interview G. Senior-level Manager 4 AMC-Industry Alliance 3

We would not be able to operate in this space without having the scientific visionary. We need to support the heck out of the scientific visionary with the right business people and with the right administrators.

Interview I. Senior-level Manager 2 AMC-Industry Alliance 1

Yeah, in a sense if you had an innovation, and are in control of the budget. You need to have a say in the kind of relationships at form. I think the best way to bridge gaps is just to put the scientist together and let them do their thing and trust that something positive will come out of this. Based on the priority of the project, and the resources, intellectual resource, and financially, you can bring to the project to make it successful. I don't think the top executives are the best bridges to solve this problem, because they have less incentive. They're complicit in terms of their incentives.

Interview K. Senior-level Manager 6 AMC-Industry Alliance 2

It's a critical thing that any network has a fantastic stakeholder at the top. I think if you take something like academic medical center/industry alliances, you probably have down the ranks, hundreds of people involved, but how the product is, how that relationship is, is somewhat dependent on how good the leadership is for it.

Theme 2

A top-of-field scientist said there had been several instances where highly trained, highly educated executives had to be taken off collaborations. These instances are a byproduct of improper alignment and training that otherwise would reflect shared and common goals between both sides of the alliance. Without these characteristics, collaborative tensions begin to develop. Perhaps the two most important participants the boundary spanner brings together are the scientific visionary and the business executive that can successfully align the parties despite the constantly changing environment.

Interview A. Top-of-field Scientist 1 AMC-Industry Alliance 1

It needs to be everybody in the alliance. Because if you depend on junior management to bridge the gap, then at the operational side, it's just not going to work and vice versa. As an alliance manager, you might like to say, "We saved the day, we're the bridge." But we're not. We are the ones which emphasize the importance of bridging that gap at all levels. What you're doing at the agreement stage is checking that this facility can bridge those gaps and then at the kickoff, you're giving the operational people and the senior managers the tools they need to work amongst all that difference and to bridge the gaps. But at the end of the day, every person working with somebody in the other institution, to some degree, must bridge that gap. And if you don't give them the skill set to do that, they're going to struggle. So, the company and the academics institutions need to help train the people.

We're talking about a large cross-section of the population. Even highly educated, highly trained, senior executives ... In my history, I have had to take off very senior executives from collaborations because they may be good at working in the company, but they may not be suited to working in an alliance. It's an additional skill set, and not everybody's got it. And some people don't want to spend the extra effort to achieve that. Also, to give some insight into the academic-industry collaboration and every other collaboration, if you used something like trust or productivity or something to measure the overall success or collaborative success of the collaboration, you'd see that it changes over time. And that's usually due to a number of factors. So, things like the alliance strategic intent, the people in charge and the success of the project can make it go from gung-ho success at the start, down to, "Gosh, why are these parties even working together?", back to, "Wow this is great." Depending on who's doing what and when and how the strategic intent and the people align.

Table 2.7 examines boundary spanner key themes from top-of-field scientist/senior-level manager interview questions that will improve the probability of knowledge creation in open innovation processes.

Table 2.7 Boundary Spanner Key Themes Study Two

Top-of-field Scientists	Senior-level Managers
We're talking about a large cross-section of the population. Even highly educated, highly trained, senior executives ... In my history, I have had to take off very senior executives from collaborations. Because they may be good at working in the company, but they may not be suited to working in an alliance. It's an additional skill set, and not everybody's got it (top-of-field scientist 1).	*It's a critical thing that any network has a fantastic stakeholder at the top. I think if you take something like academic medical center/industry alliances, you probably have down the ranks, hundreds of people involved, but how the product is, how that relationship is, is somewhat dependent on how good the leadership is for it (senior-level manager 6).*

Table 2.7 (continued)

The academic medical center is large organization typically the people we would partner with are large organizations, so it definitely helps to have point people who see the broader spectrum of everything that's going on (top-of-field scientist 2).	*We would not be able to operate in this space without having the scientific visionary. We need to support the heck out of the scientific visionary with the right business people and with the right administrators (senior-level manager 4).*

Insights from top-of-field scientists and senior level managers related to boundary spanner key themes found that highly educated scientists or high-level senior managers are not necessarily the best individuals to occupy boundary spanning roles. The boundary spanner, who is not easily identified, must have strategic vision and influence throughout the entire collaboration.

Therefore, P6: *Alliance participants with influential power, decision-making authority and strategic vision in a scientist-manager strategic alliance will increase knowledge creation.*

Discussion

This study examined critical success factors of scientist-manager collaborations in strategic alliances and the tensions that developed during the knowledge creation process. The objective was to address the scientist-manager tension within these collaborations and increase the probability of knowledge creation. The main finding is clearly defined participative roles that enable risk-taking with collaborative alignment of objectives, scientists, and managers that maintain transparency and possess a strong belief in the reliability of collaborative research and development relationships, alignment of motivations with shared mandates, top-managers that that foster communication and

facilitate organizational structure, project-level processes and procedures that are well defined and operationally structured to minimize turnover and alliance participants with influential power, decision-making authority and strategic vision in a scientist-manager strategic alliance will increase knowledge creation.

Strategic alignment in scientist-manager collaborations is fundamental and imperative however this process requires the scientist and manager to develop a collaborative thinking mindset whereby objectives are clearly defined from academic and industry standpoints. The commitment by the scientist to consciously examine the traditional conservative and risk-averse viewpoints of the university and develop a willingness to embrace risk and take advantage of groundbreaking technology will lessen the scientist-manager tension. Managers must maintain open-mindedness in understanding the investigation process and frame of mind the scientist skillset requires in technology development and discovery.

Scientist collaboration and dissemination of information among universities have been built on trust as the long-standing philosophies of the scientist-scientist relationship are less convoluted than the scientist-manager relationship. A strategic alliance between the scientist and manager demands a new agenda, and perhaps a hybrid way of thinking which weakens the foundational trust both the scientist and manager would otherwise be accustomed to. The development of trust in a scientist-manager collaborative relationship largely depends on the culture within the strategic alliance. Scientists in an academic culture encourage free thinking with the propensity to move science forward whereas managers in a corporate setting have specific procedures designed to increase profitability and shareholder value. Developing trust should not be a compromise

between the differences; it should be about finding ways to come together for one common goal as the alliance matures and the focus narrows despite employee turnover, communication challenges, and scope creep.

From a project-level management perspective, contracts can vary depending on the length of contract and membership participation from each side. Some projects are very well defined with hierarchical clarity consisting of joint steering committees and subcommittees made up of both scientists and managers whereas other projects are more open and fluid in terms of structure. Setting an environment conducive to mitigating collaborative challenges lies with top management support. It is at this level, and issues are readily raised regarding differences that threaten major milestones and objective agreements. It is the responsibility of top managers to get objectives completed despite these differences. There must be top leadership reminding the organization that the project is something they stand behind as tension can arise if focus is lost or personnel has been changed, particularly on the manager side of the alliance. And managers are equally contributing. It is when these projects are open-ended with unclear communication and uneven participation that tension develops. Alliance participants with influential power and decision-making authority on both sides of the collaboration need to be present and transparent when this tension develops as this boundary spanning characteristic is perhaps the most integral piece to developing and maintaining a successful scientist manager strategic alliance.

This study examined critical success factors involving scientist-manager tensions within two successful academic medical center-industry alliances. Further studies could examine other academic medical center collaborations with pharma, complementary to

the initiatives in this research. An increase in sample size of professionals interviewed with the addition of questions could have also uncovered more aspects of strategic alliances such as financial and intellectual property contracts. Additionally, a cross-industry examination of strategic alliances would further develop insight into alliance success and failure as well as the adoption rate from a broader spectrum. Moreover, there may have been slight interview bias based on the relationships involved in the study and environment the interviews were conducted in as certain themes in the data became repetitive.

The academic medical center pharma strategic alliances examined in this study are part of a unique industry in terms of research funding. In the past, medical research was mostly funded from public entities such as the National Institute of Health (NIH). Traditionally the NIH would be considered an "innovation investor" - a scientist would apply for a grant to fund research through this medium (Inverso et, al. 2017). More recently, however, medical research has transitioned to the private sector (Chakravarthy et, al. 2016). From 2004 to 2012 funding from the (NIH) fell from $35.6 billion to 30.9 billion and funding from the private sector grew by $10.6 billion. This growth has attracted the attention of AMCs, and they are now turning to private funding for research and development. Unlike public funds from an innovation investor, private funds would be distributed for particular purposes from an "innovation benefactor" – individual(s) and or companies looking to profit from the technology developed (Inverso et, al. 2017). This has brought forth significant change to the complex processes that comprise a scientist-manager strategic alliance in healthcare and therefore limits the generalizability of this study due to the unique set of characteristics the boundary spanner will possess.

"In the particular context of innovation networks, where knowledge is the chief currency and is dispersed, the first task of orchestration involves ensuring knowledge mobility." (Dhanaraj and Parkhe, 2006 p.660). Orchestration of knowledge creation in the case of this study is the responsibility of the boundary spanner. In the past, the role of the boundary spanner would have been played by the public funded innovation investor (NIH) who would objectively evaluate research proposals and distribute funding; now the role is played by the private funded innovation benefactor (biotech firms, foundations, charities) (Inverso et, al. 2017).

When the innovation benefactor becomes the boundary spanner, financial, scientific and ethical conflicts come into question. From a financial standpoint, innovation investors don't invest in research because they are looking for positive research results or intellectual property generation; they simply fund research based on the fact the lab will show progress towards objectives. This is in direct contrast to the innovation benefactor who expects to see financial returns from the lab which places undue pressure on the scientists. Scientific conflicts can also arise as "the interest of the innovation benefactor can place a narrower research aim ahead of scientific interest, potentially missing a broader application of research findings and scientific advancement." (Inverso et, al. 2017 p. 4).

Finally, ethical conflicts in the motivations of a private investor versus a public investor have the potential to focus on research projects that only show a high financial return potential or interest of the private investor. This stands in stark contrast to the publicly funded project which would have the propensity to show the most scientific

promise. These conflicts, unique to the life sciences industry, limit the generalizability of this study.

This study provided insight into the management flows within strategic alliances in the healthcare industry, specifically focused on an academic medical center's collaboration with three pharmaceutical companies. The objective was to uncover a set of organizational factors that lead to successful implementation strategic alliances. This study provided an overview for a hospital administrator, boundary spanner, corporate executive, scientist or physician on increasing the chances of alliance success despite the tension that arose between the top-of-field scientists and senior-level managers.

CONCLUSION

The objective of this research was to examine open innovation processes in academic medical center-industry alliances and develop insight on bridging the gap between scientific theory and manager practices to increase knowledge creation. Study one examined critical success factors of two separate institutions that have successfully implemented open innovation practices. The main finding was top-of-field scientists and senior-level managers that have access to physical resources and specialized equipment developing high quality science who engage in transparent bilateral communication, garner financial resources and promote collaborative cohesiveness that moves publishable research and technology forward, possess top-management leadership that establishes a strategic agenda and governance structure, and contain a culture consisting of trainable professionals that lower barriers to collaboration and enable risk-taking will increase knowledge creation in a strategic alliance, but not without knowledge flow tension between the two professions.

Study two addressed the scientist-manager tension and identified organizational factors that increase the probability of knowledge creation in an academic medical center-industry strategic alliance. The main finding was clearly defined participative roles that enable risk-taking with collaborative alignment of objectives, scientists, and managers that maintain transparency and possess a strong belief in the reliability of collaborative research and development relationships, alignment of motivations with shared mandates, top-managers that foster communication and facilitate organizational structure and project-level processes and procedures that is well defined and operationally structured to minimize turnover in a scientist-manager strategic alliance will increase knowledge creation.

Study two showed that there must be someone, the boundary spanner, to bring both sides of the alliance together and lessen the tension between the scientist and manager. Unfortunately, there is no blueprint that will uncover the boundary spanner. Perhaps the most important success factor of knowledge creation is the ability to identify who the boundary spanner will be.

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APPENDIX

IRB submission

Protocol for Study: Bridging the Academic findings and Practitioner practices of Open Innovation in Healthcare

1) **Abstract of the study**

All companies competing in the global information age face a common challenge, which is using knowledge more effectively than that of their competitors. Additionally, knowledge sharing is becoming an increasingly important competitive resource to firms and economies. Examining how knowledge can best be shared to increase firm performance is critical to strategy and sustaining a competitive advantage.

So how do knowledge and innovation relate? Knowledge producers and users seek out to leverage the ideas, technologies, and expertise on which their competitiveness depends. Innovation transmits knowledge through a pipeline from research to development to application. Sharing knowledge through collaborative innovation is becoming increasingly more important and this is expressly where knowledge sharing can be utilized through the process of open innovation. The objective of this research is to examine open innovation best-practices from a practitioner approach in an effort to provoke thought and further develop firm implementation.

2) **Protocol Title**

Building New Innovation Capabilities: Knowledge Sharing Through the Agency of Open Innovation

3) **Investigator**

Student: William S. Spudis, Doctoral Student, Fox School of Business

Advisor: Dr. Anthony Di Benedetto, Department of Marketing and Supply Chain Management

4) **Objectives**

Studies on open innovation have grown rapidly over the last several years, yet there is no universal language or discipline bridging the academic findings to the practitioner practices of this paradigm. The objective of this research is to examine institutions that have successfully implemented open innovation practices through effective leadership of collaborative groups and assess the attributes that lead to competent results.

Hypotheses:

H1: A universal set of open innovation leadership attributes will lead to successful implementation and execution of knowledge sharing

H2: The relationship between open innovation and knowledge sharing is moderated by trust on an individual level.

H3: The relationship between open innovation and knowledge sharing is moderated by individual altruistic tendencies.

H4: The relationship between open innovation and knowledge sharing is moderated by organizational management support.

H5: The relationship between open innovation and knowledge sharing is moderated by organizational culture.

H6: The relationship between open innovation and knowledge sharing is moderated by technology.

5) **Rationale and Signific**ance

While there has been a lot of research published on the open innovation paradigm, it is still a fairly new concept. This paper will address the advantages and disadvantages of the early adopters of open innovation in attempts to bridge the gap of academic theories and practitioner practices. The research provided in this case study will serve to provoke new thought on successful factors on open innovation processes.

6) **Setting of the Human Research**

The research will take place in person and/or by teleconference at a biomedical and genomic research that partners with a university and several hospitals. Participants for the interviews will be faculty and members from various departments within the research center.

7) **Prior Approvals**

No other non-IRB approvals are necessary in order to perform the research.

8) **Study Design**

a) Recruitment Methods

The objective of each study is to recruit approximately 30 respondents from a single research facility. The subjects included in the study will me faculty and members from various departments of the research center.

b) Inclusion and Exclusion Criteria

Subjects include faculty and associate members from the universities and affiliated hospitals.

c) Study Timelines

The duration of a subject's participation in a study will be approximately 30-60 minutes to complete the interview. The estimated date that the investigators will complete this study is May 31, 2017.

d) Study Procedures and Data Analysis

The objective of this qualitative exploratory research will be to refine the moderating variables of the conceptual model. I will test my hypotheses to determine if

trust, altruism, management support, culture and technology are accurate moderating factors of the knowledge construct. The data collection will engage semi-structured interviews and a qualitative analysis will be performed to determine any relationships in the data. A list of sample questionnaire questions will be included.

e) Withdrawal of Subjects

There are no circumstances in which subjects will be withdrawn from the study and there are also no consequences of a subject's decision to withdraw. The participant of the study can stop or exit the interview at any time.

f) Privacy & Confidentiality

The data will be stored on a password-protected computer. Regardless, there will be no personally identifiable information in the data set for this study. The subjects interviewed will not be identified and answers will not be linked back to their name. This will be explained on the consent form, during the recruitment and on the instrument (questionnaire). The results of the study will be presented in composite form and any information will be anonymized. Once complete, electronic repository of data will be destroyed.

9) **Risks to Subjects**

There are no risks to subjects in this study.

10) **Potential Benefits to Subj**ects

There are no direct benefits to the subjects in this study.

11) **Economic Burden to Subjects**

There are no costs that the subjects are responsible for.

12) **Informed Consent**

The participants will have the option to have interviews recorded. I will follow "INVESTIGATOR GUIDANCE: Documentation of Informed Consent HRP-803. The results of the interviews will not be shared with other members of the institute.

13) **Vulnerable Populations**

No vulnerable populations will be part of this study.