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Entrepreneurial intention amongst scientists and their transition to roles in research based startups

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ENTREPRENEURIAL INTENTION AMONGST SCIENTISTS AND THEIR TRANSITION TO ROLES IN RESEARCH BASED STARTUPS

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I hereby declare that this dissertation is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in this dissertation.

This dissertation has also not been submitted for any degree in any university previously.

Nallur Krishna Kumar

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Abstract

Entrepreneurial Intention amongst Scientists and their transition to roles in Research Based Startups

Nallur Krishna Kumar

The involvement of scientist and their transition to Research based Startup's (RBSU's) has been identified as a key factor in their success. This study was undertaken to better understand this transition of the scientist into the RBSU. It followed a two-step process of interviewing 28 researchers, researcher - entrepreneurs and researcher - startup employees followed by a survey with 104 individuals with similar backgrounds in research, entrepreneurship and as startup employees. the survey sought to understand the effects of entrepreneurial training / internships, access to entrepreneurs (network) and the role of events on these individuals and the likelihood of their participation in a spin off.

The study identified that researchers transition to a RBSU is influenced by their orientations, researchers were found to have an entrepreneurial, impact or career orientation. Entrepreneurially oriented researchers typically have a breadth of early experiences and exposure to entrepreneurial activities and are more likely create or join a RBSU, career oriented are inclined to stay in their career of choice as a scientist researcher , they seem to be negatively influenced in making their transition as they have increasing exposure to events and networking opportunities related to entrepreneurship, however they may be join an RBSU if a trusted team exists at the RBSU, impact oriented researchers see RBSU's as a means of creating impact for their research, they constantly seek to gain more information on how to manage

RBSU's and exposure to events and networking opportunities related to entrepreneurship result in a positive impact towards the creation of an RBSU, as they seek to identify partners to collaborate, bringing complimentary skills to the creation of a RBSU's.

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Acknowledgements

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Dedication

This research is dedicated to my parents Krishnan Kutty & Kamalam who taught me that the only worthwhile pursuit is the pursuit of knowledge.

Introduction

Research funding and the commercialization of research have become key topics of interest amongst policy makers, as they are seen to contribute to economic growth (Wright, 2017). Licensing and the formation of Spin off companies are some of the key pathways towards commercialization creating value through new venture creation, growth of existing firms and new job creation (Siegel, Waldman & Link, 2003). Research based start-ups (RBSU's) or University spin offs provide a critical pathway for commercialising technologies that are developed within universities and publicly funded research organizations This increased focus on entrepreneurship has resulted in larger numbers of university faculty & researchers making the transition from being involved purely in technology development and licensing to active participation in value creation by launching new companies that are built around technologies that they have been working with in their labs (Fuller & Rothaermel, 2012).

A key feature of RBSU's is the continued active involvement of the researcher or scientist who worked on the technology during the lab phase extend to the start-up phase. The researchers play a key role in transitioning the technology to the newly formed venture, they contribute towards the effective diffusion of knowledge from the lab to market enabling societal impact and the creation of tangible value by the newly created venture (Cohen, Nelson, and Walsh, 2002; Mansfield, 1995). This knowledge diffusion and the ability of the new start-up in being able to extract value from the knowledge (technology) created in the lab is key to the success of the new venture. A study by Rothaermel & Thursby (2005) of 79 start-ups from the technology Incubator

at Georgia Tech found that successful new venture performance was predicted by faculty that have deep ties with the new venture in the form of founders unlike weak ties where the engagement with the new venture might have been in the form of a consulting assignment. In a sense the successful commercialization of any technology created in the lab requires the continued involvement of the inventor (Jensen and Thursby, 2001).

The return on investments on R&D spending through licensing was particularly low as shown in (Velasco, F. (2018).

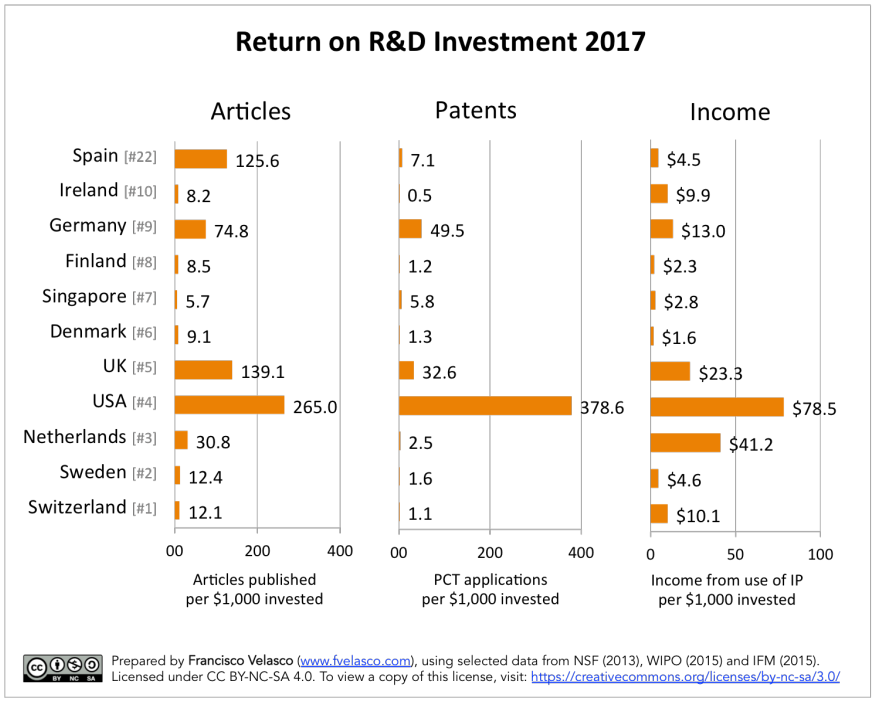


Figure 1: Return on R&D Investments

Additionally, it has been found that the economic value add through job creation was driven by new and small firms (see figure 2) (Haltiwanger, Jarmin and Miranda, 2013) which describes the Share of Employment, Job Creation & Destruction by Broad Firm (Average) Size & Age Classes; Annual Average Rates 1992-2005

Figure 2: Share of employment, job creation & destruction

While there is an increasing number of spinoffs from universities this transition by a researcher from working in a lab in the university is not common as the roles undertaken by the individual as well as the organizational context changes. However, given the importance of the continuing role of the researcher in a spin off, we need to better understand how researcher engage with market opportunities related to technologies that s/he is working on.

With increasing investments by the government both in research and support for entrepreneurship, and spin-offs being a critical component of the process of

commercialization (extracting value) from the research – it becomes important for us to understand both the motivations and barriers for a key actor (the researcher) to transition into the role of an entrepreneur.

Our research seeks to understand *"Why do some scientist researchers make a transition to the role of an entrepreneur while others do not"*.

At its heart the act of entrepreneurship is a personal one – while different theories have addressed aspects related to entrepreneurial motivation, organizing and resourcing, sources of opportunities and even role transitions undertaken by founders, they still do not give a unified view of the individuals journey and their transition from a non-entrepreneur to an entrepreneur. Our research integrates multiple streams of thought in entrepreneurship research from action orientation (Shane &Venkataraman 2000), entrepreneurial opportunities (Alvarez & Barney, 2007; Shane, 2000; Sarason, Dean, Dillard, 2006) uncertainty (McMullen and Shepherd,2006; Lipshitz & Strauss, 1997, Milliken, 1987) and identity (Hoang & Gimeno, 2010; Ibarra, 1999; Pratt, Rockmann and Kaufmann, 2006; Jain, George & Maltarich, 2009; Kyratsis, Atun, Phillips, Tracey and George, 2017) to develop a model that helps trace the transition on this journey from an researcher working at a research institution to taking up a role at a RBSU. We seek to understand the journey made by the scientist from a researcher role in a research / academic institution to a role in a RBSU and the factors that influence this transition.

We interviewed 28 individuals who were undertaking research or participating as a member of a research team at a research institute or had made a transition to a role in an RBSU to better understand their motivations, journey as a researcher and

how they viewed entrepreneurial opportunity that presented itself as a part of the development of their research to gain a better understanding of how they approached change as a result of this opportunity, these researchers were all working on technologies that either resulted in or could have resulted in a spin off's. The researchers were grouped into three categories. Category 1 – comprised of researchers who choose to move out of their role in the research organization and take on a role in the spin off, Category 2 – comprised of researchers who were still playing a role within the research organization, and Category 3 – comprised of researchers who had an experience of joining a RBSU but choose to come back and join a research institution. We followed an open ended enquiry method to identify the phenomenon that occurs as these researchers make their journey, their response were coded and categorized to gain a better understanding of the different factors that influenced their actions and their impact on the researcher. The researchers in our sample came from publicly funded research institutions across Singapore, this process heled us generate a picture of the personal motivations and uncertainties that arose out of this change in their role and the role of the institution and ecosystem in the transition of a researcher to a role in a spin off.

We followed up the interviews with a larger survey of 104 individuals who were scientist working at a research institution or were scientists who had transitioned from their roles in the research institution to a role at a RBSU. These interviews sought to validate the different categories that were developed from the analysis of the interviews and the factors that influenced the transition of a scientist from a role at a research institution to a role at an RBSU.

Theoretical Background / Literature Review

Introduction to Entrepreneurship Research

Research in the entrepreneurial domain covers a wide spectrum of areas ranging from the economic impact of entrepreneurship to the nature of entrepreneurship, the development of definitions and theories of entrepreneurship (MacMillan and Katz 1992; Amit, Glosten & Muller, 1993; Phan 2004) more recently some of the major themes around entrepreneurship include venture financing, corporate entrepreneurship, social entrepreneurship and sustainability, women and minority entrepreneurs, the global entrepreneurial movement, entrepreneurial cognition and even entrepreneurial education (Kuratko, Morris, & Schindehutte, 2015). Research in entrepreneurship at the individual level, has tried to make sense of why some people choose to start a business or act on opportunities while some others do not (Hoang and Gimeno, 2010; Mitchell and Shepherd, 2010), research in this area include the trait approach that sought to describe an entrepreneur based on certain defined personality or a set of characteristics (Gartner, 1988), another approach was based on the behavioral model that considered the formation of an organization (new venture) as an event where the entrepreneur undertakes activities that bring the organization into existence (Gartner, 1985).

Entrepreneurship is clearly a complex phenomenon that is influenced by and build around factors that include the environment, the entrepreneur himself, resource availability, the opportunity (the concept) and the context in which it occurs (see integrative framework of entrepreneurial process Kuratko, Morris, & Schindehutte, 2015). There have been many attempts to distill the entrepreneurial process into a

model, one such model proposed by Morris, Lewis, & Sexton, (1994), conceptualized entrepreneurship around entrepreneurial processes; key to these processes was the environmental opportunities (including demographic change, development of new technology, or modification in regulations) and the individual entrepreneur (the owner of the opportunity). The entrepreneur constructs an organization around which s/he can assemble resources (both financial and non-financial) towards a value creation objective. What stands out clearly from the different areas of research in entrepreneurship is the clear existence of a central actor the "entrepreneur" and the object of his / her action "the opportunity". We build our research around this focus

Centrality of Opportunity to the Entrepreneurial Process

Entrepreneurship is said to be about individuals who create opportunities where others do not, and who attempt to exploit those opportunities through various modes of organizing, without regard to resources they control (Stevenson & Jarillo, 1990). Given the centrality of opportunity to the entrepreneurial process a key question addressed by research has been around where do opportunities come from? This question of how opportunities come into being has been addressed in two ways (1) opportunities are discovered or (2) may be created (Alverez & Barney, 2007). The discovery of existing opportunities may be attributed to the distribution of Information in society (Hayek 1945), it is the asymmetry in the availability, access and knowledge of information that leads to the discovery of information by specific individuals. According to the Austrian model the possession of information (by an

individual) that is appropriate to a particular opportunity leads to opportunity discovery (Shane, 2000). Eckhardt, & Shane, (2003), categorize three sources of opportunities: (1) by the locus of the changes in parts of an existing value chain (these could be through the introduction of new products or services, discovery of new geographical markets, discovery of new raw materials or those that emerge from new ways of production or organizing, Schumpeter (1934), (2) by the source of the opportunities themselves, these include opportunities that arise due to asymmetries in information between market participants, inefficiencies between the supply and demand side of the market, productivity enhancement or rent seeking opportunities, opportunities that are generated through a change catalyst and (3) opportunities where the source (entrepreneur) is the initiator of the change.

We can therefore broadly categorize opportunity sources under two primary constructs, opportunities that are discovered or those that are created. Discovered opportunities are driven by an asymmetry in the availability, access and knowledge of information, the discovery of information by specific individuals and its possession (by an individual) appropriate and particular to the opportunity leads to its discovery (Shane, 2000). Shane & Venkataraman, 2000 ascribed the discovery of opportunity as a combination of the joint characteristics of the opportunity and the nature of the individual. Alternatively, the effectuation process which is actor dependent (entrepreneur) includes the process of creation of the opportunity as a part of the entrepreneurial process (Sarasvathy, 2001).

Specifically, in the context of our research we focus on the discovery of opportunities that arise due to an asymmetry in the availability of information Shane,

2000 posits that "*technological change will generate a range of entrepreneurial opportunities that are not obvious to all potential entrepreneurs and entrepreneurs can and will discover these opportunities without searching for them and any given entrepreneur will discover only those opportunities related to his or her prior knowledge (Venkatraman 1997)* "

If entrepreneurship is defined as the discovery, evaluation, and exploitation of future goods and services Eckhardt, & Shane, (2003). It is important to understand the process of discovery of these opportunities. McMullen and Shepherd (2006) suggested a two-stage process where individuals often recognize entrepreneurial opportunities that can be pursued without recognizing them as opportunities that they themselves can or should pursue.

Uncertainty & implications for entrepreneurial action

Whether discovered or created, opportunities require an actor to initiate and complete the process of entrepreneurship - entrepreneurship requires action. Entrepreneurship is therefore the nexus of two phenomena: the presence of lucrative opportunities and the presence of enterprising individuals" (Shane & Venkataraman, 2000). An entrepreneur acts on the possibility that s/he has identified an opportunity worth pursuing McMullen, & Shepherd, (2006). However, not all individuals who identify an opportunity act on the same, this question of why some people exploit these opportunities while others do not has been explored extensively in literature (e.g., Begley & Boyd, 1987; Brockhaus, 1980; Cooper & Dunkelberg, 1987; Sexton

& Bowman, 1984) some attribute psychological variables, personality traits and demographic factors as initiators of entrepreneurial activity. However, Lipshitz and Strauss (1997: 150) suggests that it is "uncertainty in the context of action that creates a sense of doubt that blocks or delays action", they further argued that uncertainty is subjective and that "different individuals may experience different doubts in identical situations".

Acting on the opportunity involves knowledge and motivation around the opportunity (Higgins & Kruglanski, 2000). McMullen and Shepherd (2006) identify knowledge (as it relates to the amount of uncertainty perceived), motivation (as it relates to the willingness to bear uncertainty), and, as a stimulus. These together provide the foundation of the individual's belief in their ability to act on the opportunity, while uncertainty takes the form of doubt, which prevents action by undermining the individuals beliefs regarding (1) whether an opportunity exists, (whether specific knowledge exists with the individual that helps them identify the opportunity) (2) whether s/he can act on the opportunity (what are the uncertainties around the opportunity and can they overcome the same) and (3) whether the action will lead to fulfilling some desire (what is the benefit that can be gained from acting on the opportunity – the trigger for action) they may have. This formed the basis for their two-stage model of opportunity attention & evaluation where attention involved questions of why opportunities are recognized and acted upon in general (i.e., third-person opportunities) while evaluation involved questions of why opportunities are recognized and acted upon by specific individuals (i.e., first-person opportunities). In a sense the model defined the evaluation process as a means undertaken by the

individual on a decision to take an entrepreneurial action. However, for this evaluation process to be initiated there first needs to be an acknowledgement of a third person opportunity. In the case of opportunities arising out of technological change this would imply that the individual would have the necessary knowledge to believe that there is an opportunity that is arising from the technological change and those who do not have this knowledge would not believe that there is a third person opportunity and would not attend to the same.

Our research seeks to develop on this process of enquiry to better understand the actions and activities that are undertaken during the process of opportunity recognition and evaluation. We seek to answer the following additional question

1. "*How do researchers engage in the process of sensemaking around the different opportunities that arise as an outcome of their research?*"

Uncertainty is central to the existence of opportunity and may be ascribed to the lack of information (STATE (What is happening out there?), EFFECT (How will it impact me?) and RESPONSE (What am I going to do about it?)) related to an opportunity (Milliken, 1987). "uncertainty in the context of action is a sense of doubt that blocks or delays action" (Lipshitz and Strauss, 1997), uncertainty is also said to be subjective in that "different individuals may experience different doubts in identical situations" (Lipshitz & Strauss, 1997), (Duncan, 1972). Entrepreneurship theorists have embraced the position that uncertainty is detrimental to entrepreneurial action because properties such as hesitancy, indecisiveness, and procrastination are thought to lead to missed opportunities (Casson, 1982).

An entrepreneur therefore sets out to remove / reduce these information gaps to the point where s/he is willing to bear the uncertainty and act on the opportunity. However, the question then arises what motivates these individuals to reduce these areas of uncertainty unless s/he was already acting in an entrepreneurial manner?

In their discussion on Sarason & Dean, (2006) use structuration theory as the basis for the recursive process of interaction between the individual and the opportunity that drives the entrepreneurial process forward – they indicate that opportunities and the entrepreneurs actions are interdependent and cannot be understood separately from each other. This process can describe the initiation of action by the individual in stage 1 (attention & evaluation) of the opportunity model described by McMullen and Shepherd (2006) – where the individual undertakes actions to address uncertainties around the opportunity as it relates to the environment and how it would affect the individual – the objective of these actions being to reduce the uncertainty around the opportunity. McMullen and Shepherd (2006) link stage 2 of the opportunity model – relating to accepting the opportunity as an opportunity for the actor as a willingness to bear uncertainty around the opportunity and is linked to a reduction in response uncertainty (Milliken, 1987). In their discussion McMullen and Shepherd (2006) compare the second stage of their opportunity model to the "risk/return" dilemma in which the individual would need to evaluate whether the payoff from acting on the third person opportunity justifies bearing the perceived uncertainty around the opportunity. This evaluation of risk/return is subjective to the individual and therefore what is required for an individual to act entrepreneurially is,

not have a high tolerance for uncertainty but a belief that they know what they are doing.

Mitchell, J. R., & Shepherd, D. A. (2010) focus on the entrepreneurial action and reasoning on why someone may decide to act on an opportunity while others do not - indicate that recognition of an opportunity for action is based on decision makers' images of opportunity (Potential Value (desirability), Knowledge relatedness (Feasibility) and Environment (window of opportunity & number of opportunities), which are in turn affected by their images of self (Vulnerability (Fear of Failure) and Capability (Self efficacy & Human Capital))

While images of opportunity clearly establish the attractiveness of an opportunity for the individual his / her action on that opportunity (in making it his / her own) is driven by their images of self – this is supported through behavioral action studies Ajzen (1991), in his theory on planned behavior suggests that people's behavior is strongly influenced by their confidence in their ability to perform it (i.e., by perceived behavioral control). Similarly, Krueger & Dickson, (1994), through their experiment around decision choices show that decision makers tend to see more opportunities and take risks based on their feelings of self-confidence and self-competence – further these feelings were not generalizable and could not be transferred from one to another.

Our research seeks to delve deeper into an understanding of the activities undertaken by the researcher to reduce uncertainties around both the opportunity as well as their ability to act on the opportunity

2. "*What actions did the researcher undertake to mitigate the uncertainties around the opportunities?*"

A potential outcome of addressing the uncertainties around the opportunity is the founding of a spin-off and organization founding involves a role – transition (Hoang & Gemino, 2010) which requires individuals to adjust to novel skills and social networks that underpin this role and integrating the founder role identity into an overall self-concept that may consist of contradicting and competing identities.

Researcher and Entrepreneurs operate in two very distinct environments, their identities in the context of their professional work environment are said to be distinct from their social identities. Professional identity is defined as "an individual's self-definition as a member of a profession and is associated with the enactment of a professional role" (Cherim, Williams & Hinings, 2007). These are constructed through a process of "identity work" (active construction of identity in a social context) through which they try to make sense of the their identities in the context of their work environment (Pratt, Rockmann, & Kaufmann, 2006; Ibarra & Barbulescu, 2010). These identities are are drawn from the professional contex in which they operate & the role they play within the organization.

In the case of non-entrepreneurs the situational influences around the opportunity draw them to interact with the it (Sarason, & Dean, 2006)and this process of interactions draws them into a deeper engagement with the opportunity, Identity transitions involve a complex process over a period of time and involve a process of creation of provisional selves (identities) which includes stages of observation, experimentation and evaluation leading to the identity being further

modified, reinforced or discarded (Ibarra, 1999). These transitions may lead to an incremental, substantial or radical change to the original role identity (Maurer, London, 2015) and may impact on how the individual decides to engage with the entrepreneurial opportunity.

In a study by (Jain, George and Maltarich, 2009) the complex transitions adopted by academics (faculty) highlight how they may choose to balance their self-image and the pursuit of an entrepreneurial opportunity by adopting hybrid role identities – a focal academic role and secondary commercial role managing these different roles through the acts of delegating & buffering.

The logic of how individuals operate in specific institutional settings is dictated by the institutional logic which is built around historical patterns of practise, values, beliefs and rules by which the individuals and organizations organize themselves to achieve the purpose of their existence (Friedland & Alford, 1991; Thornton & Ocasio, 1999). This logic provides the individuals with the vocabularies, values and beliefs that influence individual idenity (Thornton, 2004). The operating institutional logic and hence professional logic for a researcher within an academic / research institution is very different from that of a spin off which is entrepreneurial in nature.

Professional logic and the professional identity of an individual can therefore be said to be closely linked. Competing logics often lay the foundation for conflict, resistance and change (Marquis & Lounsbury, 2007). Professionals when faced with competing logics will percieve threats to their identity, and successful transition to a new identity is managed through a process of authenticating, reframing and

repositioning of their work to reconstruct their professional identities (Kyratsis, Atun, Phillips, Tracey and George, 2017).

Researchers have a professional degree in a specific discipline; as a part of a research organization they primarily focus on finding scientific and technological solutions to problems that may or may not have an immediate commercial value. A founder - entrepreneur in contrast seeks to assemble resources and focuses effort on addressing problem spaces / opportunities in the market so that s/he may capture value from the solutions that address that opportunity. The former's activities are conducted in a spirit of enquiry and discovery - a search for answers; while the latter's is conducted in the spirit of commercial value capture and the development of a sustainable business. These two therefore operate on fundamentally different logics, individuals who successfully transition from one to the other would require making changes to their professional identity.

Theoretical Basis

We draw on different streams of research in entrepreneurial opportunities, uncertainty and identity and identify themes that map on to a journey that a scientist entrepreneur would make in their transition to an entrepreneur. We use these theories to form the basis for the development of an integrated journey map of scientist researcher as they transition from their roles within the research lab to one at a RBSU. They help us to map the process of opportunity identification and the process of uncertainty mitigation during the process of making a transition.

We seek to develop our research using the theories around the discovery of opportunity, and the personalization of opportunity through the process of reduction in uncertainty around the opportunity, we seek to understand how researchers who have access to unique information acts on the opportunities they discover and the process they undertake to make sense of these opportunities and personalize them as they move towards acting on them.

A summary of the literature and the key concepts are provided in table 1

Table 1: Summary of literature around key concepts used to develop our researcher to entrepreneur journey

Area	Authors	Paper	Key Concepts
Entrepreneurial Opportunities	Alvarez, S. A., & Barney, J. B.	Discovery and creation: Alternative theories of entrepreneurial action	Two theories of how entrepreneurial opportunities are formed—discovery theory and creation theory
	Scott Shane	Prior knowledge and the discovery of entrepreneurial opportunities	1. Information asymmetry and the non-obviousness of opportunity 2. Technological change will generate a range of entrepreneurial opportunities that are not obvious to all potential entrepreneurs
	McMullen, J. S., & Shepherd, D. A.	Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur	Third person opportunity to first person opportunity model
	Sarason, Y. Dean, T. Dillard, J.F	Entrepreneurship as the nexus of individual and opportunity: A structuration view	A structuration view portrays the entrepreneur and opportunity as a duality in that each is interdependent upon the other
Uncertainty	Lipshitz & Strauss	Coping with Uncertainty: A Naturalistic Decision-Making Analysis	1. Uncertainty in the context of action is a sense of doubt that blocks or delays action 2. Uncertainty is also said to be subjective in that "different individuals may experience different doubts in identical situations"
	McMullen, J. S., & Shepherd, D. A	Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur	Entrepreneurial action as a result of willingness to bear uncertainty
	Milliken, F. J	Three Types of Perceived Uncertainty about the Environment: State, Effect, and Response Uncertainty	Three Types of Perceived Uncertainty About the Environment 1. State Uncertainty (or Perceived Environmental Uncertainty) - one does

Area	Authors	Paper	Key Concepts
			not understand how components of the environment might be changing 2. Effect Uncertainty - an inability to predict what the nature of the impact of a future state of the environment or environmental change 3. Response Uncertainty - uncertainty is experienced in the context of a need to make an immediate decision.
Identity	Hoang & Gimeno	Becoming a Founder: How founder role identity affects entrepreneurial transitions & persistence in founding	Organizational founding involves role transition
	Ibarra	Provisional Selves – Experimenting with Image & Identity in Professional Adaptations	People adapt to new roles by experimenting with provisional selves that serve as trials for possible but not yet fully realized professional identities
	Pratt, Rockmann and Kaufmann	Constructing Professional Identity: The role of work and identity learning cycles in the customization of identity among medical residents	1. Identity work focuses on individual's active construction of identity in a social context 2. Identity customization is reinforced through social validation
	Jain, George & Maltarich	Academics or Entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity	Creation of hybrid role identities and the mechanisms deployed to facilitate salience of their hybrid roles
	Kyratsis, Atun, Phillips, Tracey and George	Health Systems in Transition: Professional Identity work in the context of shifting institutional logics	Changes in professional logics lead to identity threats successful reframing requires addressing these conflicts through adoption of identity work

Our research will seek to better understand how & when does the scientist researcher identify a potential opportunity, the nature of uncertainty associated with the opportunity and what factors influence the scientist entrepreneur to act on the opportunity by identifying it as an opportunity for himself. We try to understand if it is possible to identify researchers who are likely to participate in creating a spin off and facilitate the process of transition from a research environment to a startup environment. What factors would influence these transitions and how can we develop a support system that will enable these transitions. If this was possible – it would facilitate the creation of RBSUs and the process of commercializing technology

The research will focus on specific themes developed from existing research around the following areas

1. How do scientist researchers identify opportunities and the role of prior knowledge related to their research and technology in identifying these opportunities?
2. How do scientist researchers engage in a recursive process of sensemaking around these opportunities? What uncertainties arise from this process of sensemaking?
3. What activities does the scientist researcher engage in to reduce the uncertainties around the opportunity?
4. What influences the scientist researcher to act on the opportunity, when does s/he become willing to bear the uncertainty around the opportunity?

Research Methods

The research was conducted in two stages – stage 1, included a set of interviews that sought to identify the motivations and the identities that the researchers associate themselves to and the actions that they undertake when an opportunity is presented to themselves. Stage 2, of the research uses the findings from stage 1 to reach out to a larger pool of researchers to better understand the ecosystem effects on these researchers decision to join a RBSU.

This research focuses on scientist researchers who worked on projects that resulted in spin-offs or had the opportunity to result in a spin-off. Some of these scientists have become entrepreneurs, while other have taken supportive roles with the spin-off while retaining their primary roles as a scientist and some others have decided against joining the spin off. The structure of this research addresses the subjective nature of both the uncertainties and the responses made to these uncertainties by the scientist, as a result two individuals working on the same research project may have a different set of uncertainties and responses resulting in differing outcomes.

The research focused on projects that received the Innovation grant funding provided by SMART (Singapore MIT Alliance for Research & Technology) over the last 10 years. The Innovation grant is a Proof of Concept grant that is provided to research projects where the technology has been identified by a panel (comprising of technology entrepreneurs, venture capitalist, industry representatives and scientific reviewers) as having the potential to spin out. These projects are associated with different parent organization which may be academic institutions or research agencies (MIT, A-STAR, NUS & NTU), and their members have multi-cultural backgrounds. The study provided us with a unique opportunity to gain an understanding

of how the different scientist-researchers responded to opportunities that arose as an outcome of their research or opportunities that they became aware of due to their position and access within a research organisation. It further explored how they interacted with the opportunity and the uncertainties around them and sought to understand their decision-making process on the creation and joining a RBSU as an outcome of their interactions with these opportunities. It sought to identify whether the uncertainty around the opportunity and their responses to the uncertainty was subjective in nature.

The study involved in-depth interviews with 28 scientist researchers and scientist entrepreneurs in semi-structured format for about 60 min each with the option of follow on questions and responses over e-mail or in the form of a short interview. The Interviews were recorded and supported through notes made by the interviewer.

The interview followed an open ended enquiry format that focused on obtaining responses from the scientist researchers in the following areas (1) Interviewee background (2) Background to the scientific project – its establishment and how the participant joined the project (3) The scientist researchers were asked to describe their role as a researcher in the project and provide details of the sets of activities they engaged in as a researcher, what were their perceptions of their role and how did they feel about being a researcher, how did they compare themselves to others in the system and what motivated them to become a researcher, who did they interact with on a regular basis and what were their relationships with others they came in contact with professionally (4) How and when did they (participant) on the project identify a potential opportunity for the technology they were working on, how did they feel about the opportunity and what were their personal views on the opportunity, did it evolve over a period of time from when it was first noticed

to the current situation (5) Did they (participant) undertake any new sets of activities as a result of identifying the opportunity, what were these sets of activities, who did it involve and how was it different from the sets of activities that they were carrying out as a researcher, was there a change in their perception of what they were doing as compared to their role as a researcher, were they comfortable with the change in role and what were their perceptions of this new role, how did it change their interactions with others and how did they view them, how did these changes compare with the changes that other researchers (6) How and when did they decide that this opportunity was worth/not worthy of pursuing for themselves, what where the drivers of this decision, how did they feel about this decision, did this lead to a change in their perception of who they were, what was their role in the project now and how did this change from the role at the time of joining the project, what were the set of activities that they engaged in and who did they interact with as a part of this role, what were their feelings about the changes in their role (6) lastly what were their views on the commercialization and creating a spin out and the role of the eco-system.

Data was tagged using descriptive labels and then through an iterative process of identifying similarities and differences developed into categories. The process sought to identify categories, negative cases and opposites until we have a set of detailed and differentiated categories.

The interviews were followed by a larger survey of researchers, and scientist entrepreneurs. The interviews identified three types of orientations that described scientist entrepreneurs and their approach to creating an RBSU. The purpose of the survey was to better understand these orientations and the factors that would influence the scientists to create an RBSU.

We developed the questionnaire around a scale first created for career orientations inventory which sought to identify factors around autonomy / independence, security / stability, technical – functional competence, general managerial competence and entrepreneurial creativity (Schein, 1987) this questionnaire designed to assess an individual's career interests, career values, and career motivators was later modified by Petroni, A. (2000) to look at career development of R&D staff and included additional variables around service or dedication to a cause, pure challenge and lifestyle. Our scale modified the one used by Petroni, A.(2007) by removing questions that were exclusively related to the starting of a business in the entrepreneurship area (3 questions) and replacing this with three additional questions one related to service for a cause and two others related to creating value around the work that they do. The final questionnaire had the same number of questions as the original scale (twenty-five) and the responses were graded on a five point Likert scale ranging from not at all important (1) to extremely important (5) as was done in the original scale.

We decided to include a separate set of questions around entrepreneurial orientation that was modified from Lumpkin and Dess's (1996) original five EO variables (innovativeness, willingness to take risks, proactiveness, competitive aggressiveness, and autonomy), the modified scale by Bolton and Lane (2012) which had three distinct factors (risk-taking, innovativeness, and proactiveness) as measured by their ten-item Individual Entrepreneurial Orientation which demonstrated reliability and validity was used for our survey and the responses were graded on a five point Likert scale that ranked each question from strongly disagree (1) to strongly agree (5). The survey captured demographic data around gender, age, qualification, marital status, employment status, family and financial status. Additionally, we sought to understand the

influence of some of the factors identified during the interviews on the preference of these individuals to license out the technology versus creating a RBSU. These factors included the effects of training and internships, access to entrepreneurs and the attendance to events including networking events. The questionnaire used for the survey is included as part of Appendix 1

The survey was mailed out to a total of 483 targeted contacts that included scientist researchers, scientist entrepreneurs & scientist employees at RBSU's – the targeted contacts included a database of scientist researchers at SMART, a database of scientist researchers who had received SMART grants and the participants to the interview carried out earlier, in addition the survey was also shared with other institutions like A-STAR, National University of Singapore (NUS) and Campus for Research Excellence And Technological Enterprise (CREATE) community. A total of 119 responses were gathered and 104 responses were considered for the analysis.

A regression analysis was carried out to establish validity of the factors relating to the independent variables around the different orientations and the moderating effects of the factors around training, access to entrepreneurs and events on their decision to spin off versus licensing their technologies.

Research Findings & Analysis

Qualitative Survey

The qualitative research involved interviews with 28 researchers across two categories, the first category comprising of 11 individuals comprised of scientist with experience of working with an RBSU, these included six first time entrepreneurs / employees with RBSU's, three scientist entrepreneurs who were a part of their second RBSU and two scientist who had decided to come back to play a role in a research institution after they had an experience of being a part of an RBSU, the second category comprised of seventeen individuals, scientist researchers who were still involved in their research role at a research institution.

The research was structured to capture snapshots of their experience as a researcher, and included aspects relating to their interests, motivations and actions that led to their decision to start their careers as a scientist. The interviews then sought to explore how they interacted with opportunities that were presented to them as a part of their interactions with others in the research environment or directly as a part of the projects they were part of and the activities they engaged in to understand these opportunities and their decision to participate in them.

We found that the research roles were nuanced – with some individuals participating in the research process being involved in other activities, we identified four such distinct roles played by individuals during their stint in a research group these included being a scientist / researcher, engineer, undertaking project management & administration roles and playing a role in commercializing the technology.

The categorization of scientist with experience in working with a RBSU and those without do not reflect the aspirations and motivations of these individuals and are only a

snapshot of their current state in their journey towards achieving their career goals. The analysis of the interviews across both categories led us to identify three orientation types based on the dominant aspirations of the researchers. These orientations are not defined by the career roles that the individuals are performing, there were scientist who had joined a startup – but their choice was driven by a career preference rather than an entrepreneurial drive, we identified impact oriented scientist working on technologies who were driven by science, they had a deep sense of ownership around the technology and were willing to take an entrepreneurial route to ensure that the value created by the technology was captured, we also identified scientist who had a clear entrepreneurial orientation who sought to discover opportunities by leveraging their understanding and access to technology. The reorganization of the categories along the lines of the orientation led us to a much finer understanding of these individuals. We had six entrepreneurially oriented (EO) individuals two who were working for the first time at a RBSU, three second time entrepreneurs – who were starting their second stint by spinning out technology from a research institution and one scientist researcher who clearly was waiting to identify the right technology that he could spin out. We identified eight impact oriented (IO) individuals, seven of whom were still researcher working on technologies that they were personally involved in developing (in that they were the primary researcher on these technologies) while one of these individuals was working at an RBSU – but her decision to move to the RBSU was driven by the potential impact that the RBSU would make in an area that was important to her personally. We also identified fourteen career oriented (CO) individuals three of whom were first time employees at an RBSU, two who had an RBSU experience but decided to return to pursue a career in research and nine researchers whose preference was to continue in a

career at a research institution or a larger organization in their area of expertise. While we have identified three different orientations – all three categories of individuals start from a deep interest and understanding of their domain and their orientation in any of the three directions is rooted within or around this domain.

The entrepreneurially oriented (EO) scientist clearly sees research as a means to entrepreneurship while the impact oriented (IO) scientists see entrepreneurship as a means to creating impact around the technologies that s/he has been working on and the career oriented (CO) scientist seeks to continue to invest and develop their careers in institutions that provide stability and security around their areas of expertise. Individuals in each category have defining characteristics that separate them from the other these are summarized below

Entrepreneurially Oriented Scientists

EO scientists typically have an early realization of their interest in entrepreneurship, this manifests early in their university days and for some even earlier in their school days, this realization of their interest in entrepreneurship seems to be linked in some manner to the diversity of their experiences especially international exposure to cultures and situations very different from where they grew up, this exposure seems to drive their curiosity and the need to constantly explore. In addition these individuals also have been exposed to entrepreneurial training and / or internships early in their student days, the fact that some of their international experiences are also linked to their internships may add to the alignment of these two factors amongst EO individuals. While EO individuals clearly operate in their domain of expertise, they

are not wedded to creating an RBSU around the technology they developed, they are comfortable in adopting technologies that are more ready then theirs or may have a better opportunity in commercialization. They leverage their networks seeking support at different times for raising funds or better understanding of how to engage in a particular situation, this enables them to explore roles outside the area of research & technology within the RBSU as they are open to and willing to learn as they perform these new roles.

We identified six characteristics of those who had entrepreneurial orientation these are described below with an example of the responses from one of the entrepreneurially oriented scientists. A more detailed table of responses is included as Table 2 in Appendix 2.

(1) These individuals were exposed to diversity of experiences – especially international exposure, this exposure as a part of their growing up / student years, some of them choose to consciously move out of their homeland. While some of this exposure occurred during a phase when they did not have a choice – many decisions they madfe in obtaining this experience was by choice as described by a researcher who was searching for the right opportunity *"At age 12 my parents decided to rip me out of that community and environment and make a move to Phoenix, Arizona. I thought it was the end of the world at the time. Looking back on that I couldn't be more grateful for that move. Because it really snapped me out of my comfort zone…I participated in that program and organized my own internship at a Chemical Engineering Laboratory, the state key Chemical Engineering Laboratory at Tshingua University…I thought that I needed to make it another change to continue to grow and move on. I ended up getting a postdoc / fellowship from the Brazilian government in Rio de Janeiro"*

(2) They had exposure to entrepreneurial training, internships and access to entrepreneurial networks – they had early exposure to entrepreneurship through either courses or internship during their university or pre-university days these jobs while not being entrepreneurial helped them develop an understanding of business and develop networks that they would leverage later on *"I got like, some intern job. Like I basically looked at actually how people apply their, the tools that they provide within academic research. And I wrote marketing material. And so I bought down a lot of scientific articles to marketing material."*

(3) An early realization of interest in entrepreneurship – these individuals had developed an early interest in entrepreneurship during their time at school & university – these experiences seemed to influence their choices in the direction of entrepreneurial effort as described by a scientist who was reprising their second role as an entrepreneur *"But realistically, during that time (doing Phd at UC Berkley), I was already involved with startup companies, I was interning in various companies, I had a pretty good idea of how it works to run a company out of academia…towards the end of my PhD, it became more and more clear, while nothing is stopping me from pursuing, an academic career. But that's not where my heart is, because I was juggling various responsibilities, organizing various entrepreneurial clubs and conferences and things"*

(4) They were opportunistic in their approach towards identifying technologies that could be commercialized and were not wedded to technologies that they were developing themselves seeming to indicate they were driven by their interest in entrepreneurship and the ability to realise an opportunity more than the technology that they were developing –

"I was open to whatever and I thought there was room for innovation and, you know, whatever you did, Obviously, I had my own particular interests, but I wasn't gonna let those cloud whatever opportunity came up"

(5) These individuals had an openness to working in new areas they were not rooted to their area of expertise, they focused on acquiring whatever skillsets were required to ensure that a job that need to be done got done *"Now, this idea that big data is going to be part of our research, we cannot be doing things by hand manually, one by one anymore, everything has to be done on a large scale and automated for us to achieve optimal results. So learned that under the PhD, and even in Brazil, so that was skill set. I'm not a computer scientist or an electrical engineer, by far. But I realized that that was a skill set that I probably should have focused on earlier on in my career."*

(6) They focused on developing and leveraging their network of connections both at the individual level and within the ecosystem. *"So The ex-colleague, so basically ex colleagues who I have built a rapport with know me, one or two advisors, they recommend these advisors to ask to engage….They know about business and know about MedTech sales and business. So it is a good opportunity to get to know these people and learn from them as well."*

Impact Oriented Scientists

In the case of IO scientists we found that they are motivated by the allure of science and research – they choose their careers due to their interest in research, these scientist have invested

time and effort in developing technologies in new areas and want to see their work create an impact in society. Their inherent strengths in science and research make the move away from research a difficult choice, this decision to move towards creating an RBSU and entrepreneurship is a means for them to ensure that the impact of their technology is not lost to the world, they are taking on the responsibility of making sure of this. They engage with different groups of people including participation in training programmes (bootcamps) around entrepreneurship and start-up competitions to get feedback on their technology and get a sense of the potential impact it can produce and as their confidence in the impact their technology can create grows they look towards understanding what is required to create an RBSU. These individuals have a clear sense of their inherent capabilities they understand their limitations around the experience and knowledge to create a spin out, however they are open to learning in areas that contribute to the process of ensuring impact creation for their technologies, to this end they engage in multiple activities to bridge the gap between their current role as a scientist and the capabilities required for a role in an RBSU. They attend training programmes (bootcamps) around entrepreneurship and start-up competitions, and startup networking events to get feedback on their approach and actively seek out mentors to help guide them through this transition stage and provide guidance in starting out. They also use the training programmes and networking events to seek out partners who bring in complimentary skills or take on more of the technology role while they develop business skills – they seek to build a team with whom they can collaborate to start the RBSU.

As in the case of the EO scientist we identified six characteristics of those who had impact orientation these are described below with an example of the responses from one of the

impact-oriented scientists. A more detailed table of responses is included as Table 3 in Appendix 2

(1) They are scientist at heart, their initial motivations are driven by their allure of science and research, they choose their careers due to their interest in research *"when I was an undergrad, I knew all that I wanted to do a PhD. Because back then I was doing a bachelor in science. And I know that with a Bachelor of Science, you probably can't get any, anywhere if you want to teach and that so the options is limited. And I'm interested in learning about the unknown, exploring how the world works, in general. And, and I'm particularly interested with biomolecules, in protein structures. So that pretty much prompted me to go to the US to pursue my PhD"*

(2) To them creating an impact in society from the work they do is what propels their research, the process of entrepreneurship is a mechanism through which the impact of their technology is brought to society *"I've never wanted to be an Academic to begin with, I always focused on how I can make something that I've discovered or have used. And by being professor or Academic, I will have to spend more times in teaching. Right? Yeah. So, to me, that wouldn't help in my goal. And I think what is the most rewarding One is to have therapeutics that can save life, Right? ... we both believed that if we were to do something, do something big, It will be saving lives. And the impact has to be there for the society. I feel like this is possibly one of the greatest reward to say, we worked on that we delivered it to people, right and we see the application and the utilization of our technology, by, people, by company by government whatsoever. So that's what I mean by the entrepreneur. "*

(3) They are constantly seeking to learn, specifically in the context of gaining abetter understanding of what it takes to bring their science to the world - *"my own (exposure) in the Innovation Center 360-degree bootcamp. Okay. And then? Well, I think, to me, this was very clear that I was exposed to things that I was very interested in without never having put my finger on it, which was, Oh, those guys are trying to help people researcher, translate the research from companies spin off, etc. in the marketplace*

(4) They actively seek out mentors and reach out for advice and guidance in areas related to entrepreneurship- *"She's a CEO she's a co-founder of one biomed company, so she developed, sort of, this whole point of care device for detection of TB. She doesn't have an engineering background, too. So I talked to her a lot that I was a biologist and not an engineer, so I don't know how I fit here, but she was a chemist. who became head of department, and she got this technology, and she's spun it off. I mean, she goes through the same path as me, and same struggle but she overcame it and she actually has a spin off. Yes, she inspired me a lot…. I would say my relationship with her is more like friends"*

(5) For them stepping out of research has to be for the right reasons – the choice of the opportunity they want to work on and the move to entrepreneurship is a decision they do not make lightly. If they believe that the opportunity presented to them will not help them create the kind of impact they desire they would rather stay back and continue to develop the technology to ensure that potential impact for the technology is not lost - *"I really think to me the line to be drawn is on this right? What is this spinoff going to achieve? And what, as a person what do I want to make out of that achievement? And in a very,*

very simplified scenario of a platform technology that does application number one, and this application number one is low on the excitement level. Right, then I may take a limited participation into the first spin off. While my strategy would be, I want to still be close enough to learn from what's going to be this venture experience? Yeah, but maybe the application number one in the venture that is formed around application number one, is also the one that is going to make application number two, then I want to be part of it. Because I want to be here on the ability to go for the least exciting, if it's a prerequisite step to the most exciting, okay, that's what I'm trying to okay. But if it's like, if those are dissociated, then I'm still like, okay, now I'm going to wait, just one I want to jump on is the one that I'm super excited by"

(6) They don't believe that they can do it all and they believe that a good team with complimentary skill sets is essential in spinning out a technology - *"but I think more importantly, will be a sort of team that eventually will be able to perform? Because currently it is only me. It will not be the right strong team if you do not have different capability, there should be a few members with complimentary skills. So actually, that will be the top (priority) How the hell do I find the right co founder? "*

Career Oriented Scientists

The CO scientists like the IO scientist are driven by the interest in science and research their choice of a career in an area is driven by their inquisitive nature and their love for discovery of new things. They feel a need to stay in their area of expertise and hesitate to move out of their

comfort zone. They seek stability and security in their career prefer staying in a research institution or working with larger organizations in a research role, they see an academic career as a natural progression where they can continue to pursue their interest in research. They continuously engage in learning to progress their career and are willing to explore areas outside their domain if it helps them in taking their career forward. Their interest in a career at a RBSU has to be seen from the context of creating additional opportunities to develop their career and is viewed as a learning opportunity as against an entrepreneurial opportunity by the EO scientist and an impact opportunity by the IO scientist. When they seek to step out and look at a role in an RBSU, it is done in the context of the background and experience of the founders of the RBSU's and whether these founders were a part of the CO scientist's network and the nature of their prior experience with these founders.

As in the case of the EO and IO scientist we identified six characteristics of those who had career orientation these are described below with an example of the responses from one of the impact-oriented scientists. A more detailed table of responses is included as Table 4 in Appendix 2

(1) They sought out a career in science and research due to their deep interest in the space, driven by their inquisitive nature and their love for discovery - *"Professor in microbiology department, said that she was interested to see me. So, I came to the interview, she told me that she can take me for like part time kind of internship. Starting like immediately. right, so that's when I got the first exposure to like the actual research and the actual work, and I stayed with them for three years when I finished (studies) I*

still continued work in junior researcher in the same lab but full time (I) loved research. And that's the natural progression for a researcher."

(2) They are focused on developing their career either by continuing research or moving to academia or a role in industry - *"I flip flop between quite a few different scenarios. Every week, I think it changes from one to the other, My two options that I'm looking at, are either to go into a bigger company, where I can learn the commercial side, from people and understand all of the different business units .... I'd like not fitting into a particular role, It's that I don't have the industry experience for a higher band, right. But most of the feeling is that I would be too frustrated in some of the lower roles"*

(3) They view startup opportunities through the lens of career development and the motivation for joining a RBSU stems from the potential learning opportunities it provides towards the development of the career - *"Frankly speaking, I think taking on more, more kind of leading role is not very comfortable at the beginning. But it is a very interesting and very nice experience for me to pick up. So for now I prefer to stay in this so my plan is to try to stay and focus at a more technical perspective. In terms of business Definitely, I need to learn, I think, to be in a spin off is the opportunity to learn all different areas"*

(4) They opportunities to join a startup are evaluated in the context of the risk involved in working with people they do not know and the trust they have in the skill of these individuals positive prior experiences with these individuals have a favorable impact on their decision making – "*So not only do I know, the team, but I knew the team, they are good workers. I trusted the (CEO) he was a good leader. So I spend some time with him. We went to a medical conference together. I spent some time with him. He has integrity. I*

trust that make sense. I think that was one of the great things for me. I knew things. I knew the professor who was in charge of this project. And I knew all of them, I trust that sense is quite a bit of faith."

(5) They are not very comfortable in undertaking activities that will destabilize their feeling of security and current lifestyle and seek to ensure stability in this area - *"naturally the first thing is the remuneration, is it appropriate, because otherwise you require a change in your lifestyle and something, and the other one is. how much time does the work take, like sometimes is it a nine to five job and your evenings and weekends are really free, sometimes is a nine to five job but then you get so much work look there you have to work for the work on the weekends. Right. Yeah, I'm expecting a baby soon. Okay, so I don't think I can put in as much hours as I did during my PhD already. Sure,so, I will need to set time aside for my wife, my baby. Yeah, so I would say number one is probably the financial and then the second is the work life balance"*

(6) They need be assured that they can perform in a new role and prefer to stay in their area of expertise - *"I don't have the skills for a startup, because I've never done it before. Right. So and then I know that it will be so different from the past experience I have here and in the university. So, I feel that that's the one part that I'm not sure if I will be able to do something expected to have a startup"*

Sensemaking & activities towards mitigating uncertainty

To better understand how these scientist – researchers engage in the process of sensemaking around the opportunities, we take a deeper look at how they engage with research & technology, the opportunities that arise from them and the activities they engage in as their interaction with the technology and opportunity develop. We get a better understanding of how they personalize these opportunities (McMullen and Shepherd, 2006) and how they act on them (Mitchell & Shepherd, 2010) based on their confidence and competence (Kruger, & Dickson, 1994, Mitchell & Shepherd, 2010).

We find that all three categories of scientist are rooted in their love for science and research – they are inherently drawn to a process of exploration and discovery, however as their interactions with the domain and their exploration develop – their engagement seems to evolve and the lens with which they view developments in their area of work differ, in the case of the EO scientist they are not solely focused in their own area of research, but seem to constantly engage in a broader scan of technology development in domains that they are comfortable with. This broader scan is coupled with their active seeking of potential market opportunities that these technologies can be put to use for. They are in a sense following the process of actively discovering opportunities in the market for technologies that they have access to, they put to good use their prior knowledge of their domain (Shane, 2000, Eckhardt, & Shane, 2003) and the asymmetric information (Hayek, 1945) they have access to, due to their proximity to the state and stage of development of the technology identifying entrepreneurial opportunities that can be generated through technology change (Sarasvathy, 2001). The evaluation of the entrepreneurial

opportunity occurs by mapping the state of readiness of the technology and their ability to bring that technology to address the market opportunity. The IO scientist too discover entrepreneurial opportunity through a similar process to that of the EO scientist, however their scan of the technology landscape is limited to the technology they are working on, the IO scientist evaluation of the entrepreneurial opportunity occurs through the lens of the impact that this technology would create in the market – even while evaluating the different market opportunities available for their technology, their choice of opportunity is made by the potential impact that the technology can make in society in the context of that opportunity.

While the EO scientist would tend to evaluate multiple opportunities and decide on a course of action that is based on the optimum path to the market, the questions they ask revolve around whether the technology is ready, does the market have a real need for this technology, how big is this need and can they generate support from the eco-system through investments and access to potential customers for that opportunity. The IO scientist in contrast pursue an opportunity that ensures that it delivers the maximum impact for the technology that they are working on. They are driven by answers to the question of which opportunity should they apply their technology to ensure maximum impact for society.

Similar to the EO & IO scientist – the CO scientists also has a deep connect with the science and research around their domain, however in contrast to the decisions made by the EO & IO scientist their response to opportunities are through the lens of the affects it has on their career. The questions that they seek to answer are around what is the additional learning that can be gained by participating in the opportunity, are there any risks associated with the same, will it affect their stability and lifestyle. These questions reflect the uncertainty (Lipshitz & Strauss,

1997) around the opportunity, their act of personalization of the opportunity (McMullen & Shepherd, 2006) as the one they seek to act upon arise from the results of the actions they undertake to mitigate them.

The progression from the stage of first identifying the opportunity to the stage where they make the decision to act on the opportunity is a multi-step process involving a constant process of gathering information and addressing uncertainties that arise with this new information. This continuous process helps them build a better understanding of the opportunity (Sarason, Dean, & Dillard, 2006) and is part of the process of personalizing it (McMullen & Shepherd, 2006).

The EO scientists engage in activities that involve the seeking out grants and funding mechanisms for the opportunity they are trying to address, they identify programmes in the eco-system that support projects similar to theirs and attend networking events that may get them access to the resources that are required to act on the opportunity. Their actions are entrepreneurial, and they are focused on bridging the gaps required to act on the opportunity. In contrast the IO scientist seem to be more circumspect the realization that they can act on the opportunity arises as they engage with the eco-system to better understand what the impact the technology can create through a process of participating in start-up competitions, hackathons or participating in entrepreneurial training programmes. These activities help them better understand the gap they need to bridge to be able to act on the opportunity. The process of mitigation of these uncertainties is addressed through a process of identifying mentors, advisors and building a team that has a complementary skill sets to the scientist, they do this by attending entrepreneurial networking events, identifying partners during training programmes and actively seeking out mentors when they attend startup competitions. The CO scientists, in contrast, seek

to ensure that the opportunity does not destabilize their career and lifestyle, their actions revolve around getting a better understanding of the role that they need to play as a part of acting on the opportunity, who are the other participants in the process of bringing the opportunity to the market and whether their participation will help them grow in their career. Their decision to act on an opportunity is largely driven by who the participants in developing the opportunity are, whether they have worked with them before and if their trust in them. The table below provides a consolidated view of the sensemaking process followed by the different types of scientist as they build on the interaction between the technology and the opportunity.

The shift for a scientist from playing a role in the research institution to one at an RBSU does not always involve a shift in their identity, as can be seen EO scientist are already playing an entrepreneurial role, their role at the research institution is not around research alone but an active engagement in identifying and validating opportunities, they then seek to assemble resources around the opportunity to execute on the same. Similarly CO scientist engage in a role that allows them to develop their careers on a path that remains in their area of expertise, so while there is a change in the organization they work for and there may be minor changes in the actual set of activities they engage in, these roles are aligned along the career trajectories that are available for a scientist – researcher.

In summary we show that scientist have different orientations and their orientations play a role in how they engage with entrepreneurial opportunities, the personalization of an opportunity occurs through a process of sensemaking based on their orientation and the actions that the scientist undertakes to reduce the uncertainty is guided by their orientation and the

scientist makes a transition to the RBSU if they have personalized the opportunity and reduced the uncertainty around the opportunity.

We created a model to identify the effects of some of the ecosystem factors discovered through the interviews in the areas of education, access to entrepreneurs and networking on scientist based on their orientation and the potential of creating a RBSUAs a next step we wanted to explore the ecosystem effects on orientation and how they influence the creation of a RBSU.

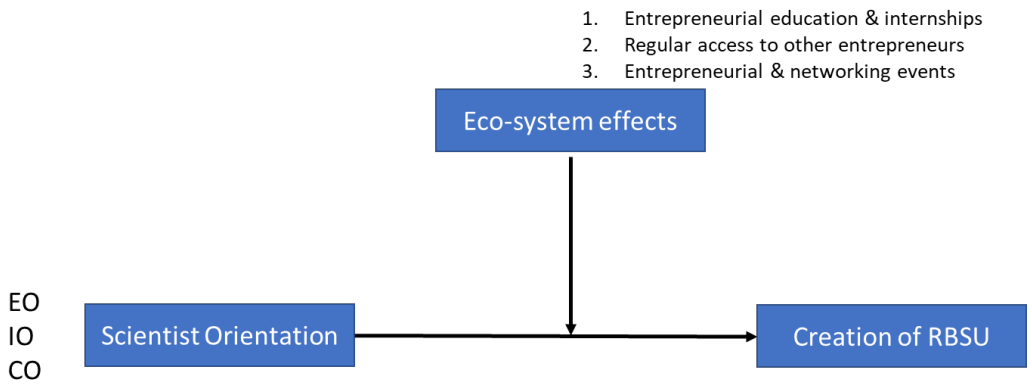


Figure 3: Model - Ecosystem effect on scientist orientation & the creation of RBSUs

We undertook a survey with a larger audience of scientist researcher and entrepreneurs to better understand these effects

Quantitative Survey

The quantitative survey analysed responses from 104 researchers across two categories, the first category comprised of scientist with experience of working with an RBSU, and the second involved scientist who were working within the research institution. The survey sought to better understand the factors that contributed the orientations of the scientist and the factors that

could influence their decision making in creating a spin off. We used a modified instrument developed to identify career orientation amongst researchers and practitioners in the information services field. This instrument was a derivative of Schein's career anchors (Igbaria & Baroudi, 1993). The instrument had a total of 25 questions – 3 questions related to entrepreneurship were removed and 3 new questions related to impact orientation were introduced. We included another scale for Individual Entrepreneurial Orientation (10 questions) that identified 3 distinct factors and had demonstrated reliability and validity (Bolton & Lane, 2012).

The survey results were analysed to check for internal validity and reliability and to identify the different factors that contributed to the types of orientations. We found that the EO scale had a Cornbach Alpha of 0.822 across the 10 questions selected, and they produced three factors similar to the original scale, the factors identified under EO are shown in the table 6 below. While the factors identified were similar they had very different set of scores when compared to the original study, we felt that this was a result in the difference in the audience to whom the survey was administered,; the original study was administered to a student sample. We modified the labeling of these factors slightly differently from the original factors to better represent the audience and the difference in scores.

Table 6: Factors identified for Entrepreneurial Orientation

Q.N.	Questions Related to Entrepreneurial Orientation	1 (Experimentation)	2 (Planning)	3 (Conservatism)
1	I like to take bold action by venturing into the unknown	.506	-.387	.282
2	I am willing to invest a lot of time and/or money on something that might yield a high return.	.571	-.374	.251
3	I tend to act "boldly" in situations where risk is involved	.669	-.362	.183
4	I often like to try new and unusual activities that are not typical but not necessarily risky	.599	-.142	.383
5	In general, I prefer a strong emphasis in projects on unique, one-of-a kind approaches, rather than revisiting tried and true approaches used before	.696	-.061	-.458
6	I prefer to try my own unique way when learning new things rather than doing it like everyone else does	.684	-.125	-.451
7	I favour experimentation and original approaches to problem solving rather than using methods others generally use for solving their problems	.758	.091	-.460
8	I usually act in anticipation of future problems, needs or changes	.600	.532	.288
9	I tend to plan ahead on projects	.571	.613	.153
10	I prefer to 'step-up' and get things going on projects rather than sit and wait for someone else to do it	.535	.236	.147

We identified three factors aligned to the original three identified by Bolton & Lane, however our labeling of these factors took into consideration the current roles of the respondents and the variances in the scores with respect to the original scoring. The original scoring identified questions 4-6 as factors related to Innovation, we relabeled these factors as those related to Experimentation given the background of the respondents and the process of experimentation being integral to the daily process of what they do. Questions 8-10 where

identified as factors that contributed to Proactiveness, we relabeled these factors as being more related to Planning, especially so due to the lower score related to Q-10 (I prefer to 'step-up' and get things going on projects rather than sit and wait for someone else to do it). The third set of factors in the original survey related to Q 1-3, and they were identified as factors that relate to the individuals ability to take risk. These factors while being present are rather subdue in the responses from the surveyed audience and could reflect a sense of conservatism in their approach towards a decision towards the move to the entrepreneurial pathway.

For the analysis of Impact orientation we used three questions related to service factor from the original set Schein's career anchors and three additional questions prepared by us to that were related to creating impact. We found that the IO scale had a Cornbach Alpha of 0.741 across the selected questions and two clear set of factors were identified. These factors are listed below

Table 7: Factors identified for Impact Orientation

Q.N.	Questions Related to Impact Orientation	1	2
1	Using my skills to make the world a better place to live and work in is	.835	-.241
2	Being able to use my skills and talents in the service of an important cause is	.899	-.025
3	I want a career in which I can be committed and devoted to an important cause	.823	-.115
4	It is important that the work I do results in benefits for society at large	.803	-.157
5	It is important that the work I do results in commercial value (generates revenue)	.248	.865
6	It is important that I get a share of the commercial value generated by the work I do	.265	.867

We identified two sets of factors, factor one relating to Q1-4 in the table above relate to the creation of societal impact, while factor two relating to questions Q5-6 in the table above relate to the creation of commercial impact.

In our analysis of the responses we identified eight questions that related to career orientation from the original Schein's career anchors that had internal validity and reliability. These questions had a Cornbach Alpha of 0.691 and resulted in the identification of 3 factors that best described career orientation amongst scientist- researchers, these are shown in the table below.

Table 8: Factors identified for Career Orientation

S.N.	Questions Related to Entrepreneurial Orientation	1	2	3
1	An employer who will provide security through guaranteed work, benefits, a good retirement program, etc., is	.544	-.120	-.744
2	An organization that will give me long-run stability is	.711	-.218	-.497
3	Developing a career that permits me to continue to pursue my own life-style is	.562	-.539	.273
4	A career is worthwhile only if it enables me to lead my life in my own way	.579	-.321	.562
5	Choosing and maintaining a certain life-style is more important than is career success	.685	-.249	.210
6	Remaining in my specialized area as opposed to being promoted out of my area of expertise is	.527	.618	.027
7	Remaining in my area of expertise throughout my career is	.450	.716	.097
8	I will accept a management position only if it is in my area of expertise	.426	.541	.180

We identified three factors that related to the career orientation amongst scientist researchers, factor 1 relates to Q 1 & 2 from the above table relate to career stability, factor 2

relates to Q 3-5 and they highlight the need to pursue their individual lifestyle, however this seems to be in contrast to the scores for stability, perhaps indicating a struggle between the need for career exploration and progression which brings pressure on stability, factor 3 relates to Q 6-8 and they indicate a preference for domain centrality wanting to remain in a role around their area of expertise.

We then carried out a regression analysis to identify factors that would influence the scientist researcher to create a spin off , for this analysis The questions relating to the factors identifying EO, IO and CO were retained as the independent variables (IV) while the question related to their preferred action of licensing versus the creation of a startup on the Intellectual Property (IP) created from their research was identified as the dependent variables (DV). The regression was run using age, educational qualification, marital status, number of dependents, year of work experience and financial stability as control variable (CV). The regression sought to identify the effects of training & internships, access to entrepreneurs and entrepreneurship and startup networking events on the IV in relation to the DV. The regression (table 9) generated shows that both training and internship and access to an entrepreneur does not have any affect on the decision of the EO, IO or CO scientists in influencing their decision to create a spin out using their technology, however attending entrepreneurship and startup networking events had a moderating effect on IO and CO scientist, however it did not show any moderating effect on EO scientists.

Table 9: Regression analysis results

	DV - Creation of a Spin off								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Age	3.824	5.629*	5.317*	6.018**	6.269**	5.996*	6.524**	4.900	12.210**
	(2.427)	(2.979)	(2.996)	(3.065)	(3.161)	(3.129)	(3.218)	(3.634)	(5.275)
Educational Qualification	-1.266	-1.874*	-1.823*	-2.096*	-2.869**	-1.894*	-2.504**	-2.867**	-4.476**
	(1.005)	(1.113)	(1.108)	(1.142)	(1.313)	(1.129)	(1.210)	(1.442)	(1.781)
Married	0.829	1.797***	1.693**	1.957***	1.951***	1.855**	1.934**	2.466***	3.859***
	(0.552)	(0.697)	(0.699)	(0.756)	(0.737)	(0.744)	(0.759)	(0.857)	(1.251)
Dependents	-0.679	-1.678*	-1.619*	-1.721*	-1.511	-1.760*	-1.413	-2.017*	-2.613*
	(0.767)	(0.885)	(0.903)	(0.923)	(0.947)	(0.968)	(0.937)	(1.105)	(1.482)
Work experience	-1.203	-3.223*	-2.892	-3.915*	-3.895**	-3.421*	-3.970*	-3.379	-8.795**
	(1.485)	(1.833)	(1.853)	(2.004)	(1.963)	(2.007)	(2.070)	(2.323)	(3.686)
Enough money to support self and family	-0.052	-0.171	-0.283	-0.227	-0.415	-0.371	-0.175	0.225	0.737
	(0.661)	(0.756)	(0.779)	(0.778)	(0.807)	(0.802)	(0.788)	(0.959)	(1.209)
Have savings for a rainy day	0.545	0.298	0.110	0.302	-0.293	0.022	0.446	0.267	1.273
	(0.708)	(0.788)	(0.810)	(0.821)	(0.852)	(0.823)	(0.849)	(0.966)	(1.264)
Have excess funds for Investment	-0.125	-0.120	-0.239	0.028	-0.493	-0.461	-0.341	-0.536	-1.255
	(0.881)	(1.008)	(1.019)	(1.031)	(1.065)	(1.047)	(1.083)	(1.225)	(1.538)
FV_CO_Score_3		-2.655**	-2.547**	-3.045**	-2.525**	-3.679	1.934	3.923	5.294
		(1.172)	(1.165)	(1.228)	(1.204)	(2.579)	(3.378)	(2.731)	(6.019)
FV_EO_Score_1		2.835**	2.887**	3.034**	2.204	0.633	6.946	0.365	7.670
		(1.429)	(1.461)	(1.490)	(1.593)	(3.029)	(5.671)	(2.633)	(11.800)
FV_IO_Score_2		2.665*	2.581*	2.307	2.349	4.951	-2.974	-3.073	-8.635
		(1.543)	(1.542)	(1.595)	(1.571)	(4.056)	(4.435)	(3.007)	(11.612)
Entrepreneurship training & internship			0.312			-0.667			-0.223
			(0.892)			(4.082)			(6.286)
Know an entrepreneur				1.437			2.521		3.736
				(0.917)			(2.902)		(5.763)
Attend Entrepreneurship / start-up networking events					1.611**			-0.908	-3.022
					(0.641)			(2.556)	(5.018)
FV_CO_Score_3:Training & Internship						1.901			25.020***
						(3.676)			(8.477)

FV_EO_Score_1: Training & Internship						4.259			4.362
						(5.093)			(8.122)
FV_IO_Score_2: Training & Internship						-3.745			-28.986***
						(5.932)			(11.127)
FV_CO_Score_3: Know an entrepreneur							-5.994		-16.471*
							(3.667)		(8.906)
FV_EO_Score_1: Know an entrepreneur							-3.858		-9.148
							(5.777)		(11.659)
FV_IO_Score_2: Know an entrepreneur							6.090		21.273**
							(4.811)		(10.734)
FV_CO_Score_3: Startup Events								-8.987***	-15.034**
								(3.240)	(5.869)
FV_EO_Score_1: Startup Events								4.873	6.282
								(3.693)	(5.016)
FV_IO_Score_2: Startup Events								8.189**	16.768***
								(3.859)	(6.478)
Constant	0.014	-1.273	-1.388	-2.035	-0.860	-0.978	-3.019	-0.852	-4.041
	(0.932)	(1.402)	(1.429)	(1.548)	(1.497)	(2.577)	(2.770)	(1.851)	(4.147)
Observations	99	94	92	92	92	92	92	92	92
Log Likelihood	-63.716	-52.449	-51.608	-50.385	-48.183	-51.134	-48.392	-40.244	-30.799
Akaike Inf. Crit.	145.431	128.899	129.217	126.771	122.366	134.267	128.784	112.488	109.598

Note: *p<0.1; **p<0.05; ***p<0.01

The moderation effect of events on IO scientists is positive as shown in figure 4 below, showing an increasing probability of creating a spin off when individuals with increasing scores on impact orientation attend events. These events possibly contribute towards providing access to

mentors and give these scientist opportunities to develop a work identity that is close to an entrepreneurial one before transitioning to a spin off.

Figure :4 Moderation of events on IO Scientists

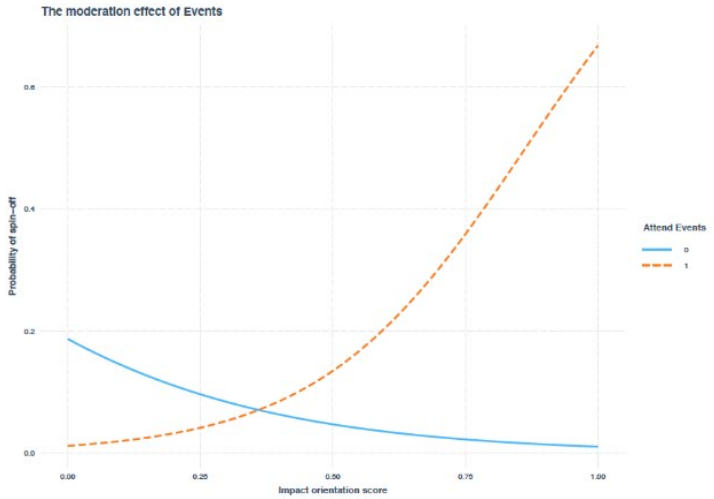
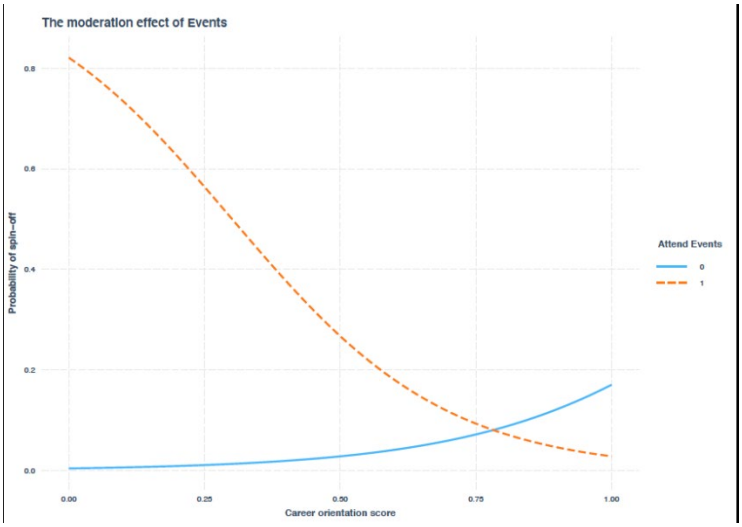


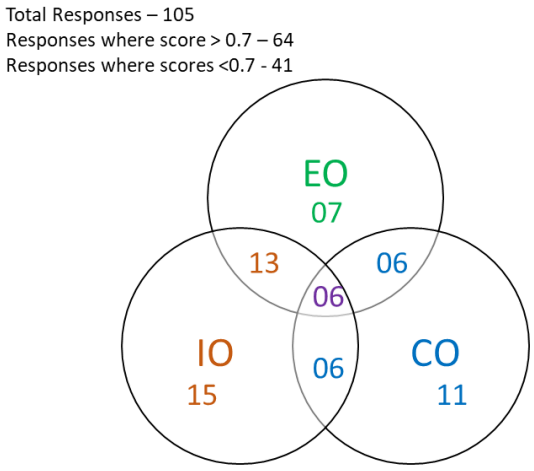
Figure 5: Moderation of events on CO Scientists



Alternatively figure 5 shows the possibility of a spin off increases moderately as career orientation score increases, this could be the result of possible opportunity towards improving or developing ones career. Entrepreneurship & networking events though have a negative moderation effect on Career Oriented Scientist towards creating a spin off, possibly due to these events bringing to the fore varied uncertainties associated with the act of entrepreneurship and individual capabilities required to found a startup, alternatively it could be a case of other career opportunities presenting itself to these individuals and their decision to choose them over joining an RBSU. As increased information becomes available to the career oriented scientist, turn away from choosing a spin out option.

In order to better understand the use of the scales and its ability to uniquely identify the orientation of the individual, we used a factor score of >0.7 to identify individuals with unique orientations, the results are shared in figure 6, we found that out of the 105 respondents to the survey we could separate only 64 individuals as the scores of the remaining individuals were too low to provide for a separation that could uniquely identify them with one or more orientations.

Figure 6: Analysis of Individual Scientist orientation with factor scores above 0.7



We also compared the orientation scores of 23 survey respondents who were also interviewed against the original categorization we had provided. Table 10, below provides details of the original categorization of the individuals based on their interviews and the recategorization made based on their factor scores.

Table 10: Recategorization of scientist orientation based on their factor scores

Total Interviewed – 28
Interviewee + Survey Participants - 23

IO recalibrated			
Interview Calib.	CO Score	EO Score	IO Score
IO	0.409	0.564	0.782
IO	0.107	0.498	0.806
IO	0.882	0.876	0.950
IO	0.544	0.476	0.625
IO	0.490	0.529	0.569
EO	0.906	0.634	0.944
EO	0.189	0.473	0.677
EO	0.410	0.547	0.681
CO	0.492	0.649	0.726
CO	0.560	0.370	0.855
CO	0.539	0.507	0.625

EO recalibrated			
Interview Calib.	CO Score	EO Score	IO Score
EO	0.331	0.897	1.000
EO	0.492	0.742	0.783
CO	0.510	0.730	0.459
CO	0.342	0.759	0.566
CO	0.659	0.741	0.581
CO	0.382	0.681	0.625
IO	0.540	0.543	0.480

CO reclaibrated			
Interview Calib.	CO Score	EO Score	IO Score
CO	0.619	0.321	0.213
CO	0.078	0.326	0.320
CO	0.125	0.152	0.250
CO	0.126	0.489	0.339
IO	0.703	0.442	0.588

We found that of the original 5 individuals who were categorized as having EO through the interview process – only 2 retained a high EO score based on the survey, the remaining 3 had a higher IO score, what was intriguing was that for one of the individuals the second highest

score was for CO. We also found that both the individuals who had a high score for EO from the survey – were second time entrepreneurs. Amongst the 7 individuals who were categorized as IO through the interview process, 5 retained their IO categorization under the survey, one individual each were recategorized under EO & CO, while 3 individuals each who were earlier categorized under EO and CO moved to the IO category based on having the highest factor scores for IO. Amongst the 11 individuals who were categorized under CO through the interview process, only 4 retained their CO categorization under the survey, 3 individuals were recategorized under IO while 4 were recategorized to EO. One individual who was earlier categorized as IO was recategorized as CO.

Conclusion

When we started this research, our objective was to identify why some scientist researchers make a transition to the role of an entrepreneur while others do not. We find that all scientist are not alike, they have different motivations and aspirations, these motivations and aspirations give them a certain orientation, an orientation towards entrepreneurship (entrepreneurship orientation EO), the creation of impact (impact orientation IO) or purely the pursuit of developing a career (career orientation CO) that provides stability and the ability to manage and maintain a preferred lifestyle. These orientations influence how the scientist researchers sets about identifying the opportunity, engages in the process of making sense around the opportunity and personalizing it and the actions they undertake to mitigate the uncertainties around the opportunity. We also identify what factors contribute most towards facilitating the process of creation of a RBSU amongst these scientist researchers.

We found that most of the EO scientist we interviewed had a very diverse experience early on in their life including international cross cultural exposure, attended internships or had undergone training in the area of business, while these seemed to provide some kind of a foundation for developing entrepreneurial orientation, this exposure happened before they became a scientist during their student years, either at school or at university, we found that training and internships did not influence the scientist researcher towards the creation of a spin off. The EO scientist engaged in the process of research started with an objective to discover opportunities, they evaluated the technologies they came across (whether they were involved in its development or otherwise) against various potential market opportunities and the sensemaking around these opportunities that led to its personalization involved activities related to addressing the state and

stage of development of the technology, identifying a potential market need that the technology could address and evaluating the different forms of support that the eco-system provided to facilitate the pursuit of the opportunity. Once they decided to act on a particular opportunity (personalize) they went about assembling the resources required to create a RBSU.

The IO scientist in contrast did not start their career as a researcher with the purpose of identifying technologies which have market opportunities. These scientists pursued a scientific problem, the solving of which could create societal impact, the IO scientist was involved in research in their specific domain and undertook research in an area they had identified (working on their own research as against being part of someone else's research group). For these scientists the opportunity developed alongside the development of the technology as the part of an ongoing engagement between themselves the technology and the market, the evolution of this opportunity occurred as they developed the use case for these technologies and validated them based on the response from the market. We find that these interactions would sometimes generate multiple opportunities for their technologies, however the IO scientist pursuit of the opportunity depended on that which could deliver the maximum societal impact for the technology. The process of sensemaking and personalization of the opportunity focused actions they undertook based on their sense of ownership and responsibility to ensure that the potential impact of the technology is not lost, this involved the process of validation of the opportunity through the participation in startup competitions and or training programmes that would enable them to engage in the process of customer validation. The process of validating the opportunity gave them insights and a better understanding of what was required to create a RBSU, they then engaged in activities that included the identifying mentors and advisors to guide them through this process and identifying team

members who would bring a set of complimentary skills required to create an RBSU. We found that the process of participating in entrepreneurial and startup networking events had a positive influence in enabling these scientists in creating a spin off.

The CO scientist was involved in the process of research due to their interests in the sciences, their interest was in the pursuit science, this was a career choice that enabled them to do what they enjoyed best. They developed skills in a specific domain and worked on research in and around that domain, they were part of a research team or worked on a set of objectives set by the organization they worked for. The CO scientist sought stability and security in their career they sought career progressions along their areas of expertise and to ensure that it could meet their lifestyle needs. They would also discover opportunities, however their sensemaking around these opportunities involved what the opportunity could do for their careers, would it provide them a potential future advancement in their career while providing the stability and lifestyle they wanted. It is not that CO scientist did not join an RBSU, their decision to join one depended on whether it provided them with greater stability than were they were currently employed and their decision making on acting on the opportunity involved the trust they had in the team members who were in the RBSU, they engaged in activities to validate whether the team involved in the RBSU could provide a stable environment for them both financially as well as in their engagements as the part of the team. We found that the exposure of CO scientist to entrepreneurial and startup networking events seem to have a negative impact on their decision to join an RBSU.

Research Implications

In an environment that requires research organisations to show better performance in their ability to deliver commercial impact around the research they undertake, this research provides insights into a strategy that they could adopt to show create more RBSUs through a right mix of EO, IO and CO scientist rather than just around specific domain skills. EO scientists have domain experience, however they come with a deep motivation to take technologies to the market embedding these scientist within a research group would enable research organisations to commercialise their technologies much more. Unlike the technology licensing officer whose primary objective is to find an organization that would license the technology and an entrepreneur in residence – who primarily works as an advisor to startups that have already formed in some universities – these EO scientists are part of the research group and have a deep understanding of the research process as well as the commercial possibilities for the technology. IO scientist are central to any research organisations as they form the central pool of talent that drives the research organisations objectives forward, however a potential model where the lead IO scientist nurtures and develops IO scientists within their group would create more opportunities for technologies that have impact and scientist that would be involved right from the start in the process of identifying impact creation opportunities for these technologies. The CO scientist would provide the backbone for conducting the ongoing research within the organization. These patterns are obvious but we are not sure if there is a well developed strategy around the recruitment of research organisations in this are, this could possibly be an area for future research – identifying the make up of successful research organisations based on the mix of the scientists.

Eco-systems that have been developed to support the process and creation of startups seem to provide many options for support both from a funding perspective as well as in the area of training and mentorship, however this support is dispersed and an individual needs to actively search for this support, for EO oriented scientist this may not be a problem, however for a first time IO scientist the opportunity identification itself happens through a process of discovery as they interact with the technology and the market and have their ideas validated by the market. Including this as a process as a part of the functioning of the research organization may allow for the development of these scientist and the identification of more opportunities, programmes that are built around providing small amounts of resources (funds, time and lab equipment and consumables) coupled with access to market feedback allowing for rapid idea validation could develop a pool of ideas as well as IO scientists committed to acting on these opportunities.

Limitations

The research is however limited in that it primarily focuses on responses from scientist based out of organisations in Singapore and those who have received funding from SMART. This provides us with an ability to control for environmental factors, the eco-system, however, support systems, local culture, cultural background of the researchers etc., would all impact how researchers interact with opportunities and the uncertainty associated with them, and the process they undertake to overcome them. Singapore also provides a very strong support structure for entrepreneurial training and has over the past few years developed a strong based of entrepreneurs, this may have contributed to the lower impact of entrepreneurial training on the

decision making towards the creation of a spin off (as many as 83% of the respondents had undertaken some form of entrepreneurial training).

The scales used to identify orientation could obtain a clear separation based on unique orientation only for small subset of survey respondents. These low numbers could in part be due to the smaller number of respondents to the survey. Additionally, the survey questions may need to be further expanded and developed to obtain better separation between the different orientations.

There were variations in the alignment between how individuals were categorized through the interview process and through the use of scales. On review of these individuals we believe that the original categorization based on the interviews were a more accurate representation of the orientation of these individuals. The scales scored the individuals based on the perceptions they have of themselves as individuals, while the categorization based on the interviews took into account aspects related to responses they made to actual situations, it also took into account their actions and the context in which they undertook those ctions – the scales would need to be further developed along these lines to obtain a better sense of individual orientation so that it may actually reflect their likely responses in real life situations

Contributions

The research provides a window into how scientist researchers view opportunities and their decision making process in creating a RBSU. A key contribution of this research is the understanding that not all scientist researchers have the same motivations, viewing them based

on their orientation helps develop a better understanding of how research organizations can structure themselves to deliver higher commercial impact in their research. This research provides a foundation to expand it to other locations (countries) to validate the different orientations and sense making process amongst scientist researchers, it also provides a starting point to explore the performance of different research organizations based on the mix of their scientist researchers who form a part of the team.

Areas for future research

Potential areas for future research include the conducting a longitudinal study of PhD students in their final years and post doctoral researchers, this can help us better understand the effects of choice of technology, research groups, technology development, and the influence of entrepreneurial training, events and networks on the creation of RBSUs. While this research was limited in its focus on scientist researchers, it would be interesting to trace the journey of other professionals & non-professionals in their transition to entrepreneurship. This research also provides a starting point for future research to develop and validate the framework across different eco-systems as well as with entrepreneurs who started their journey elsewhere.

References

Alvarez, S. A., & Barney, J. B. (2007). Discovery and creation: Alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal*, 1: 11-26.

Amit, R., Glosten, L., & Muller, E. (1993). Challenges to theory development in entrepreneurship research. Journal of Management studies, 30(5), 815-834.

Begley, T. & Boyd, D. (1987). Psychological characteristics associated with performance in entrepreneurial firms and smaller businesses. Journal of Business Venturing, 2, 79–93.

Bolton, D.L., & Lane, M. D. (2012). Individual Entrepreneurial Orientation: Development of a measurement instrument. *Education + Training*, Vol. 54 No. 2/3, pp. 219-233.

Brockhaus, R. (1980). Risk taking propensity of entrepreneurs. *Academy of Management Journal*, 23, 509–520.

Casson, M. 1982. The entrepreneur: An economic theory. *Totowa, NJ: Barnes & Noble Books*

Chreim, S., Williams, B. E., & Hinings, C. R. (2007). Interlevel influences on the reconstruction of professional role identity. *Academy of Management Journal*, 50(6), 1515-1539.

Cohen WM, Nelson RR, Walsh JP. 2002. Links and impacts: the influence of public research on industrial R&D. *Management Science*. 48: 1–23

Cooper, A.C. & Dunkelberg, W.C. (1987). Entrepreneurial Research: Old questions, new answers and methodological issues. American Journal of Small Business, 11, 11–24.

Duncan, R. B. (1972). Characteristics of organizational environmentsand perceived environmental uncertainties. *Administrative Science Quarterly*, 17: 313–327

Eckhardt, J. T., & Shane, S. A. (2003). Opportunities and entrepreneurship. *Journal of management*, 29(3), 333-349

Friedland, R., & Alford, R. R. (1991). Bringing society back in: Symbols, practices and institutional contradictions. *University of Chicago Press*

Fuller, Anne W., Rothaermel, Frank T., 2012. When Stars Shine: The effects of Faculty Founders on New Technology Ventures. *Strategic Entrepreneurship Journal.* 220-235.

Gartner W. B. (1988). "Who is an Entrepreneur?" is the wrong question. *American Journal of Small Business.*Spring, 11-32

Gartner, W. B. (1985). A framework for describing the phenomenon of new venture creation. *Academy of Management Review*. 10, 696-706.

Haltiwanger, J., Jarmin, R.S. & Miranda, J. 2013. Who Creates Jobs? Small Versus Large Versus young. *The Review of Economics and Statistics.* 95(2) 347-361.

Hayek, F. (1945). The use of knowledge in society. *American Economic Review*. 35(4) 519-530.

Hebert, R. F., & Link, A. N. (1988). The entrepreneur: Mainstream views and radical critiques (2nd ed.). *New York:Praeger*

Higgins,E.T.,&Kruglanski,A.W.2000. Motivational science: Social and personality perspectives. Philadelphia: Psychology Press.

Hoang, H., & Gimeno, J. (2010). Becoming a founder: How founder role identity affects entrepreneurial transitions and persistence in founding. *Journal of Business Venturing*, 25(1), 41-53.

Ibarra, H. (1999). Provisional Selves: Experimenting with Image and Identity in Professional Adaptation. *Administrative Science Quarterly*, 44: 764-791.

Igbaria, M., & Baroudi, J. J. (1993). A short-form measure of career orientations: A psychometric evaluation. *Journal of Management Information Systems*, 10(2), 131-154

Jensen R, Thursby MC. 2001. Proofs and prototypes for sale: the licensing of university inventions. *American Economic Review* 91: 240–259

Kauffman Foundation. 2012, University Technology Transfer Through Entrepreneurship: Faculty & Student Spinoffs

Krueger, N., & Dickson, P. (1994). How believing in ourselves increases risk taking: Perceived self-efficacy and opportunity recognition. *Decision Sciences*, 25, 385-400.

Kuratko, D. F., Morris, M. H., & Schindehutte, M. (2015). Understanding the dynamics of entrepreneurship through framework approaches. *Small Business Economics*, 45(1),1-13

Kyratsis, Y., Atun, R., Phillips, N., Tracey, P., & George, G. (2017). Health systems in transition: Professional identity work in the context of shifting institutional logics. *Academy of Management Journal*, 60(2), 610-641.

Lipshitz, R., & Strauss, O. (1997). Coping with uncertainty: A naturalistic decision-making analysis. *Organizational Behavior and Human Decision Processes*, 69: 149–163.

Lumpkin, G. T. & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *The Academy of Management Review*, Vol. 21 No. 1, pp. 135-172.

MacMillan, I. C., & Katz, J. (1992). Idiosyncratic milieus of entrepreneurial research: The need for comprehensive theories. *Journal of Business Venturing*, 7(1), 1-8.

Mansfield E. 1995. Academic research underlying industrial innovations: sources, characteristics, and financing. *Review of Economics and Statistics*. 77: 55–65)

Marquis, C., & Lounsbury, M. (2007). Vive la résistance: Competing logics and the consolidation of US community banking. *Academy of Management Journal,* 50(4), 799-820.

Maurer, J. T. London, M. (2015). From Individual Contributor to Leader: A Role Identity Shift Framework for Leader Development Within Innovative Organizations. *Journal of Management,* 44(4), 1426–1452.

McMullen, J.S., Shepherd, D.A., 2006. Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. Academy of Management Review 31 (1), 132–152.

Milliken, F. J. (1987). Three types of perceived uncertainty about the environment: State, effect, and response uncertainty.*Academy of Management Review*, 12: 133–143.

Mitchell, J. R., & Shepherd, D. A. (2010). To thine own self be true: Images of self, images of opportunity, and entrepreneurial action. Journal of Business Venturing, 25(1), 138–154.

Morris, M. H., Lewis, P., & Sexton, D. L. (1994). Reconceptualizing entrepreneurship: An input–output perspective. Advanced Management Journal, 59(1), 21–31.

Petroni, A. (2000). Strategic career development for R&D staff: a field research. Team Performance Management: An International Journal, 6(3/4), 52-62.

Phan, Phillip H. (2004). Entrepreneurship theory: Possibilities and future directions. *Journal of Business Venturing* 19 (2004) 617 – 620.

Pratt, M. G., Rockmann, K. W., & Kaufmann, J. B. (2006). Constructing professional identity: The role of work and identity learning cycles in the customization of identity among medical residents. *Academy of management journal*, 49(2), 235-262.

Rothaermel FT, Thursby MC. 2005. Incubator firm failure or graduation? The role of university linkages. *Research Policy* 34: 1076–1090

Sanjay Jain, Gerard George, Mark Maltarich. (2009). Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity. *Research Policy, 38*(6), 922-935

Sarason, Y. Dean, T. Dillard, F. J. (2006). Entrepreneurship as the nexus of individual and opportunity: A structuration view. *Journal of Business Venturing*. 21: 286-305.

Sarasvathy, S. D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of management Review,* 26(2), 243-263.

Schein, E.H. Individuals and careers. In J.W. Lorsch (ed.). Handbook of Organizational Behavior. Englewood Cliffs, NJ: Prentice-Hall, 1987, pp. 155-171

Schumpeter, J. A. 1934. The theory of economic development: An inquiry into profits, capital credit, interest, and the business cycle. Cambridge: Harvard University Press.

Sexton, D. & Bowman, N. (1984). Entrepreneurship education: Suggestions for increasing effectiveness. Journal of Small Business Management, 22, 18–25.

Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities. *Organization Science*; Jul/Aug, Vol.11, No.4, 448-469

Shane, S. & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. Academy of Management Review, 25(1), 217–226.

Siegel, D. S., Waldman, D., & Link, A. (2003). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. *Research policy,* 32(1), 27-48.

Stevenson, H. H. and J. C. Jarillo (1990). 'A paradigm of entrepreneurship: Entrepreneurial management'*, Strategic Management Journal*, 11, pp. 17-27.

Thornton, P. H., & Ocasio, W. (1999). Institutional logics and the historical contingency of power in organizations: Executive succession in the higher education publishing industry, 1958–1990. *American journal of Sociology,* 105(3), 801-843.

Thornton, P. H. (2004). Markets from culture: Institutional logics and organizational decisions in higher education publishing. *Stanford University Press.*

Venkataraman, S. (1997). The distinctive domain of entrepreneurship research: An editor's perspective. In J. Katz & R. Brockhaus (Eds.), *Advances in entrepreneurship, firm emergence, and growth*, vol. 3:119-138. Greenwich, CT: JAI Press.

Velasco, F. (2018). What is the actual return on R&D Investment?. Media Release April 16, by Francisco Velasco. Accessed online https://fvelasco.com/tag/nsf/. Viewed August 3, 2020.

Wright, R. F. (2017). Institutional determinants of university spin-off quantity and quality: a longitudinal, multilevel, cross-country study. *Small Business Economics*(48(2)), 361-391.

Appendix 1

Entrepreneurship intention & identity transition from scientist to entrepreneur

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Start of Block: Consent

INTRODUCTION

This research seeks to understand why some scientists make the transition to become entrepreneurs while others do not? Participation involves filling in the online survey form, You will require 30 minutes to complete the survey, which will include some demographic data and questions related to your career orientations, entrepreneurial opportunities etc., You are encouraged to provide answers to all the questions in the survey as skipping these questions may lead to incomplete information that may impact the outcome of the survey. The questions will not ask for sensitive information or pose any risk to you. You also have a choice of not participating in the survey and can choose to withdraw from the survey by not submitting their response and closing the browser window Data collected will be anonymized for analysis You can request for your data to be withdrawn within 14 days from the date of close of the survey by emailing the Principal Investigator (PI) to withdraw their information from the research study as long as the data is identifiable Participation in this study is entirely voluntary and will in no way affect your relationship with SMART and/or SMU. The study is expected to contribute to scientific understanding how scientists become entrepreneurs and may lead to insights for programme development that could facilitate future role transitions in this area. There are no anticipated risks in this study beyond what one would typically experience in everyday life. The information you provide will be kept strictly confidential. Only the Principal Investigator will have access to the raw data. Anonymized data from this study may be shared with qualified researchers or research institutions, where deemed appropriate, consistent with academic association, journal, or university policies. Any reports from this study will be done at the aggregate level, and/or with individual and company information anonymized or disguised, so that it would not be possible to identify participants or their companies. Although the PI is an employee of SMART and would have access to the raw data, this study is being conducted in the PI's capacity as a Doctor of Innovation Student at Lee Kong Chian School of Business at Singapore Management University. The raw data collected for this study will not be disseminated within SMART. Only aggregated results, with individual and company information anonymized or disguised, will be shared with SMART. For questions/clarifications on this study, please contact the Principal Investigator, NALLUR Krishna Kumar, at email address krishnan.2015@dinn.smu.edu.sg and/or office/mobile number: +6583216350. The project will

be supervised by Prof. Gerard George who may be contacted at the following email address ggeorge@smu.edu.sg If you have any questions or concerns regarding your rights as a participant in this research study and wish to contact someone unaffiliated with the research team, please contact the SMU Institutional Review Board Secretariat at irb@smu.edu.sg or + 65 68281925. When contacting SMU IRB, please provide the title of the Research Study and the name of the Principal Investigator, or quote the IRB approval number IRB-18-073-A117-M1(719).

PARTICIPANT'S CONSENT

I understand that participation is voluntary. Refusal to participate will involve no penalty. I declare that I am at least 18 years of age. If I am affiliated with Singapore Management University and / or SMART , my decision to participate, decline, or withdraw from participation will have no adverse effect on my status at or future relations with Singapore Management University and / or SMART. I have read and fully understood the contents of this form, and hereby give consent to the Singapore Management University research team and its affiliates for this project to collect and/or use my data for the purpose(s) described in this form. By clicking the “YES” button, I consent to participate in this study and agree to all of the above. Please Click YES to confirm participation and to proceed with the survey Please Click NO to leave the survey now

- ○ YES - I consent to participate in this study and agree to all of the above. (1)
- ○ No - I want to leave the survey now (2)

Skip To: End of Survey If QID73 = No - I want to leave the survey now

---

Please input your full name in the space provided below

_____

Please provide your e-mail address in the space provided below

_____

End of Block: Consent

Start of Block: Please answer the following demographic questions

Please provide the answers to the following demographic questions

Q1 What is your gender?

- Male (1)
- Female (2)

Q2 How old are you?

- 19-29 years (1)
- 30-39 years (2)
- 40-49 years (3)
- 50-59 years (4)
- > 60 years (5)

Q3 What is your educational qualification?

- Diploma (4)
- Bachelor degree (5)
- Some graduate coursework (6)
- Master's degree (7)
- Doctoral degree (8)

Q4 What is your marital status?

- Single (1)
- Married (2)

Display This Question:

If Q4 = Married

Q5 What is your spouse's employment status?

- ○ Employed full time (1)
- ○ Employed part time (2)
- ○ Unemployed looking for work (3)
- ○ Unemployed not looking for work (4)
- ○ Student (5)

Q6 How many children do you have?

- ○ 0 (1)
- ○ 1 (2)
- ○ 2 (3)
- ○ 3 (4)
- ○ >4 (5)

Q7 How many dependents do you have (including, spouse, children, dependent parents, siblings etc.,)?

- ○ 0 (1)
- ○ 1 (2)
- ○ 2 (3)
- ○ 3 (4)
- ○ 4 (5)
- ○ >5 (6)

Q8 How many years of work experience do you have?

- ○ 0-4 years (1)
- ○ 5-9 years (2)
- ○ 10-14 years (3)
- ○ 15-19 years (4)
- ○ 20 -24 years (5)
- ○ >25 years (6)

Q9 What is your current employment status?

- ○ Employed full time (1)
- ○ Employed part time (2)
- ○ Unemployed looking for work (3)
- ○ Unemployed not looking for work (4)
- ○ Retired (5)
- ○ Student (6)

Q10 Which one of the following describes your employment position best?

- Post doctoral researcher (1)
- Research scientist (2)
- Faculty (3)
- Non-manager (4)
- Lower level manager / supervisor (5)
- Mid- upper level manager (6)

Q11 Have you ever been an entrepreneur?

- First time entrepreneur (1)
- Involved in at least one start-up activity before (2)
- Neither (3)

Q12 Which of the following statements best describes your financial status?

- ○ I have enough money only to support myself (1)
- ○ I have enough money to support myself and my family (2)
- ○ I have enough savings for a rainy day (3)
- ○ I have excess funds for investments (4)

End of Block: Please answer the following demographic questions

---

Start of Block: Please answer the following questions related to career orientation

Please answer the following questions by ranking the statements on a scale of Not at all important (1) to Extremely important (5)

Q13 The process of supervising, influencing, leading and controlling people at all levels is

- ○ Not at all important (49)
- ○ Slightly important (50)
- ○ Moderately important (51)
- ○ Very important (52)
- ○ Extremely important (53)

Q14 The chance to do things my way and not to be constrained by the rules of an organization is

- ○ Not at all important (20)
- ○ Slightly important (21)
- ○ Moderately important (22)
- ○ Very important (23)
- ○ Extremely important (24)

Q15 An employer who will provide security through guaranteed work, benefits, a good retirement program, etc., is

- ○ Not at all important (20)
- ○ Slightly important (21)
- ○ Moderately important (22)
- ○ Very important (23)
- ○ Extremely important (24)

Q16 Working on a problem that is almost insolvable is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q17 Remaining in my specialized area as opposed to being promoted out of my area of expertise is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q18 To be in charge of a whole organization is

- Not at all important (21)
- Slightly important (22)
- Moderately important (23)
- Very important (24)
- Extremely important (25)

Q19 A career that is free from organization restriction is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q20 An organization that will give me long-run stability is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q21 Using my skills to make the world a better place to live and work in is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q22 Developing a career that permits me to continue to pursue my own life-style is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q23 Remaining in my area of expertise throughout my career is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q24 To rise to a high position in general management is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q25 Remaining in one geographical area rather than moving because of a promotion is

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q26 Being able to use my skills and talents in the service of an important cause is

- Not at all important (23)
- Slightly important (24)
- Moderately important (25)
- Very important (26)
- Extremely important (27)

Q27 The only real challenge in my career has been confronting and solving tough problems, no matter what area they are in

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q28 It is more important for me to remain in my present geographic location then to receive a promotion or new job assignment in another location

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q29 A career is worthwhile only if it enables me to lead my life in my own way

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q30 I will accept a management position only if it is in my area of expertise

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q31 I do not want to be constrained by either an organization or the business world

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q32 I want a career in which I can be committed and devoted to an important cause

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q33 I feel successful only if I am constantly challenged by a tough problem or a competitive situation

- Not at all important (23)
- Slightly important (24)
- Moderately important (25)
- Very important (26)
- Extremely important (27)

Q34 Choosing and maintaining a certain life-style is more important than is career success

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q35 It is important that the work I do results in benefits for society at large

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q36 It is important that the work I do results in commercial value (generates revenue)

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

Q37 It is important that I get a share of the commercial value generated by the work I do

- Not at all important (20)
- Slightly important (21)
- Moderately important (22)
- Very important (23)
- Extremely important (24)

End of Block: Please answer the following questions related to career orientation

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Start of Block: Please answer the following questions related to entrepreneurial orientation

Please answer the following questions by ranking the statements on a scale of Strongly disagree (1) to Strongly Agree(5)

Q38 I like to take bold action by venturing into the unknown

- ○ Strongly disagree (1) (1)
- ○ Disagree (2) (2)
- ○ Neutral (3) (3)
- ○ Agree (4) (4)
- ○ Strongly agree (5) (5)

Q39 I am willing to invest a lot of time and/or money on something that might yield a high return.

- ○ Strongly disagree (1) (1)
- ○ Disagree (2) (2)
- ○ Neutral (3) (3)
- ○ Agree (4) (4)
- ○ Strongly agree (5) (5)

Q40 I tend to act “boldly” in situations where risk is involved

- ○ Strongly disagree (1) (1)
- ○ Disagree (2) (2)
- ○ Neutral (3) (3)
- ○ Agree (4) (4)
- ○ Strongly agree (5) (5)

Q41 I often like to try new and unusual activities that are not typical but not necessarily risky

- Strongly disagree (1) (1)
- Disagree (2) (2)
- Neutral (3) (3)
- Agree (4) (4)
- Strongly agree (5) (5)

Q42 In general, I prefer a strong emphasis in projects on unique, one-of-a kind approaches, rather than revisiting tried and true approaches used before

- Strongly disagree (1) (1)
- Disagree (2) (2)
- Neutral (3) (3)
- Agree (4) (4)
- Strongly agree (5) (5)

Q43 I prefer to try my own unique way when learning new things rather than doing it like everyone else does

- Strongly disagree (1) (1)
- Disagree (2) (2)
- Neutral (3) (3)
- Agree (4) (4)
- Strongly agree (5) (5)

Q44 I favor experimentation and original approaches to problem solving rather than using methods others generally use for solving their problems

- Strongly disagree (1) (1)
- Disagree (2) (2)
- Neutral (3) (3)
- Agree (4) (4)
- Strongly agree (5) (5)

Q45 I usually act in anticipation of future problems, needs or changes

- Strongly disagree (1) (1)
- Disagree (2) (2)
- Neutral (3) (3)
- Agree (4) (4)
- Strongly agree (5) (5)

Q46 I tend to plan ahead on projects

- Strongly disagree (1) (1)
- Disagree (2) (2)
- Neutral (3) (3)
- Agree (4) (4)
- Strongly agree (5) (5)

Q47 I prefer to ‘step-up’ and get things going on projects rather than sit and wait for someone else to do it

- ○ Strongly disagree (1) (1)
- ○ Disagree (2) (2)
- ○ Neutral (3) (3)
- ○ Agree (4) (4)
- ○ Strongly agree (5) (5)

End of Block: Please answer the following questions related to entrepreneurial orientation

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Start of Block: Please answer the following questions related to entrepreneurial opportunities

Please answer the following questions by picking the most appropriate response

---

Q48 Do you currently own or are likely to own Intellectual Property (IP) as a result of your research

- ○ Yes (1)
- ○ No (2)

Q49 What are you likely to do with the Intellectual Property (IP) generated from your research

- License the IP (1)
- Create a spin off (2)

Q50 Have you ever had the opportunity to be a part of the founding team or early employee at a start-up

- Yes (1)
- No (2)

Skip To: Q55 If Q50 = No

Q51 Did the opportunity to work in the start-up arise out of

- Your own research (1)
- Research that you were collaborating on (2)
- Invitation from someone you know (3)
- Invitation from someone you did not know (4)
- Click to write Choice 5 (5)

Q52 This start-up opportunity surfaced during a phase when

	Disagree (1) (1)	Not Applicable (2) (2)	Agree (3) (3)
Funding for my research was coming to an end (1)	○	○	○
There was a lack of institutional support in your area of work (2)	○	○	○
You were facing challenges related to domicile and stay in the country where you wanted to continue working (3)	○	○	○
You were looking for career growth opportunities (4)	○	○	○
You were looking for learning opportunities (5)	○	○	○
You were looking to create societal impact with your work (6)	○	○	○
You were actively seeking out a start-up opportunity (7)	○	○	○
The opportunity evolved as a natural progression of the research (8)	○	○	○

Q53 At the time you were evaluating the start-up opportunity were there any other career opportunities that you were exploring

- ○ No other job opportunities (1)
- ○ Other research job opportunity (2)
- ○ Academic job (3)
- ○ Industry job (4)

Q54 How important are the following factors in influencing your decision to join / not join the start up opportunity	Not at all important (1)	Slightly important (2)	Moderately important (3)	Very important (4)	Extremely important (5)
Timing of the opportunity (1)	○	○	○	○	○
Potential for financial gain (2)	○	○	○	○	○
Ability to absorb financial uncertainty (3)	○	○	○	○	○
Family support for joining the start-up (4)	○	○	○	○	○
Personal confidence in making the start-up a success (5)	○	○	○	○	○
Ability to create social impact (6)	○	○	○	○	○
The opportunity to learn new things (7)	○	○	○	○	○

Support available for start-up in the eco-system (8)	○	○	○	○	○
Availability of funds for the start-up (13)	○	○	○	○	○
The start-up team that had been assembled (9)	○	○	○	○	○
Readiness of the technology (10)	○	○	○	○	○
Uniqueness of the technology (11)	○	○	○	○	○
Personal confidence in the technology (12)	○	○	○	○	○

Q55 Rank the following roles that you would have played in the start-up - or you would play if you had joined a start-up from least likely to most likely

	Least likely (1)	Somewhat likely (2)	Little likely (3)	Likely (4)	Most likely (5)
Chief Executive Officer (CEO) (1)	☐	☐	☐	☐	☐
Chief Financial Officer (CFO) (2)	☐	☐	☐	☐	☐
Chief Operating Officer (COO) (3)	☐	☐	☐	☐	☐
Chief Scientific Officer (CSO) (4)	☐	☐	☐	☐	☐
Head of R&D (5)	☐	☐	☐	☐	☐
Product Development (6)	☐	☐	☐	☐	☐
Business Development (7)	☐	☐	☐	☐	☐
Research (8)	☐	☐	☐	☐	☐
Project Management (9)	☐	☐	☐	☐	☐
Operations (10)	☐	☐	☐	☐	☐

End of Block: Please answer the following questions related to entrepreneurial opportunities

Start of Block: Questions related to eco-system

Q56 Have you ever attended any entrepreneurship training programme (workshops, bootcamps, lean launchpad etc.,)

- Yes (1)
- No (2)

Skip To: Q57 If Q56 = Yes

Q57 When did you attend the entrepreneurship training programme

- During your student days (1)
- When you were working (2)
- Attended multiple programmes while being a student and at work (3)

Q58 Have you at any point interned at a start-up

- Yes (1)
- No (2)

Q59 Do you know anyone who is an entrepreneur

- [ ] Family member (1)
- [ ] Friend (2)
- [ ] Colleague (3)
- [ ] Mentor (4)
- [ ] Do not know any entrepreneur (5)

Display This Question:

If Q59 != Do not know any entrepreneur

Q60 How frequently do you interact with the entrepreneur

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q61 Do you attend entrepreneurship events / start-up networking events

- Yes (1)
- No (2)

Display This Question:

If Q61 = Yes

Q62 How frequently do you interact with the entrepreneur

- Never (1)
- Sometimes (2)
- About half the time (3)
- Most of the time (4)
- Always (5)

End of Block: Questions related to eco-system

Start of Block: Questions related to Identity

Q63 I would best describe myself to be a

- Scientist (1)
- Academic faculty (2)
- Employee at a company (3)
- Entrepreneur (4)

Q64 In five (5) years I'm likely to describe myself as a

- Scientist (1)
- Academic faculty (2)
- Employee at a company (3)
- Entrepreneur (4)

End of Block: Questions related to Identity

Appendix 2

Table 2: Summary of extracts from interviews with entrepreneurially oriented (EO) scientists

S.N.	Key orientation characteristics	Descriptors from the interviews
1.	Exposure to entrepreneurial training / internships / networks	*"Actually, it was an economics class, I guess, I can go back to a single event. It was a macro economics class in which we were supposed to write up a business plan for a future business"* *"I got like, some intern job. Like I basically looked at actually how people apply their, the tools that they provide within academic research. And I wrote marketing material. And so I bought down a lot of scientific articles to marketing material."* *"I did some work with an incubator for short while and with a, just some simple project management and stuff like that….I was more just helping to piece things together, getting resources and putting these little teams together getting new grads together… come tell us about your technology, I will go find the market need, I'll do a bit of that kind of digging up. And then we'll put together (a team) if they needed more resources, we will try to bring in people to support them, because they are more the science side of things. Maybe they need an engineer or something that you can pay with. And then I basically, I would just have to facilitate everything, everything from what you see the conceivable administration, all those kind of things"* *"when I was doing the US overseas college program, The internship at a biotech startup in Philadelphia"* *"I attended, Stanford bio-design, network. And that kind of helped me to shift my focus a little bit Since 2013. So because I was quite involved in like, I was there as a teaching assistant, as well, for a period of time. I think that exposure, really give me new insight like, like every session, or every new person you*

S.N.	Key orientation characteristics	Descriptors from the interviews
		meet is just like new information for you. And I just wanted to admit that, I also wanted to do a start up"
2.	Diversity of experience	*"At age 12 my parents decided to rip me out of that community and environment and make a move to Phoenix, Arizona. I thought it was the end of the world at the time. Looking back on that I couldn't be more grateful for that move. Because it really snapped me out of my comfort zone…I participated in that program and organized my own internship at a Chemical Engineering Laboratory, the state key Chemical Engineering Laboratory at Tsinghua University…I thought that I needed to make it another change to continue to grow and move on. I ended up getting a postdoc slash fellowship For the Brazilian government in Rio de Janeiro"* *"They didn't even realize (the company he was interning at) that I was not living in Cologne anymore. I thought it's not necessary to tell them that I've already applied for my PhD and like working on my PhD in Berkeley, but I was going back and forth all the time anyway. And a lot of that was remote work."* *"I ended up doing a bit of finance at the end of it special. looking specifically at how to finance a startup. Okay, startup journey, and doing a review of the landscape in New Zealand"* *"I was doing the US overseas college program, The internship at a biotech startup in Philadelphia,.. I went to Hopkins do my PhD,"* *"Also, a bit of the rebellion. And The reason why I chose Singapore (moving from Russia to Singapore) was nobody knew here my father, grandfather, Okay, I didn't want It to be much harder to get, I think I could have a much easier life"*

S.N.	Key orientation characteristics	Descriptors from the interviews
3.	An early realization of interest in entrepreneurship	*"I'd like to say that even before I think I started my career, I've always seen myself starting from high school as an entrepreneur, who viewed research as a necessary part of being an entrepreneur…I always knew that the end goal was being an entrepreneur or doing something on my own that came out of my ambitions in my scientific fields"* *"But realistically, during that time (doing PhD at UC Berkley), I was already involved with startup companies, I was interning in various companies, I had a pretty good idea of how it works to run a company out of academia…towards the end of my PhD, it became more and more clear, while nothing is stopping me from pursuing, an academic career. But that's not where my heart is, because I was juggling various responsibilities, organizing various entrepreneurial clubs and conferences and things"* *"But actually, the whole genesis of the idea of studying a biotech company, came back in my undergrad days, and when I was doing the US overseas college program…. So when I went to Hopkins to do my PhD, I knew I was going to start company, I just didn't know what the idea was going to be."* *"I just kept going to like a lot of meetings and all that stuff. .. lifestyle talks, networking, and all just a lot of stuff. And I've always wanted to do a start up since the first year of my PhD"*
4.	Opportunistic – not wedded to their own technologies	*"I was open to whatever and I thought there was room for innovation and, you know, whatever you did, Obviously, I had my own particular interests, but I wasn't going to let those cloud whatever opportunity came up"* *"we won a few competitions here and there. And the PI came to us and was like, This looks promising. We, haven't been able to license out the technology. So why don't you guys start a company and start negotiating with Hopkins for*

S.N.	Key orientation characteristics	Descriptors from the interviews
		the technology. And this was our first aha moment, everything, maybe we are onto something when we could get the PI. It's an interesting technology. So we started it." *"I felt that the principles are pretty simple. You know, it's, it's identifying a unmet need, its making sure that customers would buy this particular technology, right, and I think that when, when we looked at sit - we applied the same principles to this universal vaccine"*
5.	Openness to working in new areas – not rooted to their area of expertise	*"Now, this idea that big data is going to be part of our research, we cannot be doing things by hand manually, one by one anymore, everything has to be done on a large scale and automated for us to achieve optimal results. So learned that under the PhD, and even in Brazil, so that was skill set. I'm not a computer scientist or an electrical engineer, by far. But I realized that that was a skill set that I probably should have focused on earlier on in my career."* *"Because if I'm going to take this career seriously as a guy that does technology I need to get into the mind of the investors I need to understand how they thinking I did CFA level one I did all these other financial things in the past but I haven't actually lived and breathed as an investor so I don't really know what's the motivation and alignment behind it. So for me it was good at least one year I got to understand how they think what is it that they evaluate … at least I got a glimpse and I think indirectly with the various other investors in the market I got a sense of okay this is how in general people make decisions"* *"if you do something, you're responsible for it. It doesn't matter what your job description is, right? If I can change it, and I feel it's my responsibility, then I will act on it. And there was my responsibility to act on it. I already run the company, as the CEO of the company, dedicated entirely to that, even though theoretically, I was a postdoc on the papers still"*

S.N.	Key orientation characteristics	Descriptors from the interviews
		"I can live with it not being the expert, okay. And, and something I often explain also, is that overcoming the big ego, as you know, best, I don't have that, I am completely fine in saying I want to have the best people. And if they know I will listen"
6.	Leveraging networks	*"So it was good to know both of the founders, and they are not so far away from me. Both of them are about 10 years older than Okay, so I could really connect, I could see how that works for them. Right. And I think having role models is crucial for any career decision. That worked out well, they became the first investors in my company that was a very easy conversation. Like, I originally wanted to just meet them for lunch in a tiny restaurant behind the train station, said what I was doing this kind of interesting. And it was a handshake agreement with the seven-digit figure"* *"So The EX colleague, so basically ex colleagues who have built rapport with me know, one or two advisors, they recommend these advisors to ask to engage….They know about business and know about medtech sales and business. So is a good, good opportunity to get to know these people and learn from them as well."* *"I think we were in three or four incubators, accelerators. when I was at Dana Farber, I was, going to MIT to join the accelerator programs. And half of the activities I technically wasn't supposed to go to because I was not from MIT, you know, you when you're an entrepreneur, you just find any means that can get you results, and I think that was essentially the way we started off there was the mindset that We clearly didn't know what we didn't know. And so our goal is to find out as much as we can learn as fast as we can, you know, be as humble as we can, and make sure that people want to teach us."*

Table 3: Summary of extracts from interviews with impact oriented (IO) scientists

S.N.	Key orientation characteristics	Descriptors from the interviews
1.	Scientist at heart	*"I got an internship opportunity that married our work at the Genome Institute of Singapore and I started research there and then I started developing interest in research. And then while I was finishing the programme, near to six months for the completion of my internship. And I started applying for PhD because I got interested in the research, and then I applied to NTU, they rejected my application, first time and second time I got into the PhD program of NTU."* *"when I was an undergrad, I knew all that I wanted to do was a PhD. Because back then I was doing a Bachelor in Science. And I know that with a Bachelor of Science, you probably can't get any, anywhere if you want to teach and that so the options is limited. And I'm interested in learning about the unknown, exploring how the world works, in general. And, and I'm particularly interested with biomolecules, in protein structures. So that pretty much prompted me to go to the US to pursue my PhD"* *So I like the intellectual gymnastics behind research. I like, of course, the experimental part that you try things that have not been tried before. And I didn't know that beforehand. along that process, I started defining something that, why am I doing it? And what do I like in this? What do I value? And then these are these concepts that are very personal."*
2.	Impact as a central theme of doing what they do – link to entrepreneurship	*"The thing that you really like about the research is when you get good results, and you think you can apply to the level where you can solve patient's problem. So whatever research I'm doing right now has a direct impact on the patient health. So, this is the third patent contributing something. I'm enjoying that"* *"I've never wanted to be an Academic to begin with, I always focused on how I can make something that I've discovered or have used. And by being professor or Academic, I will have to spend more times in teaching. Right? Yeah. So to me, that wouldn't help in my goal. And I think what is the most rewarding One*

S.N.	Key orientation characteristics	Descriptors from the interviews
		is to have therapeutics that can save life, Right? ... we both believed that if we were to do something, do something big, it will be saving lives. And the impact has to be there for the society. I feel like this is possibly one of the greatest reward to say, we worked on that we delivered it to people. And we see the application and the utilization of our technology, by, by, in by people, by company by government whatsoever. So that's what I mean by the entrepreneur." *"when developing the latest platform that I was working on, I realized that there's actually much more practical application that can come out of it, some of which, in terms of performance, around what is required in the real world. And I guess, at the end of the day, when I talk about me trying to solve problems is about creating impact…. if I see something with more practical use, like, for example, what I'm working on now, I like to see being translated into practical innovation and outcome that can directly improve humans know… So that's I kind of transit then there was this entrepreneurial pathway,"* *"In that sense. Knowing that the development stages of obviously very difficult, but once you reach that the impact that you make, It's a lot more than a few papers. Right? Yeah. And of course, another draw of being an entrepreneur. I remember how during the last boot camp they said that maybe for once you get a chance to drive a Ferrari. So the financial part is definitely one because the risk taking you know, you can form you can go from drawing zero salary to getting a lot of money when a company is mature and somebody acquire the company. Yeah, that's for millions of dollars and they suddenly become millionaire."* *"After a while, if you really look into the career of several old professors, including my previous advisors, what have they really achieved? What you can say, I mean, he's got all kinds of awards, but any of his discovery or technology impacted other people's life. And to be absolutely critical. No. And, and I don't want to be like, I don't want to be like, I spend my next 50 years working on*

S.N.	Key orientation characteristics	Descriptors from the interviews
		something that, frankly, no one cares in, you can publish all kinds of nice fancy journals. But no one will pick it up. And therefore, there's no impact that lets me meet at all."
3.	Constantly seeking to learn	*"So, I applied for the smart bootcamp about three months program, I joined that I was learning there I was applying to my startup, which is not there. As I started applying, you know, I started to learn it. I realized during this whole journey; one important thing is networking."* *"when I first joined and get a grant, I got to opportunity to join some business training, Lean Launchpad, right. And the idea is very simple, is to talk to customer How Do you know your stuff is good, right? So I joined in for half a year or so. And I start to talk to more people and companies, Okay. And of course, because of the grants, their job is to hook us link us up with different companies to evaluate ideas. So I get an opportunity to get further exposure. Now, not only labs, but companies from oversee, and almost all the meeting they say that this, technology is important, and people need it. And that build confidence that I can actually build it further"* *"Yeah, so actually does when I joined TECH launch? Okay. And biotechnology, I met a couple of other, some of them are techies -... there is actually a more rigorous way of designing interviews. So they taught us how you can you will need to have a proper hypothesis, and you go and interview the right audience for the hypothesis, rather than just randomly talking to people trying to get sort of insight."* *"And then I went into the boot camp, to say that the best part of the boot camp is, is really when they force me to go out and interview the potential customers, so to speak. And that really, really pushed me way out of my comfort zone"* *"my own (exposure) in the Innovation Center 360-degree bootcamp. Okay. And then? Well, I think, to me, this was very clear that I was exposed to things that I*

S.N.	Key orientation characteristics	Descriptors from the interviews
		was very interested in without never having put my finger on it, which was, Oh, those guys are trying to help people researcher, translate the research from companies spin off, etc. in the marketplace."
4.	Seeking out mentors	*"Then we started getting mentorship that kind of build my interest mode because they wanted to refine our business plan. They taught us how to pitch. And, you know, what is an investor pitch. As a scientist, what do we lack? And what do we need to learn more to this? I had a mentor from Johnson & Johnson and McKinsey. There was another competition that was in Sweden actually where I took part, at that time we already were at a state that we had some knowledge about pitching and at the business plan competition there we won the second price. And there too, we had mentors. So again, with the mentorship program, I started learning more about the business aspect of research."* *"I think what will be most important will be the kind of connection that the mentors and the lecturers actually bring for us"* *"She's a CEO, she's a co-founder of one biomed company. So, she developed, sort of, this whole point of care device for detection of TB based. She doesn't have an engineering background, too. So, I talked to her a lot that I was a biologist and not an engineer, so I don't know how I fit here, but she was a chemist. who became head of department, and she got this technology, and she's spun it off. I mean, she goes through the same path as me, and same struggle but she overcame it and she actually has a spin off. So I was. Yes, she inspired me a lot…. I would say my relationship with her is more like friends"*
5.	Ownership towards ensuring that their technology creates impact	*"I really don't want to leave the university setting community, I want to be a part of research. But I also really wish to grow out of the university setting and do something of my own, because that's what I have dedicated myself now in the last four years to do something of my work. And in next year or two years' time, I wish to have an incubator space or something where we are focusing on one or two applications and having our own ideas and taking it forward"*

S.N.	Key orientation characteristics	Descriptors from the interviews
		"So, I have two projects, right? One is on traffen and the other one is with the spin off okay. So, at the time that I graduate, I worked with two other seniors, right. And then they spun out a company and they joined the company. I was asked whether I want to join in as well. But I decided to stay back way to develop traffen, because traffen was something that I discovered. Okay, I was the main inventor for this." *"Let's see that right at the beginning. We thought obvious licensing, okay. Because there's the usual easy as it sounds, it's just a goal. But as, as we were trying to figure out how to get the licensing started and doing more work in the background, I realized as much more potential audience that I would like to be part of it. So that's when I graduated to two words, why not?"* *"I really think to me the line to be drawn is on this right? What is this spinoff going to achieve? And what, as a person what do I want to make out of that achievement? And in a very, very simplified scenario of a platform technology that does application number one, and this application number one is low on the excitement level. Right, then I may take a limited participation into the first spin off. While my strategy would be, I want to still be close enough to learn from what's going to be this venture experience? Right, so that I can utilize this, what I will understand what I will learn for application number two, okay. And number three, with having in mind that with again, I think that's very theoretical. For me right now, that's a big theoretical. Because I'm not confronted with it. Because it's like, Yeah, but maybe the application number one in the venture that is formed around application number one, is also the one that is going to make application number two, then I want to be part of it. Because I want to be here on the ability to go for the least exciting, if it's a prerequisite step to the most exciting, okay, that's what I'm trying to okay. But if it's like, if those are dissociated, then I'm still like, okay, now I'm going to wait, just one I want to jump on is the one that I'm super excited by"*

S.N.	Key orientation characteristics	Descriptors from the interviews
6.	Central role of a team	*"This all I have is the mentors and advisors who take out some time. But really a passionate guy who is an expert in business and one also has a knowledge of the pharma industry is I would love that. And at the same time, how can I bring that person when I don't have anything to offer to that person at this stage? "* *"But in two years time, I think we will have good people, we have some good people now that we can actually build before we speak. I will not spin off if I don't have a good team"* *"but I think more importantly, will be a sort of team that eventually will be able to perform? Because currently it is only me. It will not be the right strong team if you do not have different capability, there should be a few members with complimentary skills. So actually, that will be the top How the hell do I find the right co founder? "*

Table 4: Summary of extracts from interviews with career oriented (CO) scientists

S.N.	Key orientation characteristics	Descriptors from the interviews
1.	A love for science and research	*"when I was young, growing up, I was always fascinated with science engineering. So when I went to university it was natural to do a engineering course. And through the course of it, when at the last year, when they expose us to find a year project, we did one that was quite research base in the tissue engineering field. And I thought that was really interesting. So after discussion, I decided I wanted to do a PhD,"* *"so when I started my research career, I just seen saw myself studying doing basic science, biology, immunology, I was not really interested in startups, by the way, so I was a pure scientists, I was interested in looking at fundamental pathways in science"* *"Professor in microbiology department, said that she was interested to see me. So, I came to the interview, she told me that she can take me for like part time kind of internship. Starting like immediately. right, so that's when I got the first exposure to like the actual research and the actual work, and I stayed with them for three years when I finished (studies) I still continued work in junior researcher in the same lab but full time (I) loved research. And that's the natural progression for a researcher."* *"I originally came to Singapore with the specific intent of transitioning from academic research into either an industry role with in one of the larger corporate firms or into something that was more of a startup - the position I had before I came here was an industry linked research job, but specifically tailoring existing an existing technology that's used in the medical industry across to be able to be used in the food and beverage industries for microbial quality control. And I took that not because I cared at all about microbial quality control, but because I saw that as a translational way to get into more of an industry linked position and just test it out"*

S.N.	Key orientation characteristics	Descriptors from the interviews
		"So, I started reading up and that was like, close to 20 years ago, Okay. And I started reading them, and you're talking about nanobots designing nano robots to secure your system, and that was back then. And I was interested, and I said, Okay, I think in the future, I want to do research and when I graduated from NUS from bio engineering, Okay, it didn't occur to me that I wanted to find a job, I wanted to do research back then the pay was really low" *"I knew that the career ladder was fine - as a fresh grad with a degree I didn't want to be a lab tech forever and then receiving instructions from people. So, but, and I knew that I wanted to do a PhD. I wanted to further myself, but then they're all this amazing science in A-star that I wanted to know about, but I don't know enough to decide. So, then I just got a job. So I got a job as a tech lead biologist, when I was there, I applied for a PhD scholarship and a self-funded so I did my PhD in Oxford University after two years as a lab tech"*
2.	Startup opportunities as learning opportunities	*"So, the reward for my motivation was largely about learning. I didn't want to be a sales guy. Because it seemed like very non-technical, you know, just persuasion, and numbers and all that kind of thing. So, so I decided that marketing might be interesting idea, because it's a mix of supporting sales, but also understanding what technical on the technical side, what products right your products can do. In this case, in the semiconductor world for fabs, it was, what processes your processes can deliver, Right? Yeah. So, I went for that. I was thinking I can learn a lot here. Right? I don't know anything about the customer interactions, how that happens."* *"I have no experience in - I'm not even trained in running clinical trials, they have hired solely just the clinical trial managers, right. And I know how to read So I was, trying to figure things out. Another one was, I knew that I was going to have to give up some form of engineering, in a sense that this place will not involve a lot of mechanical design"*

S.N.	Key orientation characteristics	Descriptors from the interviews
		"Frankly speaking, I think taking on more, more kind of leading role is not very comfortable at the beginning. But it is a very interesting and very nice experience for me to pick up. So for now I prefer to stay in this so my plan is to try to stay and focus at a more technical perspective. In terms of business Definitely, I need to learn, I think, to be in a spin off is the opportunity to learn all different areas"
3.	De-risking startup opportunities by working with those who they know	*"So, two things one, I know (the founder)? Well, so I know that his track record is pretty cool. The other thing was all the obstacles I was thinking about, well, all engineering portions. So, there was some assurance that I got from (the founder) that the science behind it is already pretty much there. And for these for all the papers that he sent me. Actually, before I kind of saw that, okay, the basics are there is some stuff we have to advance a little bit more, but it definitely was a was not out of like, like a unicorn kind of thing, like I know it was not out the sky or something, Something achievable if we could do it."* *"So not only do I know, the team, but I knew the team, are good workers. I trusted the (CEO) he was a good leader. So, I spend some time with him. We went to a medical conference together. I spent some time with him. He has integrity. I trust that make sense. I think that was one of the great things for me. I knew things. I knew the professor who was in charge of this project. And I knew all of them, I trust that sense is quite a bit of faith."* *"We, worked together before - He was a MERCY employee? Yes. And he had already gone out with some other company, I was in MERCY for a while and he joined. He joined the other organization for a while, and we come together again. I think spin off the team is the most important. Must be must nice to work with, and the people who are also capable and similarly competing for the same goal and same success of the company."*

S.N.	Key orientation characteristics	Descriptors from the interviews
4.	A focus on the domain of interest however open to explore & learn new things as long as they help in building a career	*'I just wanted to the nature of the job was less of the attraction the attraction was more the domain, the domain. Yeah. And, and the attraction to the domain was because all the way back to know the end value that it could create"* *"I flip flop between quite a few different scenarios. Every week, I think it changes from one to the other, My two options that I'm looking at, are either to go into a bigger company, where I can learn the commercial side, from people and understand all of the different business units …. I'd like not fitting into a particular role, it's that I don't have the industry experience for a higher band, right. But most of the feeling is that I would be too frustrated in some of the lower roles"* *"Because you're no longer so fresh, curious, I don't consider myself very senior. But I'm also not fresh. And when that happens, you have many other things that you have to let your carry that you cannot just drop…. Energy. I mean, I feel it right now, the energy I have doing things right now. It's a far cry from when I was doing my PhD. I expect that to drop it when I hit the 45."* *"I was planning for myself to be here for another two or three years. Right. And then I'll keep reevaluating - at least a project will have reached the ESG phase where then somebody will take it off anyway? Right? Well, yeah. And then I was thinking either I would move either to industry or Start-up"* *"So, I see, now I'm trying two things. One is the Masters, the other one is the PI position. So, for the PI position I'm writing grants to get a grant under my own name. Okay, so in November, there's going to be a grant call for the YRG so I'll be putting up a grant next May there to be an investigator"*
5.	A focus on security and maintaining their lifestyle	*"then is the whole slew of uncertainty that's usually associated with startup, will they run out of money will they have the right team, would I be able to get the regulatory approval and get this out in business"*

S.N.	Key orientation characteristics	Descriptors from the interviews
		"At the moment, my job very much like a nine to five. But and I know, maybe the realization hasn't fully sunk in, but I know that was the case, when we I'm going to start up and I have a young family. So there has been that question of is now the right time for me to go into a startup when I have, I got an 18 month old kid to think about, okay, is it a good time? Is it ever going to be a good time? So, there's, there's those kind of..." *Changing jobs - "And also, my family's young, me, my wife and young son, we could easily go in again, what's the worst that can happen? If it doesn't work out? We'll just come back. Right. So, the risk seemed less, and you were still an employee working for the same organization"* *"the realities of going from academia to industry, you kind of have to start at the bottom. And I didn't really like that idea. And the prospect of going into a spin out of a startup way, your call can grow with that company. It's risky"* *"naturally the first thing is the remuneration. Is it appropriate, because otherwise you require a change in your lifestyle and something. And the other one is. How much time does the work things like sometimes is a nine to five job and your evenings and weekends are really free, sometimes is a nine to five job but then you get so much work look there you have to work on the weekends. Right. Yeah I'm expecting a baby soon. Okay, so I don't think I can put in as much hours as I did during my PhD already. Sure. So I will need to set time aside for my wife, my baby. Yeah. So I would say number one is probably the financial. And then the second is the work life balance*
6.	Discomfort in moving outside their area of expertise	*"So my biggest thing that I see is a risk. And that I am not willing to waver on is that I am unwilling to jump out of my current comfortable position where I am still learning a little bit. I mean, the reason I want to jump is because I'm not learning enough. But I don't want to jump somewhere where I'm fumbling around in the dark, Without the business, experienced people to learn from my fear and jumping out into a small company, is that you're trying to do stuff"*

S.N.	Key orientation characteristics	Descriptors from the interviews
		"I don't have the skills for startup because I've never done it before. Right. So, and then I know that it will be so different from the experience I have here and in the university. So, I feel that that's the one part that I'm not sure if I will be able to do something expected to have a startup"

Table 5: Sensemaking process followed by the different scientist based on their orientation

Scientist Orientation	Technology focus	Questions around the opportunity	Actions taken to address these questions	Potential outcomes
EO	Agnostic – they seek work with technology they understand	• How ready is the technology? • What is the market need? • How large is the market? • Is there investor interest and availability of funds? • Do we have access to resources required for the pursuit of this opportunity (incl. labs etc.?)	• Explore the eco-system for support structures • Identify mechanisms for raising funds • Identify partners to execute on the opportunity by joining incubators, participating in networking events	• Spin off created if the actions result in favourable outcome • In case the outcomes are not favourable the EO scientist continues to engage in scanning the environment for potential technologies that have market opportunities

Scientist Orientation	Technology focus	Questions around the opportunity	Actions taken to address these questions	Potential outcomes
IO	Specific – focused on technology that they have developed	• In what areas does this technology create an impact in society? • How do I bring this technology to the market?	• Participation in start-up competitions to gain validation of the opportunities • Identifying mentors and advisors who can provide guidance through the process of creating a start-up • Participating in training programmes and bootcamps to understand what is required for creating a spin off • Actively seeking out partners with complementary skill sets who can participate in the spin off	The creation of a spin off is linked to • The technologies potential for impact for that particular opportunity • The ability of the IO scientist to build a team that can execute on the opportunity

Scientist Orientation	Technology focus	Questions around the opportunity	Actions taken to address these questions	Potential outcomes
CO	Domain centric – open to technology within their domain of expertise	• How does this opportunity help me in my career? • Will the opportunity provide me with the stability required to maintain my lifestyle • Will I be able to function in the areas required by pursuing this opportunity?	• Gaining a better understanding of the roles involved • Understanding the level of trust associated with the other participants • Understanding the capability of the team and its leadership to successfully pursue the opportunity • Comfort in working with the team	Joining a spin off is related to • Comfort and trust in the team to execute on the opportunity • Confidence in their ability to contribute to the development of the opportunity