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Building Entrepreneurial Behaviours in Academic Scientists: Past Perspective and New Initiatives

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7.1 Background: Entrepreneurial Behaviours

In general, entrepreneurship contains two fundamental components: (1) innovation and (2) opportunity exploitation (e.g. Covin and Miles 1999; Covin and Slevin 1991; Lumpkin and Dess 1996; Zahar et al. 1999). Innovation refers to organizational commitment to developing and combining resources in order to introduce new products/services, production, organizational systems and new businesses (Covin & Slevin 1991). Entrepreneurship also involves opportunity discovery and exploitation for profits (e.g. Hamel and Prahalad 1994; Miller 1983; Shane and Venkataraman 2000). Shane (2003: 4) suggested a combined definition

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of entrepreneurship, whereby entrepreneurship refers to 'discovery, evaluation and exploitation of opportunities to introduce new goods and services, ways of organizing, markets, processes and raw materials through organizing efforts that previously had not existed'. As such, entrepreneurial behaviour is typically composed of three characteristics. First, entrepreneurial behaviour is innovative and involves an organizational ability to create new ideas, support creativity and conduct R&D in developing new products and processes (Lumpkin et al. 1996). Second, it is associated with organizational proactive willingness to anticipate and act on future market demands and needs and to introduce new products, processes and services ahead of its competitors to shape future demand and opportunities (Lumpkin et al. 1996). Third, the behaviour encompasses risk-taking which 'take bold actions by venturing into the unknown, borrowing heavily, and/or committing significant resources to ventures in uncertain environments' (Rauch et al. 2009: 763).

The recognition and focus on these characteristics of entrepreneurship enables researchers to link entrepreneurship with the development of organizational knowledge/resource bases. Prior research suggests that entrepreneurship is a knowledge-creation and resource configuration process (e.g. Borch et al. 1999; Zahra et al. 1999). Entrepreneurial behaviour therefore influences 'the selection of resources and skills and promoting organizational learning processes to capture external knowledge' as new situations arise (Zahra et al. 2006: 925), and specifically, it is required to pursue dynamic capabilities at both organizational and individual levels (Teece 2012). Recent research has suggested that individual entrepreneurial behaviour is more important for any organizational strategy of resource/capability development (de Jong et al. 2015; Ireland et al. 2009). Individual entrepreneurial behaviour is different but associated with organizational-level entrepreneurial behaviour. For example, de Jong et al. (2015: 982) conceptualize individual entrepreneurial behaviour as 'the extent to which individual workers proactively engage in the creation, introduction, and application of opportunities of work, marked by taking business-related risks'. According to this definition, entrepreneurial individuals continuously seek out opportunities, take autonomous and future-orientated actions to generate solutions for problems they identified previously and champion their ideas in the organization to exploit opportunities of change with a high acceptance of the risk of potential losses.

7.2 Academic Entrepreneurship and Entrepreneurial Behaviours

Entrepreneurship in the academic context can be characterized by initiatives positioned on a spectrum ranging from hard (e.g. creation of technology park, patenting, licencing) to soft (e.g. producing graduates, consulting, industry training) (Philpott et al. 2011). Further developing our understanding of this range of entrepreneurial activity, Perkmann et al. (2013) make a distinction between research commercialization and academic engagement. According to the authors, commercialization activities, which are more in line with the harder entrepreneurial initiatives, are reflective of academic entrepreneurship and are often motivated by the chance of financial reward. They typically involve intellectual property creation (e.g. patenting) and exploitation (e.g. licencing and firm creation). Academic engagement is broader and has a more diverse set of goals (Perkmann et al. 2013). On the one hand, academic engagement tends to be characterized by scientists' collaboration with non-academic organizations, and these arrangements can provide access to valuable resources (e.g. financial or access to data) that support and develop scientists' primary or more traditional research agendas. On the other hand, these collaborations benefit the non-academic partner through the availability of unique insights and expertise on their industrial problems, products and markets. Interestingly, in distinguishing both activities, Perkmann et al. (2013) also point out that commercialization and academic entrepreneurship activities can often follow on from academics' engagement with industry.

In the context of such entrepreneurship within academia, entrepreneurial behaviours have some differentiated characteristics from the aforementioned traditional industry entrepreneurial behaviour. For instance, unlike traditional industry entrepreneurs, academic entrepreneurs have to consent to a set of institutional rules, and share the ownership of intellectual property and the revenue of inventions with the research institution which they are working for (e.g. Aghion and Tirole 1994; Halilem et al. 2017; Siegel and Wright 2015). However, we can also see that the requisite entrepreneurial behaviours share similar features (i.e. innovation, proactivity and risk-taking) with more general conceptualizations of business entrepreneurship. Indeed, risk-taking can be extenuated for academic entrepreneurs as they have to compromise on the time and focus they would otherwise direct at their core academic role. In terms of innovation, Shane (2004) explains how entrepreneurial academics are innovative in how they create new products from their science and establish spin-off firms based on their research knowledge. Entrepreneurial academics are also increasingly proactive in their approach to science work, particularly in regard to resource acquisition. According to Haller and Welch (2014: 807), entrepreneurial academics are those individuals that 'proactively seek and secure resources to explore new scientific or technological opportunities'. Scientists who behave in an entrepreneurial manner identify opportunities and set about ensuring they secure resources that can facilitate their activities (Dorner et al. 2017). Reflecting this development, a rich stream of literature has emerged examining the transformational (Mangematin et al. 2014), boundary breaking (Boehm and Hogan 2014) and entrepreneurial role (Baglieri and Lorenzoni 2014; Cunningham et al. 2018; Kidwell 2014; O'Kane 2016) of scientists in the principal investigator (PI) role. O'Kane et al. (2015a) show how effective PIs are challenged to proactively balance curiosity and opportunity boundaries (strategic posture), as well as scientific freedom and conformance pressures, when articulating new or reinforcing existing science trajectories for funding bodies. Furthermore in terms of risk-taking, Abreu and Grinevich (2013: 408) argue that academic entrepreneurship can be regarded as 'any activity that occurs beyond the traditional academic roles of teaching and/or research, is innovative, carries an element of risk, and leads to financial rewards for the individual academic or his/her institution'. Supporting this point, Lockett and Wright (2005) emphasize the importance acquiring appropriate capital and risk capital when creating university spin-out firms. In more extreme forms of academic commitment to entrepreneurship, scientists can decide to work part time or full time on commercialization using for-profit firms through equity alliances (Toole and Czarnitzki 2010).

7.2.1 Entrepreneurial Behaviours Among the Science Community: Past Perspectives

Despite their importance, engendering entrepreneurial behaviours among the science community is not straightforward as scientists are more accustomed to operating in a non-commercial university environment. To date, scholars have dedicated considerable work to understanding some of the key determinants and challenges associated with developing entrepreneurial behaviours among academic scientists. In the paragraphs that follow, we review some of the most prominent (among other) themes—motives, professional role identity, social environment, university support structures and competencies—that have been discussed by scholars before suggesting that greater attention to how initiatives like government-funded grand challenges dedicated to the subject of capacity development may provide an interesting and fruitful line of inquiry.

A significant body of research has focused on the challenges associated with motivating and incentivising scientists to pursue more entrepreneurial agendas. Universities have traditionally focused on basic research (Nelson 1959) which is characterized by scientific autonomy (Nelson 2004) and guiding norms of scepticism, universalism, communism and disinterestedness (Merton 1973). Academics who pursue science careers are therefore typically motivated by originality and discovery and are rewarded through open dissemination, citation, professional awards (Merton 1973), scientific priority (Merton 1957) and recognition (Latour and Woolgar 1979). In a close examination of this subject, Lam (2011) finds that scientists, for whom entrepreneurial activities resonate with their internal belief structures, are intrinsically motivated by the associated opportunities to freely pursue problem solving and to acquire financial gain. In contrast, entrepreneurial scientists who have belief structures more closely aligned with the traditional norms of academic science tend to be extrinsically motivated by the opportunity to acquire additional research resources to grow their status and reputation in science. Scholars report that university administrators can help to foster entrepreneurial activity by promoting an entrepreneurial culture with transparent regulations around IP (Debackere and Veugelers 2005; Tartari and Breschi

2012) and also by giving more recognition to patenting, licencing and start-up formation in promotion and tenure decisions (Ambos et al. 2008; Link et al. 2007). In addition, the literature in this area has highlighted the importance of universities providing attractive rewards and incentives for staff who develop new technologies in the form of attractive royalty schemes that sufficiently incorporate faculty interests. Lockett and Wright (2005) find that university spin-out creation is positively associated with the university reward scheme.

In terms of identity, according to Ashforth (2000: 475), role identity explains one's self-definition, which arises from the 'goals, values, beliefs, norms, interaction styles and time horizons' associated with a role. Professional role identities are set by people's definition of self within their work environment, and this arises from an individual's enactment of work roles (Goodrick and Reay 2010). However, as explained through Dutton et al.'s (2010) 'adaptive identity perspective', professional identities must often change when individuals experience work environment changes that require new tasks and skills. Consistent with this perspective, the emergence of academic entrepreneurship has resulted in academic scientists modifying their professional identities (Lam 2010). Jain et al. (2009) report how academic scientists enact a hybrid role identity with a primary academic self and a secondary commercial persona when participating in technology transfer activities. Supporting such perspectives, Meek and Wood (2016) suggest that scientists must undertake purposeful and distinct identity adaptations when responding to university initiatives in order to foster commercialization engagement.

Another stream of literature has brought attention to the key social environment determinants related to entrepreneurial behaviours among academic scientists (Haeussler and Colyvas 2011; Tartari et al. 2014). Fernández-Pérez et al. (2015) find that professional ties in the form of mentors and business networks and personal connections in the form of family, friends and colleagues can play positive roles in encouraging academic scientists to pursue new business ventures. In a prominent study on this subject, Stuart and Ding (2006) examined the key determinants that prompted life scientists to establish a company or join the science advisory board of new firm, either of which they regarded as 'becoming and entrepreneur'. The authors show how working with colleagues in environments where 'pro-entrepreneurship' norms are socialized (e.g. at grad school, department-level or institutional-level) can increase the likelihood of engaging in commercial forms of science. Bercovitz and Feldman (2008) find that although academic scientists are likely to engage in academic entrepreneurship if their training or previous experience encouraged such activity, these personal attributes will be mediated by what occurs in their current local work environment. Perkmann et al.'s (2013) framework similarly highlights the influence that an academic's home organization, colleagues and work context can have in promoting academic entrepreneurship.

University support structures in the form of technology transfer offices (TTOs) represent another prominent stream of literature in the area of academic entrepreneurship. TTOs can foster entrepreneurship among academic scientists in a number of ways. In connecting with industry, TTOs encourage industry interest and involvement in scientific research (Phan and Siegel 2006; Sanders and Miller 2010). TTOs can also provide important skills that can help scientists. It is reported that TTOs help academics to understand the needs of industry and to access critical resources, expertise and support in the commercialization process (Markman et al. 2005; Siegel et al. 2003). Lockett and Wright (2005) find that university spin-out creation is positively associated with the business development capabilities of technology transfer offices. O'Kane (2016) finds that TTO executives are backward integrating along the commercial development path and establishing a more diverse portfolio of skills that facilitates their involvement in activities that span scientists' accumulation of research resources through to their exploitation of research outcomes. Weckowska (2015) finds that TTOs undertake 'pro-active searches' to identify and attract early research that could be commercialized and to align appropriate scientific discoveries and invention disclosures with industry needs, expertise and investment. Wu et al. (2015) show how TTOs promote 'intention-based inventions' in which commercial outcomes are agreed prior to the research being undertaken. However, within this literature scholars also draw attention to some limitations with respect to TTOs' ability to stimulate entrepreneurial activity. Muscio (2010) finds that TTOs only have a marginal direct effect in stimulating academic entrepreneurship. O'Kane et al. (2015b) show that

TTO executives' ability to promote academic entrepreneurship is hindered by their inability to shape a distinctive and value-adding identity for the academic community. Scholars have also pointed to academic scientists deliberately bypassing their TTO (Aldridge and Audretsch 2011; Freitas et al. 2013) and to perceptions of underwhelming business-related skills among TTO executives to help them with their commercial intentions (O'Kane 2016; Chapple et al. 2005). Overall, TTO research suggests that academic entrepreneurship may be constrained if academics lack particular competencies and that this may be especially true when TTO activities cannot overcome these constraints.

A final area we consider relates to the personal attributes and competencies held by academic scientists and how this impacts their likelihood to engage in entrepreneurial activities. In the broader entrepreneurship literature, research suggests that individual experience, knowledge/skills, motivation and emotional state explain the variance of individual decision on entrepreneurial behaviour (Shane and Venkataraman 2000). However, in the context of academic entrepreneurship, mastering the required capabilities is not easy for scientists. For example, Ambos et al. (2008) show how scientists engaging in entrepreneurship need to become sufficiently ambidextrous to deal with the tensions that arise between academic and commercial outputs. Unsurprisingly, a considerable body of literature continues to focus on the competencies necessary for academic scientists to be more effective at entrepreneurship. Huynh et al. (2017) show how the capabilities and networks possessed by founding teams at the time of spin-off formation can influence future performance. Likewise, Hayter (2016) focuses on the role of networks in academics' entrepreneurial endeavours. The authors report how social networks act as a critical resource to stimulate and support spin-offs in the early stages of their development, but to remain effective these networks must evolve in order to expose the academic(s) to industry norms, values and key resource providers. Rasmussen et al. (2014) also study the importance of networks; however, their focus is specifically on how these networks facilitate the development of key entrepreneurial competencies among academics, which in turn help academics to establish and grow new ventures. Again, Rasmussen et al. (2014) highlight the importance of networks being dynamic and flexible enough to be frequently recalibrated for various competency requirements. In an earlier study, Rasmussen et al. (2011) pinpoint three competencies—opportunity refinement, leveraging and championing—that when developed effectively over time can benefit academics' transition to entrepreneurship, as well as their legitimacy as entrepreneurs in the eyes of investors and business partners. Specifically, in order to be effective, the deployment of each of these competencies needs to be accompanied by the academic entrepreneur (and their team) brokering relationships with a range of key stakeholders, for example, industry partners, university management, investors. Interestingly, integrating some of the earlier themes discussed in this section, Clarysse et al. (2011) find that academics' social environment and the quality of their supporting TTOs are secondary factors in stimulating entrepreneurial behaviour among academics. Instead, the authors find that 'opportunity recognition capacity', which they refer to as entrepreneurial capacity, is the biggest influence on academic scientists' tendency to pursue entrepreneurship activities.

7.3 New Entrepreneurial Behaviour Initiatives Connecting Macro- and Micro-Levels

Although this literature has contributed hugely to our overall understanding of academic entrepreneurship, there has been less consideration afforded to emerging macro-level initiatives aimed at stimulating and developing entrepreneurship capacity among the science community. Indeed more generally, it remains poorly understood how value is created, shaped and transferred between micro- and macro-levels (Lepak et al. 2007). This is surprising as macro-level policy makers have an interest in growing entrepreneurial skills among the science community because this can lead to outputs that improve regional and national performance (Etzkowitz and Leydesdorff 2000). Universities staffed by entrepreneurial people are more likely to transfer useful knowledge into industry and society (Kalar and Antoncic 2015). Furthermore, academic spin-offs can lead to job creation and improved economic performance

(Soetanto and Jack 2016). In the remainder of this chapter, we present details on an 'entrepreneurial' policy initiative underway in NZ aimed at 'Building New Zealand's Innovation Capacity', which has the specific goal of understanding, stimulating and developing greater engagement and entrepreneurial skills among the physical science and engineering community. Our focus on this initiative is a step change from that presented above, nevertheless it ultimately has the same objective in trying to grow entrepreneurial capacity. It does this by revisiting and experimenting with aspects at the funding and direction setting phases when initiating science stretch research, in contrast to waiting until the base research has largely been completed.

7.3.1 Case Example: Building New Zealand's Innovation Capacity (BNZIC)

Enhancing the New Zealand (NZ) research system's capacity is a key focus of the Science for Technological Innovation (SfTI) National Science Challenge (NSC). Launched in September 2015, SfTI's overall mission is to improve NZ's capacity to use physical sciences and engineering to enhance economic growth. It is the 7th of the 11 NSCs, which are cross-disciplinary, mission-led programmes designed to tackle NZ's biggest science-based challenges. Missions for each challenge were initially developed via a crowd-sourced engagement process in 2012/2013, which included stakeholders from a range of sectors, and subsequently refined based on peak panel feedback. Inherent to their formation was a view that to achieve the outcomes desired would require collaboration across NZ's leading researchers, whether they were based in universities, Crown Research Institutes, businesses or non-governmental organizations.

The SfTI challenge proposal also argued that if a tenuous connection between NZ's researchers and industry was undermining the nation's ability to benefit from public spending on physical sciences and engineering, then examining in greater detail how co-innovation actually happens in New Zealand must be a priority. Due to New Zealand being a smaller economy, public-sector researchers are vital actors in the nation benefiting from an open innovation system. However, for such benefits to occur, the effects that the science system broadly has, as well as its processes, on collaboration, engagement and commercialization needed to be considered. These more macro-level effects could be particularly critical in terms of whether they support the development of foundational factors that have been identified as important at the individual researcher level.

As noted above, SfTI has an explicit focus on economic growth through the harnessing of physical sciences and engineering research. It is targeted at increasing the value generated for the nation through the high-value manufacturing (HVM) sector. In 2015, it was estimated that the HVM sector in NZ consisted of over 5300 firms, with a total of more than 26,000 employees, and accounted for about NZ$1.43bn in exports (NZTE 2015). While this was only 0.7% of NZ's GDP, the sector represents about 3% of exports (MBIE 2015) which contributes to a desire to see further growth and a stronger connection between investments in public science and value-adding commercial revenues. These figures also highlight that NZ's HVM sector has distinctive features, with many firms relatively small in size (<10 full-time equivalent employees) and thus likely more dependent on external research(ers) to achieve innovative outcomes.

The SfTI challenge was approved after an 18-month set-up process which included a 'resubmit' phase where it was advocated that the physical science and engineering 'spearhead' projects also become case studies for better understanding existing researcher capacity to collaborate and engage with industry as well as Vision Mātauranga (VM). With parallels to the benefits reported for academic engagement with industry, the VM theme recognized the importance of and opportunity for enhancing the capacity of researchers to engage with Māori (NZ's indigenous people) and Māori organizations as they move to embrace science and technology in their business activities. Vision Mātauranga (a policy to unlock the innovation potential of Māori knowledge, resources and people) had arisen separately from the NSCs and has become a required component addressed in public science funding processes. The BNZIC research team was, therefore, expanded to track engagement and team processes with respect to Māori as well as industry. The team has also evaluated the range of novel initiatives being trialled by the challenge with respect to innovating the processes for forming mission-led, multi-disciplinary, co-innovation projects. These process innovations currently address science funding and organizing, increasing stakeholder involvement throughout the science research process, as well as monitoring capacity development by individual researchers. Figure 7.1 illustrates the capacity model at the heart of the SfTI's thinking, which adapts the absorptive capacity notion into a combined framework for studying collaborations between science researchers and business (Daellenbach et al. 2017). While the initial focus has been on what can shift and enhance the capacities required by science researchers, it is recognized that such collaboration is a dyadic relationship between public-sector researchers and user organizations which entails that there needs to be a complementary set of capacities for industrial partners as well (and that these may differ for Māori businesses).

Of particular relevance here are non-technical capacities labelled human and relational. Where human capacity is associated with a willingness to develop and apply entrepreneurial skills to identify knowledge gaps, needs or opportunities of the user organization, as well as to propose paths to fill these through technological means, relational capacity brings in recognition that first establishing and then sustaining relationships with user organizations is critical for knowledge diffusion to occur

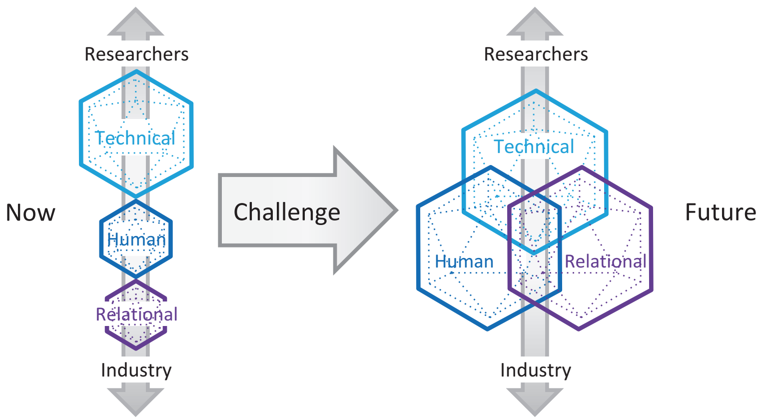

Fig. 7.1 SfTI approach to capacity. (Source: Adapted and reproduced with permission from New Zealand's Science for Technological Innovation (SfTI) National Science Challenge: https://www.sftichallenge.govt.nz/)

(in both directions). Technological entrepreneurship training and other ways of exposing researchers to latest business trends are typical ways in which human capacity is seen to be best enhanced since this sets a platform for having mutual understanding of science/engineering needs as well as business/commercialization imperatives. However, where others have recognized such capacities to be influential, most have placed the onus of upgrading these on each individual researcher. The SfTI challenge, though, has expanded its emphasis, by augmenting a requirement for individual capacity development for researchers with macro-level initiatives that trial how process innovations for setting missions, funding and organizing science research could also play an important role. This opportunity to experiment at the macro-level, and the responsibilities to learn how changes may impact key outcomes, provides a unique possibility for the NSCs to shift both the science knowledge and processes within science whose broad applicability and validity have rarely been questioned.

Survey data collected from SfTI researchers suggest that there is a complementarity between leading science and commercial engagement (as reported by Perkmann et al. 2013). Even though team members for the spearhead projects were chosen because they represented the leading researchers in these areas, bringing knowledge and skills applicable to the science being pursued, these researchers had a history of engaging with industry for particular research projects. About 50% of researchers reported having collaborated with industry partners in the previous five years, substantially more than the 14% of researchers indicating that they had not participated in any form of academic engagement recently. Academic entrepreneurship among SfTI researchers was relatively infrequent (11%), although these individuals did not appear to have more total or more frequent recent industry collaborations. What perhaps was more surprising was that despite their track record of engagement, involving or interacting with industry did not occur early on in all spearheads. In fact, there was a stark contrast between those whose mission was investigator-led vs. those where missions had been defined initially via an industry consultation process, followed by workshops where researchers and industry interacted to refine the specific technology to be pursued.

By experimenting with new methods of stakeholder involvement at an early stage of funding science projects, the challenge promoted greater ownership of missions by industry representatives. The workshops with participants from industry and Māori organizations established that there were mutual interests across both groups. While a conflict remains between the requirement for it to be stretch science that the challenge invests in and the desire for the science to be able to be applied in the shorter term by industry, the process appears to have provided a forum where conversations across perspectives do take place, with implicit assumptions about the others' domain, whether it be industry or publicly funded science research, being surfaced and tested. At other times, engagement may not be initiated due to it being assumed that industry would not be interested in stretch science.

The challenge's organizing experiments may also be shifting researchers' approaches to research funding. By bringing in notions similar to pivoting associated with entrepreneurial ventures as well as clearer stage gates or milestones, SfTI management is seeking to de-escalate commitment to the predetermined science phases in cases where it becomes clear that the project as initially conceived is unlikely to deliver the outcomes anticipated or significant additional knowledge or commercializable value. Research contracts currently tend to lock activities to a fixed predetermined sequence of activities, even though science research projects are designed to generate knowledge that can usefully inform whether these activities should still be pursued. The longer timeframe of the NSCs (a ten-year plan initially) provides other options, where the paradox of stretch science co-innovation spearhead and seed projects with industry could be used to get closer to commercialization if the outputs from initial projects can find continuing funding to get through their developmental phase. Overall, these initiatives recognize that the macro-settings associated with organizing and funding science can serve as a crucial additional driver that affects academic engagement and, in turn, the level of academic entrepreneurship that is likely to eventuate. Table 7.1 offers an overview of the unique approach to entrepreneurial capacity development among the science community being facilitated through the SfTI funding programme.

Table 7.1 Summary of SfTI's unique approach to entrepreneurial capacity development

Publicly funded programme	Unique approach to entrepreneurial capacity development
New Zealand's Science for Technological Innovation (SfTI) National Science Challenge (NSC)	Mission development through bottom-up crowd-sourced stakeholder engagement process 'Real-time' longitudinal case studies of physical science and engineering 'spearheads' allow monitoring of: Researcher capacity to collaborate and engage with industry and indigenous (Māori) perspectives on knowledge and people Evolving research team and science leadership processes Effectiveness of novel capacity development initiatives among the science community Particular research focus on human and relational (non-technical) capacity development among scientists Agile approach to science funding by embracing 'fast fails'—de-escalating commitment to predetermined science objectives

7.4 Conclusion

This chapter argues that that macro-level capacity development initiatives aimed at generating greater entrepreneurial behaviours among academic scientists remain under-explored in the literature. In comparison to the literature on a range of meso- and micro-level determinants and challenges such as researchers' motives/incentives, role identity, social environment, support structures, and individual attributes and competencies, scholarly attention on how the formation and roll-out of publicly funded mission-led programmes aimed at addressing grand science challenges can grow entrepreneurial capacity among the research community is minimal. We present an overview of an exciting initiative underway in New Zealand that helps to address this gap in the literature. Specifically, we offer novel insights on the initiation and first four years of the Science for Technological Innovation (SfTI) National Science Challenge (NSC). Central to this initiative is a commitment to grow individual researcher capacity in areas related to stakeholder engagement and industry interactions throughout the innovation and research commercialization process. While the initiative cannot yet provide concrete outcomes with regard to its impact on growing entrepreneurial behaviours, it is already generating promising insights and exciting avenues deserving of closer inspection and future research. These include the merits of incorporating agility and fast failures into publicly funded science programmes which in turn de-escalate the medium- to long-term commitment to predetermined science objectives that may be proving less promising soon after the science gets underway. Another avenue relates to longitudinally mapping how research scientists conceptualize and thereafter interact with key stakeholders throughout the innovation process. A third avenue that holds rich promise is that of systematically incorporating indigenous world views into mainstream publicly funded research programmes. Early indications in SfTI are that Māori organizations' and researchers' perspectives on knowledge, resources and people are adding significant value to the more publicized or mainstream approaches to innovation that are often assumed to be best practice. We therefore encourage researchers to examine this issue in more depth across a range of geographies and cultural communities. A final takeaway from our ongoing research is the pivotal and innovative role macro-level initiatives can have in stimulating value creation in the form of enhanced entrepreneurial capacity at the micro-level. We believe that the macro-level organization of experiments and innovative trials with respect to growing entrepreneurial engagement through public funding offers a new mechanism through which micro-macro value creation and transformation can be examined and understood.

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